



**FULTON
COUNTY**

CONTRACT

23RFP139070K-JAJ (Phase 2)

**Progressive Design/Build Services Campbellton Pump
Station & Force Main**

For

DEPARTMENT OF PUBLIC WORKS

OWNER - CONTRACTOR AGREEMENT

Contractor: **SOL CONSTRUCTION, LLC**
Contract No: **25RFP139070K-JAJ (Phase 2)**

Address: **4120 Presidential Parkway, Suite 115**

City, State **Atlanta, GA 30340**

Telephone: **(770) 455-1822**

Email: **jgomez@solconstructionllc.com**

Contact: **Juliana Gomez**

THIS AGREEMENT is effective as of the 17 day of November, 2025, by and between Fulton County, a political subdivision of the State of Georgia (hereinafter called the "County"), and the above named CONTRACTOR in accordance with all provisions of this Construction Agreement ("Contract"), which consists of the following: Owner-Contractor Agreement, guaranteed maximum price, performance bond, payment bond, general conditions, scope of work and specifications, list of drawings, Purchasing forms and Certificate of Insurance.

The specific Exhibits of this Contract are as follows:

- Exhibit A: General Conditions
- Exhibit B: Purchasing Forms
- Exhibit C: Guaranteed Maximum Price
- Exhibit D: Scope of Work & Technical Specifications
- Exhibit E: Bonds (Payment & Performance)
- Exhibit F: List of Drawings
- Exhibit G: Certificate of Insurance

WITNESSETH: That the said Contractor has agreed, and by these present does agree with the said County, for and in consideration of a Guaranteed Maximum Price (GMP) of **Twenty Million Three Hundred Thirty-Two Thousand Nine-Hundred Six Dollars and Zero Cents, (\$20,332,906.00)** and other good and valuable consideration, and under the penalty expressed on Bonds hereto attached, to furnish all equipment, tools, materials, skill, and labor of every description necessary to carry out and complete in good, firm, and workmanlike manner, the Work specified, in strict conformity with the Drawings and the Specifications hereinafter set forth, which Drawings and Specifications together with the GMP submittals made by the Contractor, General Conditions, Special Provisions, Specifications, Exhibits, and this Construction Agreement, shall all form essential parts of this Contract. The Work covered by this Contract includes all Work indicated on the list of Drawings and Specifications as listed in the GMP entitled:

Project Number: #23RFP139070K-JAJ (Phase 2)

Title: Progressive Design Build Services Campbellton Pump Station and Force Main

The Contractor, providing services as an Independent Contractor, shall commence the Work with adequate force and equipment within 10 days from receipt of Notice to Proceed ("NTP") from the County, and shall complete the work within seven hundred thirty (**730**) consecutive days (twenty-four months) from issuance of the Notice to Proceed or the date work begins, whichever comes first. The Contractor shall remain responsible for performing, in accordance with the terms of the Contract, all work assigned prior to the expiration of the said consecutive days allowed for completion of the work even if the work is not completed until after the expiration of such days. The Contractor shall agree that in the performance of this Contract he will comply with all lawful agreements, if any, which the contractor has made with any association, union or other entity, with respect to wages, salaries and working conditions, so as to cause inconvenience, picketing or work stoppage.

As full compensation for the faithful performance of this Contract, the County shall pay the Contractor in accordance with the General Conditions and the prices stipulated in the GMP, hereto attached.

It is further mutually agreed between the parties hereto that if, at any time after the execution of this Agreement and the Surety Bonds hereto attached for its faithful performance, the County shall deem the surety or sureties upon such bonds to be unsatisfactory, or, if, for any reason, such bonds cease to be adequate to cover the performance of the Work, the Contractor shall, at his expense, within five days after receipt of notice from the County so to do, furnish an additional bond or bonds in such form and amount, and with such surety or sureties as shall be satisfactory to the County. In such event no further payment to the Contractor shall be deemed to be due under this Agreement until such new or additional security for the faithful performance of the Work shall be furnished in manner and form satisfactory to the County.

The Contractor hereby assumes the entire responsibility and liability for any and all injury to or death of any and all persons, including the Contractor's agents, servants, and employees, and in addition thereto, for any and all damages to property caused by or resulting from or arising out of any act or omission in connection with this contract or the prosecution of work hereunder, whether caused by the Contractor or the Contractor's agents, Servants, or employees, or by any of the Contractor's subcontractors or suppliers, and the Contractor shall indemnify and hold harmless the County, the Construction Manager, County's Commissioners, officers, employees, successors, assigns and agents, or any of their subcontractors from and against any and all loss and/or expense which they or any of them may suffer or pay as a result of claims or suits due to, because of, or arising out of any and all such injuries, deaths and/or damage, irrespective of County or Construction Manager negligence (except that no party shall be indemnified for their own sole negligence). The Contractor, if requested, shall assume and defend at the Contractor's own expense, any suit, action or other legal proceedings arising there from, and the Contractor hereby agrees to satisfy, pay, and cause to be discharged of record any judgment which may be rendered against the County and the Construction Manager arising there from.

In the event of any such loss, expense, damage, or injury, or if any claim or demand for damages as heretofore set forth is made against the County or the Construction Manager, the County may withhold from any payment due or thereafter to become due to the Contractor under the terms of this Contract, an amount sufficient in its judgment to protect and indemnify it and the Construction Manager, County's Commissioners, officers, employees, successors, assigns and agents from any and all claims, expense, loss, damages, or injury; and the County, in its discretion, may require the Contractor to furnish a surety bond satisfactory to the County providing for such protection and indemnity, which bond shall be furnished by the Contractor within five (5) days after written demand

has been made therefore. The expense of said Bond shall be borne by the Contractor. **[See General Conditions for similar provision]**

This Contract constitutes the full agreement between the parties, and the Contractor shall not sublet, assign, transfer, pledge, convey, sell or otherwise dispose of the whole or any part of this Contract or his right, title, or interest therein to any person, firm or corporation without the previous consent of the County in writing. Subject to applicable provisions of law, this Contract shall be in full force and effect as a Contract, from the date on which a fully executed and approved counterpart hereof is delivered to the Contractor and shall remain and continue in full force and effect until after the expiration of any guarantee period and the Contractor and his sureties are finally released by the County.

This agreement was approved by the Fulton County Board of Commissioners on **August 6,2025 Item #25-0570.**

[SIGNATURES NEXT PAGE]

IN WITNESS THEREOF, the Parties hereto have caused this Contract to be executed by their duly authorized representatives as attested and witnessed and their corporate seals to be hereunto affixed as of the day and year date first above written.

OWNER:

FULTON COUNTY, GEORGIA

Signed by:

Robert L. Pitts

14E1B4A85F6A44A...

Robert L. Pitts, Chairman
Fulton County Board of Commissioners

CONTRACTOR:

SOL CONSTRUCTION, LLC

Signed by:

Juliana Gomez

5478541F78194A5...

Juliana Gomez
President

ATTEST:

Signed by:

Tonya R. Grier

EEC476C4837648D...

Tonya R. Grier
Clerk to the Commission

(Affix Corporate Seal)



APPROVED AS TO FORM:

Signed by:

Kaye Burwell

40352859B237414...

Office of the County Attorney

APPROVED AS TO CONTENT:

DocuSigned by:

David Clark

65CE1C9FDD834B8...

David Clark, Director
Public Works

ITEM#: 25-0570	RM: 08/06/2025	ITEM#: _____	2 ND RM: _____
REGULAR MEETING		SECOND REGULAR MEETING	

GENERAL CONDITIONS

00700-1 FAMILIARITY WITH SITE

Execution of this agreement by the Contractor is a representation that the Contractor has visited the site, has become familiar with the local conditions under which the work is to be performed, and has correlated personal observations with the requirements of this agreement.

00700-2 CONTRACT DOCUMENTS

This agreement consists of Owner's invitation for bid, instructions to bidders, bid form, performance bond, payment bond, acknowledgments, the contract, general conditions, special conditions, specifications, plans, drawings, exhibits, addenda, and written change orders.

- A. Notice of Award of Contract:
- B. Execution of Contract Documents

Upon notification of Award of Contract, the Owner shall furnish the Contractor the conformed copies of Contract Documents for execution by the Contractor and the Contractor's surety.

Within ten (10) days after receipt the Contractor shall return all the documents properly executed by the Contractor and the Contractor's surety. Attached to each document shall be an original power-of-attorney for the person executing the bonds for the surety and certificates of insurance for the required insurance coverage.

After receipt of the documents executed by the Contractor and his surety with the power-of-attorney and certificates of insurance, the Owner shall complete the execution of the documents. Distribution of the completed documents will be made upon completion.

Should the Contractor and/or Surety fail to execute the documents within the time specified; the Owner shall have the right to proceed on the Bid Bond accompanying the bid.

If the Owner fails to execute the documents within the time limit specified, the Contractor shall have the right to withdraw the Contractor's bid without penalty.

Drawings and Specifications:

The Drawings, Specifications, Contract Documents, and all supplemental documents, are considered essential parts of the Contract, and requirements occurring in one are as binding as though occurring in all. They are intended to define, describe and provide for all Work necessary to complete the Project in an acceptable manner, ready for use, occupancy, or operation by the Owner.

In case of conflict between the Drawings and Specifications, the Specifications shall govern. Figure dimensions on Drawings shall govern over scale dimensions, and detailed Drawings shall govern over general Drawings.

In cases where products or quantities are omitted from the Specifications, the description and quantities shown on the Drawings shall govern.

Any ambiguities or need for clarification of the Drawings or Specifications shall be immediately reported to the Construction Manager in writing. Any such ambiguity or need for clarification shall be handled by the Construction Manager in writing. No clarification of the Drawings and Specifications hereunder by the Construction Manager shall entitle the Contractor to any additional monies unless a Change Order has been processed as provided by "Changes in the Contract" hereof.

Any work done by the Contractor following a discovery of such differing site condition or ambiguity or need for clarification in the Contract Drawings and Specifications prior to a written report to the

Construction Manager shall not entitle the Contractor to additional monies and shall be done at the Contractor's risk.

The Construction Manager will furnish the Contractor five (5) copies of the Contract Drawings and the Specifications, one copy of which the Contractor shall have available at all times on the Project site.

00700-3 DEFINITIONS

The following terms as used in this agreement are defined as follows to the extent the definitions herein differ or conflict with those in the Instructions for Bidders, Section 00100, the definitions herein shall control.

Alternate bids – the amount stated in the bid or proposal to be added to or deducted from the amount of the base bid or base proposal if the corresponding change in project scope or alternate materials or methods of construction is accepted.

Base bid – the amount of money stated in the bid or proposal as the sum for which the bidder or proposer offers to perform the work.

Change Order - an alteration, addition, or deduction from the original scope of work as defined by the contract documents to address changes or unforeseen conditions necessary for project completion. A written order to the Contractor issued by the County pursuant to Fulton County Code Section 102-420 for changes in the work within the general scope of the contract documents, adjustment of the contract price, extension of the contract time, or reservation of determination of a time extension.

Construction Manager - shall mean the individual designated in writing, by the Director of the Public Works Department as the Construction Manager.

Contractor - shall mean the party of the second part to the Contract Agreement or the authorized and legal representative of such party.

Contract Documents- include the Contract Agreement, Contractor's Bid (including all documentation accompanying the Bid and any post-Bid documentation required by the County prior to the Notice of Award), Bonds, all Special Conditions, General Conditions, Supplementary Conditions, Specifications, Drawings and addenda, together with written amendments, change orders, field orders and the Construction Manager's written interpretations and clarifications issued in accordance with the General Conditions on or after the date of the Contract Agreement.

Shop drawing submittals reviewed in accordance with the General Conditions, geotechnical investigations and soils report and drawings of physical conditions in or relating to existing surface structures at or contiguous to the site are not Contract Documents.

Contract Price - The sum specified in the Agreement to be paid to the Contractor in consideration of the Work.

Contract Time - shall mean the number of consecutive calendar days as provided in the Contract Agreement for completion of the Work, to be computed from the date of Notice to Proceed.

Owner or County - shall mean Fulton County Government, party of the first part to the Contract Agreement, or its authorized and legal representatives.

Day - A calendar day of twenty-four hours lasting from midnight of one day to midnight the next day.

Director - Director of the Public Works Department of Fulton County, Georgia or the designee thereof.

Final Completion - shall mean the completion of all work as required in accordance with the terms and conditions of the contract documents.

Liquidated Damages - shall mean the amount, stated in the Contract Agreement, which the Contractor agrees to pay to the Owner for each consecutive calendar day beyond the Contract time required to complete the Project or for failing to comply with associated milestones. Liquidated Damages will end upon written notification from the Owner of Final Acceptance of the Project or upon written notification of from the Owner of completion of the milestone.

Notice to Proceed - A written communication issued by the County to the Contractor authorizing it to proceed with the work, establishing the date of commencement and completion of the work, and providing other direction to the Contractor.

Products - shall mean materials or equipment permanently incorporated into the work.

Project Manual - The Contract Documents.

Provide - shall mean to furnish and install.

Substantial Completion - The date certified by the Construction Manager when all or a part of the work, as established pursuant to General Condition 0700-81, is sufficiently completed in accordance with the requirements of the contract documents so that the identified portion of the work can be utilized for the purposes for which it is intended.

Work or Project - All of the services specified, indicated, shown or contemplated by the contract documents, and furnishing by the Contractor of all materials, equipment, labor, methods, processes, construction and manufacturing materials and equipment, tools, plans, supplies, power, water, transportation and other things necessary to complete such services in accordance with the contract documents to insure a functional and complete facility.

00700-4 CODES

All codes, specifications, and standards referenced in the contract documents shall be the latest editions, amendments and revisions of such referenced standards in effect as of the date of the request for proposals for this contract.

00700-5 REVIEW OF CONTRACT DOCUMENTS

Before making its proposal to the County, and continuously after the execution of the agreement, the Contractor shall carefully study and compare the contract documents and shall at once report to the Construction Manager any error, ambiguity, inconsistency or omission that may be discovered, including any requirement which may be contrary to any law, ordinance, rule, or regulation of any public authority bearing on the performance of the work. By submitting its proposal, the Contractor agrees that the contract documents, along with any supplementary written instructions issued by or through the Construction Manager that have become a part of the contract documents, appear accurate, consistent and complete insofar as can be reasonably determined. If the Contractor has timely reported in writing any error, inconsistency, or omission to the Construction Manager, has properly stopped the affected work until instructed to proceed, and has otherwise followed the instructions of the Construction Manager, the Contractor shall not be liable to the County for any damage resulting from any such error, inconsistency, or omission in the contract documents. The Contractor shall not perform any portion of the work without the contract documents, approved plans, specifications, products and data, or samples for such portion of the work. For purposes of this section "timely" is defined as the time period in which the contractor discovers, or should have discovered, the error, inconsistency, or omission, with the exercise of reasonable diligence.

00700-6 STRICT COMPLIANCE

No observation, inspection, test or approval of the County or Construction Manager shall relieve the Contractor from its obligation to perform the work in strict conformity with the contract documents except as provided in General Condition 00700-48.

00700-7 APPLICABLE LAW

All applicable State laws, County ordinances, codes, and rules and regulations of all authorities having jurisdiction over the construction of the project shall apply to this agreement. The Contractor shall comply with the requirements of any Fulton County program concerning non-discrimination in contracting. All work performed within the right of way of the Georgia Department of Transportation and any railroad crossing shall be in accordance with Georgia Department of Transportation regulations, policies and procedures and, where applicable, those of any affected railroad. The Contractor shall comply with all laws, ordinances, codes, rules and regulations bearing on the conduct of the work as specified and the Contractor agrees to indemnify and hold harmless the County, its officers, agents and employees, as well as the Construction Manager and the Program Manager against any claim or liability arising from or based on the violation of any law, ordinance, regulation, order or decree affecting the conduct of the work, whether occasioned by the Contractor, his agents or employees.

00700-8 PERMITS, LICENSES AND BONDS

All permits and licenses necessary for the work shall be secured and paid for by the Contractor. If any permit, license or certificate expires or is revoked, terminated, or suspended as a result of any action on the part of the Contractor, the Contractor shall not be entitled to additional compensation or time. The Contractor shall obtain and keep in force at all times performance and payment bonds payable to Fulton County in penal amounts equal to 100% of the Contract price.

00700-9 TAXES

- A. The Contractor shall pay all sales, retail, occupational, service, excise, old age benefit and unemployment compensation taxes, consumer, use and other similar taxes, as well as any other taxes or duties on the materials, equipment, and labor for the work provided by the Contractor which are legally enacted by any municipal, county, state or federal authority, department or agency at the time bids are received, whether or not yet effective. The Contractor shall maintain records pertaining to such taxes and levies as well as payment thereof and shall make the same available to the County at all reasonable times for inspection and copying. The Contractor shall apply for any and all tax exemptions which may be applicable and shall timely request from the County such documents and information as may be necessary to obtain such tax exemptions. The County shall have no liability to the Contractor for payment of any tax from which it is exempt.
- B. The Contractor is obligated to comply with all local and State Sales and Use Tax laws. The Contractor shall provide the Owner with documentation to assist the Owner in obtaining sales and/or use tax refunds for eligible machinery and equipment used for the primary purpose of reducing or eliminating air or water pollution as provided for in Chapter 48-8-3 (36) and (37) of the Official Code of Georgia. All taxes shall be paid by the Contractor. All refunds will accrue to the Owner.

Acceptance of the project as complete and final payment will not be made by the Owner until the Contractor has fully complied with this requirement.

00700-10 DELINQUENT CONTRACTORS

The County shall not pay any claim, debt, demand or account whatsoever to any person firm or corporation who is in arrears to the County for taxes. The County shall be entitled to a counterclaim, back charge, and offset for any such debt in the amount of taxes in arrears, and no assignment or transfer of such debt after the taxes become due shall affect the right of the County to offset any taxes owed against said debt.

00700-11 LIEN WAIVERS

The Contractor shall furnish the County with evidence that all persons who have performed work or furnished materials pursuant to this agreement have been paid in full prior to submitting its demand for final payment pursuant to this agreement. A final affidavit, Exhibit A, must be completed, and submitted to comply with requirements of 00700-11. In the event that such evidence is not furnished, the County may retain sufficient sums necessary to meet all lawful claims of such laborers and materialmen. The County assumes no obligation nor in any way undertakes to pay such lawful claims from any funds due or that may become due to the Contractor.

00700-12 MEASUREMENT

All items of work to be paid for per unit of measurement shall be subject to inspection, measurement, and confirmation by the Construction Manager.

00700-13 ASSIGNMENT

The Contractor shall not assign any portion of this agreement or moneys due there from (include factoring of receivables) without the prior written consent of the County. The Contractor shall retain personal control and shall provide personal attention to the fulfillment of its obligations pursuant to this agreement. Any assignment without the express written consent of the County shall render this contract voidable at the sole option of the County.

00700-14 FOREIGN CONTRACTORS

In the event that the Contractor is a foreign corporation, partnership, or sole proprietorship, the Contractor hereby irrevocably appoints the Secretary of State of Georgia as its agent for service of all legal process for the purpose of this contract only.

00700-15 INDEMNIFICATION

The Contractor hereby assumes the entire responsibility and liability for any and all injury to or death of any and all persons, including the Contractor's agents, servants, and employees, and in addition thereto, for any and all damages to property caused by or resulting from or arising out of any act or omission in connection with this contract or the prosecution of work hereunder, whether caused by the Contractor or the Contractor's agents, Servants, or employees, or by any of the Contractor's subcontractors or suppliers, and the Contractor shall indemnify and hold harmless the County, the Construction Manager, County's Commissioners, officers, employees, successors, assigns and agents, or any of their subcontractors from and against any and all loss and/or expense which they or any of them may suffer or pay as a result of claims or suits due to, because of, or arising out of any and all such injuries, deaths and/or damage, irrespective of County or Construction Manager negligence (except that no party shall be indemnified for their own sole negligence). The Contractor, if requested, shall assume and defend at the Contractor's own expense, any suit, action or other legal proceedings arising there from, and the Contractor hereby agrees to satisfy, pay, and cause to be discharged of record any judgment which may be rendered against the County and the Construction Manager arising there from.

In the event of any such loss, expense, damage, or injury, or if any claim or demand for damages as heretofore set forth is made against the County or the Construction Manager, the County may withhold from any payment due or thereafter to become due to the Contractor under the terms of this Contract, an amount sufficient in its judgment to protect and indemnify it and the Construction Manager, County's Commissioners, officers, employees, successors, assigns and agents from any and all claims, expense, loss, damages, or injury; and the County, in its discretion, may require the Contractor to furnish a surety bond satisfactory to the County providing for such protection and indemnity, which bond shall be furnished by the Contractor within five (5) days after written demand has been made therefore. The expense of said Bond shall be borne by the Contractor.

00700-16 SUPERVISION OF WORK AND COORDINATION WITH OTHERS

The Contractor shall supervise and direct the work using the Contractor's best skill and attention. The Contractor shall be solely responsible for all construction methods and procedures and shall coordinate all portions of the work pursuant to the contract subject to the overall coordination of the Construction Manager. All work pursuant to this agreement shall be performed in a skillful and workmanlike manner.

The County reserves the right to perform work related to the Project with the County's own forces and to award separate contracts in connection with other portions of the project, other work on the site under these or similar conditions of the contract, or work which has been extracted from the Contractor's work by the County.

When separate contracts are awarded for different portions of the project or other work on the site, the term "separate contractor" in the Contract Documents in each case shall mean the contractor who executes each separate County Agreement.

The Contractor shall cooperate with the County and separate contractors in arranging the introduction and storage of materials and equipment and execution of their work, and shall cooperate in coordinating connection of its work with theirs as required by the Contract Documents.

If any part of the Contractor's Work depends for proper execution or results upon the work of the County or any separate contractor, the Contractor shall, prior to proceeding with that portion of the Work, promptly report to the Construction Manager any apparent discrepancies or defects in such other work that render it unsuitable for such proper execution and results within fourteen (14) days of discovery of such discrepancy or defect. Failure of the Contractor to so report in writing shall constitute an acceptance of the County's or separate contractor's work as fit and proper to receive the Work, except as to any defects which may subsequently become apparent in such work by others.

Any costs caused by defective or untimely work shall be borne by the party responsible therefore.

Should the Contractor wrongfully cause damage to the work or property of the County or to other work or property on the site, including the work of separate contractors, the Contractor shall promptly remedy such damage at the Contractor's expense.

Should the Contractor be caused damage by any other contractor on the Project, by reason of such other contractor's failure to perform properly his contract with the County, no action shall lie against the County or the Construction Manager inasmuch as the parties to this agreement are the only beneficiaries hereof and there are no third party beneficiaries and neither the County nor the Construction Manager shall have liabilities therefore, but the Contractor may assert his claim for damages solely against such other contractor. The Contractor shall not be excused from

performance of the contract by reason of any dispute as to damages with any other contractor or third party.

Where the Work of this Contract shall be performed concurrently in the same areas as other construction work, the Contractor shall coordinate with the Construction Manager and the separate contractors in establishing mutually acceptable schedules and procedures that shall permit all jobs to proceed with minimum interference.

If a dispute arises between the Contractor and separate contractors as to their responsibility for cleaning up, the County may clean up and charge the cost thereof to the Contractor or contractors responsible therefore as the County shall determine to be just.

00700-17 ADMINISTRATION OF CONTRACT

The Program Manager and the Construction Manager shall provide administration services as hereinafter described.

For the administration of this Contract, the Construction Manager shall serve as the County's primary representative during design and construction and until final payment to the Contractor is due. The Construction Manager shall advise and consult with the County and the Program Manager. The primary point of contact for the Contractor shall be the Construction Manager. All correspondence from the Contractor to the County shall be forwarded through the Construction Manager. Likewise, all correspondence and instructions to the Contractor shall be forwarded through the Construction Manager.

The Construction Manager will determine in general that the construction is being performed in accordance with design and engineering requirements, and will endeavor to guard the County against defects and deficiencies in the Work.

The Construction Manager will not be responsible for or have control or charge of construction means, methods, techniques, sequences, or procedures, or for safety precautions and programs in connection with the Work, nor will it be responsible for the Contractor's failure to carry out the Work in accordance with the Contract Documents. The Construction Manager will not be responsible for or have control or charge over the acts or omissions of the Contractor, its engineers, consultants, subcontractors, or any of their agents or employees, or any other persons performing the Work.

Based on the Construction Manager's observations regarding the Contractor's Applications for Payment, the Construction Manager shall determine the amounts owing to the Contractor, in accordance with the payment terms of the Contract, and shall issue Certificates for Payment in such amount to the County.

The Construction Manager shall render interpretations necessary for the proper execution or progress of the Work. Either party to the Contract may make written requests to the Construction Manager for such interpretations.

Claims, disputes and other matters in question between the Contractor and the County relating to the progress of the Work or the interpretation of the Contract Documents shall be referred to the Construction Manager for interpretation.

All interpretations of the Construction Manager shall be consistent with the intent of and reasonably inferable from the Contract Documents and shall be in writing or in graphic form.

Except as otherwise provided in this Contract, the Construction Manager shall issue a decision on any disagreement concerning a question of fact arising under this Contract. The Construction Manager shall reduce the decision to writing and mail or otherwise furnish a copy thereof to the Contractor. The decision of the Construction Manager shall be final and conclusive unless, within

thirty (30) days from the date of receipt of such copy, the Contractor files a written appeal with the Director of Public Works and mails or otherwise furnishes the Construction Manager a copy of such appeal. The decision of the Director of Public Works or the Director's duly authorized representative for the determination of such appeals shall be final and conclusive. Such final decision shall not be pleaded in any suit involving a question of fact arising under this Contract, provided such is not fraudulent, capricious, arbitrary, so grossly erroneous as necessarily implying bad faith, or is not supported by substantial evidence. In connection with any appeal proceeding under this Article, the Contractor shall be afforded an opportunity to be heard and to offer evidence in support of Contractor's appeal. Pending any final decision of a dispute hereunder, the Contractor shall proceed diligently with the performance of the Contract as directed by the Construction Manager.

The Construction Manager shall have authority to reject Work which does not conform to the Contract Documents. Whenever, in the Construction Manager's opinion, it is considered necessary or advisable for the implementation of the intent of the Contract Documents, the County shall have authority to require special inspection or testing of the Work whether or not such Work be then fabricated, installed or completed. The Contractor shall pay for such special inspection or testing if the Work so inspected or tested is found not to comply with the requirements of the contract; the County shall pay for special inspection and testing if the Work is found to comply with the contract. Neither the Construction Manager's authority to act under this Subparagraph, nor any decision made by the Construction Manager in good faith either to exercise or not to exercise such authority, shall give rise to any duty or responsibility of the Construction Manager to the Contractor, any subcontractor, any of their agents or employees, or any other person performing any of the Work.

The Contractor shall provide such shop drawings, product data, and samples as may be required by the Construction Manager and/or as required by these Contract Documents.

The Construction Manager shall conduct inspections to determine Substantial Completion and Final Completion, and shall receive and forward to the County for review written warranties and related documents required by the Contract Documents and assembled by the Contractor. The Construction Manager shall approve and issue Certificates for Payment upon compliance with Substantial and Final Completion requirements indicated in General Conditions 00700-81, 00700-82, 00700-84 and 00700-85 of this Agreement.

Except as provided in General Condition 00700-48, the Contractor shall not be relieved from the Contractor's obligations to perform the work in accordance with the contract documents by the activities or duties of the County or any of its officers, employees, or agents, including inspections, tests or approvals, required or performed pursuant to this agreement.

00700-18 RESPONSIBILITY FOR ACTS OF EMPLOYEES

The Contractor shall employ only competent and skilled personnel. The Contractor shall, upon demand from the Construction Manager, immediately remove any superintendent, foreman or workman whom the Construction Manager may consider incompetent or undesirable.

The Contractor shall be responsible to the County for the acts and omissions of the Contractor's employees, subcontractors, and agents as well as any other persons performing work pursuant to this agreement for the Contractor.

00700-19 LABOR, MATERIALS, SUPPLIES, AND EQUIPMENT

Unless otherwise provided in this agreement, the Contractor shall make all arrangements with necessary support agencies and utility companies provide and pay for all labor, materials,

equipment, tools, construction equipment and machinery, water, heat, utilities, transportation, and other facilities and services necessary for the execution and completion of the work.

00700-20 DISCIPLINE ON WORK SITE

The Contractor shall enforce strict discipline and good order among its employees and subcontractors at all times during the performance of the work, to include compliance with the Fulton County Drug Free Work Place Policy. The Contractor shall not employ any subcontractor who is not skilled in the task assigned to it. The Construction Manager may, by written notice, require the Contractor to remove from the work any subcontractor or employee deemed by the Construction Manager to be incompetent.

00700-21 HOURS OF OPERATION

All work at the construction site shall be performed during regular business hours of the Fulton County government, except upon the Construction Manager's prior written consent to other work hours. It is further understood that the Contractor's construction schedule is based on a normal 40 hours, five day work week, less Fulton County-recognized holidays. Contractors work schedule shall not violate Fulton County Noise Ordinance by working hours inconsistent with the Fulton County Noise Ordinance. The County's current noise ordinance or other applicable ordinance shall govern. If the Contractor desires to work in excess of this limit, the Contractor shall submit a written request to the Construction Manager, a minimum of five days prior to the desired work date. The Contractor shall be responsible for any additional expenses incurred by the Owner as a result of the extended work hours, including resident inspection overtime. The cost associated with resident inspector overtime shall be deducted from the Contractor monthly payment request.

00700-22 FAMILIARITY WITH WORK CONDITIONS

The Contractor shall take all steps necessary to ascertain the nature and location of the work and the general and local conditions which may affect the work or the cost thereof. The Contractor's failure to fully acquaint itself with the conditions which may affect the work, including, but not limited to conditions relating to transportation, handling, storage of materials, availability of utilities, labor, water, roads, weather, topographic and subsurface conditions, other separate contracts to be entered into by the County relating to the project which may affect the work of the Contractor, applicable provisions of law, and the character and availability of equipment and facilities necessary prior to and during the performance of the work shall not relieve the Contractor of its responsibilities pursuant to this agreement and shall not constitute a basis for an equitable adjustment of the contract terms. The County reserves the right to perform with its own forces or to contract with other entities for other portions of the project work, in which case the Contractor's responsibility to assure its familiarity with work conditions hereunder shall include all coordination with such other contractors and the County necessary to insure that there is no interference between contractors as will delay or hinder any contractor in its prosecution of work on the project. The County assumes no responsibility for any understandings or representations concerning conditions of the work made by any of its officers, agents, or employees prior to the execution of this agreement.

00700-23 RIGHT OF ENTRY

The County reserves the right to enter the site of the work by such agent, including the Construction Manager, as it may elect for the purpose of inspecting the work or installing such collateral work as the County may desire. The Contractor shall provide safe facilities for such access so that the County and its agents may perform their functions.

00700-24 NOTICES

Any notice, order, instruction, claim or other written communication required pursuant to this agreement shall be deemed to have been delivered or received as follows:

Upon personal delivery to the Contractor, its authorized representative, or the Construction Manager on behalf of the County. Personal delivery may be accomplished by in-person hand delivery or bona fide overnight express service.

Three days after depositing in the United States mail a certified letter addressed to the Contractor or the Construction Manager for the County. For purposes of mailed notices, the County's mailing address shall be 141 Pryor Street, 6th Floor, Atlanta, Georgia 30303, or as the County shall have otherwise notified the Contractor. The Contractor's mailing address shall be the address stated in its proposal or as it shall have most recently notified the Construction Manager in writing.

00700-25 SAFETY

SAFETY, HEALTH AND LOSS PREVENTION

The Contractor shall be responsible for implementing a comprehensive project-specific safety, health and loss prevention program and employee substance abuse program for this project. All Sub-Contractors must either implement their own program or follow the Contractor's safety, health and loss prevention program and employee substance abuse program.

The Contractor's safety, health and loss prevention program and employee substance abuse program must meet or exceed all governmental regulations (OSHA, EPA, DOT, State, local), and any other specific Fulton County requirements

COUNTY'S SAFETY, HEALTH, AND LOSS PREVENTION PROCESS GUIDELINES AND REQUIREMENTS

The County and its agents reserve the right, but assume no duty, to establish and enforce safety, health, and loss prevention guidelines and to make the appropriate changes in the guidelines, for the protection of persons and property and to review the efficiency of all protective measures taken by the Contractor. The Contractor shall comply with all safety, health, and loss prevention process guidelines and requirements and changes made by the County or its agent(s). The issuance of any such guidelines or changes by the County or its agent(s) shall not relieve the Contractor of its duties and responsibilities under this Agreement, and the County or its agent(s) shall not thereby assume, nor be deemed to have assumed, any such duties or responsibilities of the Contractor.

COMPLIANCE OF WORK, EQUIPMENT, AND PROCEDURES WITH ALL APPLICABLE LAWS and REGULATIONS

All Work, whether performed by the Contractor or its Sub-Contractors of any tier, or anyone directly or indirectly employed by any of them, and all equipment, appliances, machinery, materials, tools and like items incorporated or used in the Work, shall be in compliance with and conform to:

All applicable laws, ordinances, rules, regulations and orders of any public, quasi-public or other governmental authority relating to the safety of persons and their protection against injury, specifically including, but in no event limited to, the Federal Occupational Safety and Health Act of 1970, as amended, and all rules and regulations now or hereafter in effect pursuant to said Act.

All rules, regulations, and requirements of the County or its agent(s) and its insurance carriers relating there to. In the event of a conflict or differing requirements the more stringent shall govern.

PROTECTION OF THE WORK

The Contractor shall, throughout the performance of the Work, maintain adequate and continuous protection of all Work and temporary facilities against loss or damage from whatever cause, shall protect the property of the County and third parties from loss or damage from whatever cause arising out of the performance of the Work, and shall comply with the requirements of the County or its agent(s) and its insurance carriers, and with all applicable laws, codes, rules and regulations, (as same may be amended) with respect to the prevention of loss or damage to property as a result of fire or other hazards.

The County or its agent(s) may, but shall not be required to, make periodic inspections of the Project work area. In such event, however, the Contractor shall not be relieved of its aforesaid responsibilities and the County or its agent(s) shall not assume, nor shall it be deemed to have assumed, any responsibility otherwise imposed upon the assurance of Contractor by this Agreement.

SAFETY EQUIPMENT

1. The Contractor shall provide to each worker on the Project work area the proper safety equipment for the duties being performed by that worker and will not permit any worker on the Project work area who fails or refuses to use the same. The County or its agent shall have the right, but not the obligation, to order the removal of a worker from the Project work site for his/her failure to comply with safe practices or substance abuse policies.

EMERGENCIES

1. In any emergency affecting the safety of persons or property, or in the event of a claimed violation of any federal or state safety or health law or regulation, arising out of or in any way connected with the Work or its performance, the Contractor shall act immediately to prevent threatened damage, injury or loss and to remedy said violation. Failing such action the County or its agent(s) may immediately take whatever steps it deems necessary including, but not limited to, suspending the Work as provided in this Agreement.

2. The County or its agent(s) may offset any and all costs or expenses of whatever nature, including attorneys' fees, paid or incurred by the County or its agent(s) (whether such fees are for in-house counsel or counsel retained by the County or its agent), in taking the steps authorized by Section 00700-25(G) (1) above against any sums then or thereafter due to the Contractor. The Contractor shall defend, indemnify and hold the County, its officers, agents, and employees harmless against any and all costs or expenses caused by or arising from the exercise by the County of its authority to act in an emergency as set out herein. If the Contractor shall be entitled to any additional compensation or extension of time change order on account of emergency work not due to the fault or neglect of the Contractor or its Sub-Contractors, such additional compensation or extension of time shall be determined in accordance with General Condition 00700-52 and General Condition 00700-87 of this Agreement.

SUSPENSION OF THE WORK

1. Should, in the judgment of the County or its agent(s), the Contractor or any Sub-Contractor fail to provide a safe and healthy work place, the County or its agent shall have the right, but not the obligation, to suspend work in the unsafe areas until deficiencies are corrected. All costs of any nature (including, without limitation, overtime pay, liquidated damages or other costs arising out of delays) resulting from the suspension, by whomsoever incurred, shall be borne by the Contractor.

2. Should the Contractor or any Sub-Contractor fail to provide a safe and healthy work place after being formally notified in writing by the County or its agents of such non-compliance, the contract may be terminated following the termination provision of the contract.

CONTRACTOR'S INDEMNITY OF THE COUNTY FOR CONTRACTOR'S NON-COMPLIANCE WITH SAFETY PROGRAM

1. The Contractor recognizes that it has sole responsibility to assure its Safety Program is implemented and to assure its construction services are safely provided. The Contractor shall indemnify, defend and hold the County and its agents harmless, from and against any and all liability (whether public or private), penalties (contractual or otherwise), losses, damages, costs, attorneys' fees, expenses, causes of action, claims or judgments resulting, either in whole or in part, from any failure of the Contractor, its Sub-Contractors of any tier or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, to comply with the safety requirements of the contract. The Contractor shall not be relieved of its responsibilities under the safety requirements of the Contract should the County or its agent(s) act or fail to act pursuant to its rights hereunder.

2. The Contractor shall not raise as a defense to its obligation to indemnify under this Subparagraph I any failure of those indemnified hereunder to assure Contractor operates safely, it being understood and agreed that no such failure shall relieve the Contractor from its obligation to assure safe operations or from its obligation to so indemnify. The Contractor also hereby waives any rights it may have to seek contribution, either directly or indirectly, from those indemnified hereunder.

3. In any and all claims against those indemnified hereunder by any employee of the Contractor, any Sub-Contractor of any tier or anyone directly or indirectly employed by any of them or anyone for whose acts any of them may be liable, the indemnification obligation under this Subparagraph I shall not be limited in any way as to the amount or type of damages, compensation or benefits payable by or for the Contractor or any Sub-Contractor of any tier under any workers' compensation act, disability benefit or other employee benefit acts.

00700-26 BLASTING AND EXCAVATION

The Contractor acknowledges that it is fully aware of the contents and requirements of O.C.G.A. § 25-9-1 through 25-9-12 concerning blasting and excavation near underground gas pipes and facilities and shall fully comply therewith.

00700-27 HIGH VOLTAGE LINES

The Contractor acknowledges that it is fully aware of the contents and requirements O.C.G.A. § 46-3-30 through 46-3-39 concerning safeguards against contact with high voltage lines, and the Contractor shall fully comply with said provisions.

00700-28 SCAFFOLDING AND STAGING

The Contractor acknowledges that it is the person responsible for employing and directing others to perform labor within the meaning of O.C.G.A. § 34-1-1 and agrees to comply with said provisions.

00700-29 CLEAN-UP

The Contractor shall clean up all refuse, rubbish, scrap materials, and debris caused by its operations to the end that the site of the work shall present a neat, orderly and workmanlike appearance at all times.

00700-30 PROTECTION OF WORK

The Contractor shall be responsible for maintenance and protection of the work, which shall include any County-furnished supplies, material, equipment, until final completion of this agreement and acceptance of the work as defined herein. Any portion of the work suffering injury,

damage or loss shall be considered defective and shall be corrected or replaced by the Contractor without additional cost to the County.

00700-31 REJECTED WORK

The Contractor shall promptly remove from the project all work rejected by the Construction Manager for failure to comply with the contract documents and the Contractor shall promptly replace and re-execute the work in accordance with the contract documents and without expense to the County. The Contractor shall also bear the expense of making good all work of other Contractors destroyed or damaged by such removal or replacement.

00700-32 DEFECTIVE WORK

If the Contractor defaults or neglects to carry out any portion of the work in accordance with the contract documents, and fails within three days after receipt of written notice from the Construction Manager to commence and continue correction of such default or neglect with diligence and promptness, the County may, after three days following receipt by the Contractor of an additional written notice and without prejudice to any other remedy the County may have, make good such deficiencies and complete all or any portion of any work through such means as the County may select, including the use of a separate Contractor. In such case, an appropriate change order shall be issued deducting from the payments then or thereafter due the Contractor the cost of correcting such deficiencies. In the event the payments then or thereafter due the Contractor are not sufficient to cover such amount, the Contractor shall pay the difference to the County on demand.

The County may, at its option, accept defective or nonconforming work instead of requiring its removal or correction. In such case, a change order shall be issued reducing the price due the contractor to the extent appropriate and equitable. Such contract price adjustment shall be effected whether or not final payment has been made.

00700-33 WARRANTY OF NEW MATERIALS

The Contractor warrants to the County that all materials and equipment furnished under this contract will be new unless otherwise specified, and the Contractor further warrants that all work will be of good quality, free from faults and defects, and in conformance with the contract documents. The warranty set forth in this paragraph shall survive final acceptance of the work.

00700-34 CONTRACTOR'S WARRANTY OF THE WORK

If within one year after the date of issuance of the certificate of final payment pursuant to General Condition 84, or within such longer period of time as may be prescribed by law or by the term of any applicable special warranty required by the contract documents, any of the work is found to be defective or not in accordance with the contract documents, the Contractor shall correct such work promptly after receipt of written notice from the Construction Manager to do so. This obligation shall survive both final payment for the work and termination of the contract.

00700-35 ASSIGNMENT OF MANUFACTURERS' WARRANTIES

Without limiting the responsibility or liability of the Contractor pursuant to this agreement, all warranties given by manufacturers on materials or equipment incorporated in the work are hereby assigned by the Contractor to the County. If requested, the Contractor shall execute formal assignments of said manufacturer's warranties to the County. All such warranties shall be directly enforceable by the County.

00700-36 WARRANTIES IMPLIED BY LAW

The warranties contained in this agreement, as well as those warranties implied by law, shall be deemed cumulative and shall not be deemed alternative or exclusive. No one or more of the warranties contained herein shall be deemed to alter or limit any other.

00700-37 STOP WORK ORDERS

In the event that the Contractor fails to correct defective work as required by the contract documents or fails to carry out the work in accordance with contract documents, the Construction Manager, in writing, may order the Contractor to stop work until the cause for such order has been eliminated. This right of the County to stop work shall not give rise to any duty on the part of the County or the Construction Manager to execute this right for the benefit of the Contractor or for any other person or entity.

00700-38 TERMINATION FOR CAUSE

If the Contractor is adjudged bankrupt, makes a general assignment for the benefit of creditors, suffers the appointment of a receiver on account of its insolvency, fails to supply sufficient properly skilled workers or materials, fails to make prompt payment to subcontractors or materialmen, disregards laws, ordinances, rules, regulations, or orders of any public authority having jurisdiction, fails to diligently prosecute the work, or is otherwise guilty of a material violation of this agreement and fails within seven days after receipt of written notice to commence and continue correction of such default, neglect, or violation with diligence and promptness, the County may, after seven days following receipt by the Contractor of an additional written notice and without prejudice to any other remedy the County may have, terminate the employment of the Contractor and take possession of the site as well as all materials, equipment, tools, construction equipment and machinery thereon. The County may finish the work by whatever methods the County deems expedient. In such case, the Contractor shall not be entitled to receive any further payment until the work is completed.

Upon completion of the work, the County shall determine in its sole discretion whether the Contractor is due any compensation for those services the Contractor performed prior to the termination to the satisfaction of the County ("Unpaid Satisfactory Work"), and shall compensate Contractor for the same. The County shall further determine in its sole discretion whether the County's completion of the work was made more costly as a result of failures, acts, or omissions of the Contractor, and if so, shall deduct such amounts ("Overages") from any amounts that may be due to the Contractor. In the event that the Overages exceed the Unpaid Satisfactory Work, the Contractor shall immediately pay the difference to the County on demand. These obligations for payment shall survive the termination of the contract. Termination of this agreement pursuant to this paragraph may result in disqualification of the Contractor from bidding on future County contracts.

00700-39 TERMINATION FOR CONVENIENCE

The County may, at any time upon written notice to the Contractor, terminate the whole or any portion of the work for the convenience of the County. The effective date of the termination shall be provided in the written notice. Said termination shall be without prejudice to any right or remedy of the County provided herein. In addition, in the event this agreement has been terminated by the County through the Termination for Cause provisions due to a claim of default by the Contractor, and it is later determined that the Contractor was not in default pursuant to the provisions of this agreement at the time of termination, then such termination shall be considered a Termination for Convenience pursuant to this paragraph and administered according to the provisions related to Termination for Convenience set out in this Contract.

00700-40 TERMINATION FOR CONVENIENCE - PAYMENT

If the Contract is terminated for convenience by the Owner as provided in this article, Contractor will be paid compensation for those services actually performed as approved by the Owner or his representative. Partially completed tasks will be compensated for based on a signed statement of completion prepared by the Project Manager and submitted to the Contractor which shall itemize each task element and briefly state what work has been completed and what work remains to be done. Contractor shall also be paid for reasonable costs for the orderly filing and closing of the project.

00700-41 TERMINATION FOR CONVENIENCE - PAYMENT LIMITATIONS

Except for normal spoilage, and except to the extent that the County shall have otherwise expressly assumed the risk of loss, there shall be excluded from the amounts payable to the Contractor the fair value, as determined by the Construction Manager, of property which is destroyed, lost, stolen or damaged so as to become undeliverable to the County or to another buyer.

00700-42 COST TO CURE

If the County terminates for cause the whole or any part of the work pursuant to this agreement, then the County may procure upon such terms and in such manner as the Construction Manager may deem appropriate, supplies or services similar to those so terminated, for the purpose of completing the work for which the Contractor was contractually engaged, and the Contractor shall be liable to the County for any excess costs for such similar supplies or services. The Contractor shall continue the performance of this agreement to the extent not terminated hereunder.

00700-43 ATTORNEY'S FEES

Should the Contractor default pursuant to any of the provisions of this agreement, the Contractor and its surety shall pay to the County such reasonable attorney's fees as the County may expend as a result thereof and all costs, expenses, and filing fees incidental thereto.

00700-44 CONTRACTOR'S RESPONSIBILITIES UPON TERMINATION

After receipt of a notice of termination from the County, and except as otherwise directed by the Construction Manager, the Contractor shall:

1. Stop work under the contract on the date and to the extent specified in the notice of termination;
2. Place no further orders or subcontracts for materials, services or facilities, except as may be necessary for completion of such portion of the work under the agreement as is not terminated;
3. Unless otherwise directed by the Construction Manager, terminate all orders and subcontracts to the extent that they relate to the performance of work terminated by the notice of termination;
4. Assign to the County in the manner, at the times, and to the extent directed by the Construction Manager, all of the rights, title and interest of the Contractor under the orders and subcontracts so terminated, in which case the County shall have the right, at its discretion, to settle or pay any and all claims arising out of the termination of such orders or subcontracts;
5. Settle all outstanding liabilities and all claims arising out of such termination of orders and subcontracts with the approval or ratification of the Construction Manager, to the extent the Construction Manager may require, which approval or ratification shall be final for all purposes;
6. Transfer title and deliver to the entity or entities designated by the Construction Manager, in the manner, at the times, and to the extent, if any, directed by the Construction Manager, and

to the extent specifically produced or specifically acquired by the Contractor for the performance of such portion of the work as has been terminated:

The fabricated or un-fabricated parts, work, and progress, partially completed supplies, and equipment, materials, parts, tools, dyes, jigs, and other fixtures, completed work, supplies, and other material produced as a part of or acquired in connection with the performance of the work terminated by the notice of termination; and

The completed or partially completed plans, drawings, information, and other property to the work.

7. Use its best efforts to sell in the manner, at the times, to the extent, and at the prices directed or authorized by the Construction Manager, any property described in Section 6 of this paragraph, provided, however, that the Contractor shall not be required to extend credit to any buyer and further provided that the proceeds of any such transfer or disposition shall be applied in reduction of any payments to be made by the County to the Contractor pursuant to this agreement.

8. Complete performance of such part of the work as shall not have been terminated by the notice of termination; and

9. Take such action as may be necessary, or as the Construction Manager may direct, for the protection and preservation of the property related to the agreement which is in the possession of the Contractor and in which the County has or may acquire an interest.

00700-45 RECORDS

The Contractor shall preserve and make available to the County all of its records, books, documents and other evidence bearing on the costs and expenses of the Contractor and any subcontractor pursuant to this agreement upon three days advance notice to the Contractor.

00700-46 DEDUCTIONS

In arriving at any amount due the Contractor pursuant to the terms of this agreement, there shall be deducted all liquidated damages, advance payments made to the Contractor applicable to the termination portion of the contract, the amount of any claim which the County may have against the Contractor, the amount determined by the Construction Manager to be necessary to protect the County against loss due to outstanding potential liens or claims, and the agreed price of any materials acquired or sold by the Contractor and not otherwise recovered by or credited to the County.

00700-47 REIMBURSEMENT OF THE COUNTY

In the event of termination for cause or convenience, the Contractor shall refund to the County any amount paid by the County to the Contractor in excess of the costs properly reimbursable to the Contractor.

00700-48 SUSPENSION, INTERRUPTION, DELAY, DAMAGES

The Contractor shall be entitled to only those damages and that relief from termination by the County as specifically set forth in this agreement. The Construction Manager may issue a written order requiring the Contractor to suspend, delay or interrupt all or any part of the work for such period of time as the County may determine to be appropriate for the convenience of the County. If the Construction Manager issues a written order requiring the Contractor to suspend, delay or interrupt all or any part of the work and if the performance of the work is interrupted for an unreasonable period of time by an act of the County or any of its officers, agents, employees, contractors, or consultants in the administration of this agreement, an equitable adjustment may be made for any increase in the Contractor's costs of performance and any increase in the time required for performance of the work necessarily caused by the unreasonable suspension, delay,

or interruption. Any equitable adjustment shall be reduced to writing and shall constitute a modification to this agreement. In no event, however, shall an equitable adjustment be made to the extent that performance of this agreement would have been suspended, delayed or interrupted by any other cause, including the fault or negligence of the Contractor. No claim for an equitable adjustment pursuant to this paragraph shall be permitted before the Contractor shall have notified the Construction Manager in writing of the act or failure to act involved, and no claim shall be allowed unless asserted in writing to the Construction Manager within ten days after the termination of such suspension, delay or interruption.

00700-49 COMMENCEMENT AND DURATION OF WORK

The County may issue a Notice to Proceed at any time within 120 days following execution of the contract by the County. The Contractor shall commence work pursuant to this agreement within ten days of mailing or delivery of written notice to proceed. The Contractor shall diligently conduct the work to completion within the time specified therefore in the Agreement. The capacity of the Contractor's construction and manufacturing equipment and plan, sequence and method of operation and forces employed, including management and supervisory personnel, shall be such as to insure completion of the work within the time specified in the Agreement. The Contractor and County hereby agree that the contract time for completion of the work is reasonable taking into consideration the average climatic conditions prevailing in the locality of the work and anticipated work schedules of other contractors whose activities are in conjunction with or may affect the work under this contract.

00700-50 TIME OF THE ESSENCE

All time limits stated in this agreement are of the essence of this contract.

00700-51 IMPACT DAMAGES

Except as specifically provided pursuant to a stop work order or change order, the Contractor shall not be entitled to payment or compensation of any kind from the County for direct or indirect or impact damages including, but not limited to, costs of acceleration arising because of delay, disruption, interference or hindrance from any cause whatsoever whether such delay, disruption, interference or hindrance is reasonable or unreasonable, foreseeable or unforeseeable, or avoidable, provided, however, that this provision shall not preclude the recovery of damages by the Contractor for hindrances or delays due solely to fraud or bad faith on the part of the County, its agents, or employees. The Contractor shall be entitled only to extensions in the time required for performance of the work as specifically provided in the contract.

00700-52 DELAY

The Contractor may be entitled to an extension of the contract time, but not an increase in the contract price or damages, for delays arising from unforeseeable causes beyond the control and without the fault or negligence of the Contractor or its subcontractors for labor strikes, acts of God, acts of the public enemy, acts of the state, federal or local government in its sovereign capacity, by acts of another separate contractor, or by an act or neglect of the County.

00700-53 INCLEMENT WEATHER

The Contractor shall not be entitled to an extension of the contract time due to normal inclement weather. Unless the Contractor can substantiate to the satisfaction of the Construction Manager that there was greater than normal inclement weather and that such greater than normal inclement weather actually delayed the work, the Contractor shall not be entitled to an extension

of time therefore. The following shall be considered the normal inclement weather days for each month listed, and extensions of time shall be granted in increments of not less than one half day only for inclement weather in excess of the days set out.

January	10 days
February	10 days
March	7 days
April	6 days
May	4 days
June	3 days
July	4 days
August	2 days
September	2 days
October	3 days
November	6 days
December	9 days

00700-54 DELAY - NOTICE AND CLAIM

The Contractor shall not receive an extension of time unless a Notice of Delay is filed with the Construction Manager within ten days of the first instance of such delay, disruption, interference or hindrance and a written Statement of the Claim is filed with the Construction Manager within 20 days of the first such instance. In the event that the Contractor fails to comply with this provision, it waives any claim which it may have for an extension of time pursuant to this agreement.

00700-55 STATEMENT OF CLAIM - CONTENTS

The Statement of Claim referenced in Article 00700-54 shall include specific information concerning the nature of the delay, the date of commencement of the delay, the construction activities affected by the delay, the person or organization responsible for the delay, the anticipated extent of the delay, and any recommended action to avoid or minimize the delay.

00700-56 WORK BEHIND SCHEDULE, REMEDY BY CONTRACTOR

If the work actually in place falls behind the currently updated and approved schedule, and it becomes apparent from the current schedule that work will not be completed within the contract time, the Contractor agrees that it will, as necessary, or as directed by the Construction Manager, take action at no additional cost to the County to improve the progress of the work, including increasing manpower, increasing the number of working hours per shift or shifts per working day, increasing the amount of equipment at the site, and any other measure reasonably required to complete the work in a timely fashion.

00700-57 DILIGENCE

The Contractor's failure to substantially comply with the requirements of the preceding paragraph may be grounds for determination by the County that the Contractor is failing to prosecute the work with such diligence as will insure its completion within the time specified. In such event, the County shall have the right to furnish, from its own forces or by contract, such additional labor and materials as may be required to comply with the schedule after 48 hours written notice to the Contractor, and the Contractor shall be liable for such costs incurred by the County.

00700-58 SET-OFFS

Any monies due to the Contractor pursuant to the preceding paragraph of this agreement may be deducted by the County against monies due from the County to the Contractor.

00700-59 REMEDIES CUMULATIVE

The remedies of the County under Articles 00700-56, 00700-57, and 00700-58 are in addition to and without prejudice to all of the rights and remedies of the County at law, in equity, or contained in this agreement.

00700-60 TITLE TO MATERIALS

No materials or supplies shall be purchased by the Contractor or by any Subcontractor subject to any chattel mortgage or under a conditional sales contract or other agreement by which any interest is retained by the seller. The Contractor hereby warrants that it has good and marketable title to all materials and supplies used by it in the work, and the Contractor further warrants that all materials and supplies shall be free from all liens, claims, or encumbrances at the time of incorporation in the work.

00700-61 INSPECTION OF MATERIALS

All materials and equipment used in the construction of the project shall be subject to adequate inspection and testing in accordance with accepted standards and in accordance with the requirements of the contract documents. Additional tests performed after the rejection of materials or equipment shall be at the Contractor's expense.

00700-62 CONSTRUCTION MANAGER'S PRESENCE DURING TESTING

All tests performed by the Contractor shall be witnessed by the Construction Manager unless the requirement therefore is waived in writing. The Construction Manager may perform additional tests on materials previously tested by the Contractor, and the Contractor shall furnish samples for this purpose as requested.

00700-63 MATERIALS INCORPORATED IN WORK

The Contractor shall furnish all materials and equipment to be incorporated in the work. All such materials or equipment shall be new and of the highest quality available. Manufactured materials and equipment shall be obtained from sources which are currently manufacturing such materials, except as otherwise specifically approved by the Construction Manager.

00700-64 STORAGE OF MATERIALS

Materials and equipment to be incorporated in the work shall be stored in such a manner as to preserve their quality and fitness for the work and to facilitate inspection.

00700-65 PAYROLL REPORTS

The Contractor may be required to furnish payroll reports to the Construction Manager as required by the Owner Controlled Insurance Program.

00700-66 CONTRACTORS' REPRESENTATIVE

Before beginning work, the Contractor shall notify the Construction Manager in writing of one person within its organization who shall have complete authority to supervise the work, receive orders from the Construction Manager, and represent the Contractor in all matters arising pursuant to this agreement. The Contractor shall not remove its representative without first designating in writing a new representative. The Contractor's representative shall normally be present at or about the site of work while the work is in progress. When neither the Contractor nor its representative is present at the work site, the superintendent, foreman, or other of the

Contractor' employee in charge of the work shall be an authorized representative of the Contractor.

00700-67 SPECIALTY SUB-CONTRACTORS

The Contractor may utilize the services of specialty subcontractors on those parts of the project which, under normal contracting practices, are performed by specialty subcontractors. The Contractor shall not award more than seventy-five percent of the work to subcontractors.

00700-68 INSPECTION BY THE CONSTRUCTION MANAGER

All work pursuant to this agreement shall be subject to inspection by the Construction Manager for conformity with contract drawings and specifications. The Contractor shall give the Construction Manager reasonable advance notice of operations requiring special inspection of a portion of the work.

00700-69 WORK COVERED PRIOR TO CONSTRUCTION MANAGER'S INSPECTION

In the event that work is covered or completed without the approval of the Construction Manager, and such approval is required by the specifications or required in advance by the Construction Manager, the Contractor shall bear all costs involved in inspection notwithstanding conformance of such portion of the work to the contract drawings and specifications.

00700-70 SCHEDULING OF THE WORK

The work of this contract shall be planned, scheduled, executed, and reported as required by the Contract Documents.

00700-71 PROGRESS ESTIMATES

The Contractor shall prepare a written report for the Construction Manager's approval, on County forms, of the total value of work performed and materials and equipment obtained to the date of submission. Such a report must accompany each request for a progress payment and is subject to review and approval by the Construction Manager. Approval of a progress estimate or tendering of a progress payment shall not be considered an approval or acceptance of any work performed, and all estimates and payments shall be subject to correction in subsequent estimates. Progress payments shall be made for all completed activities and for materials suitably stored on-site.

00700-72 PROGRESS PAYMENTS

Upon approval of each monthly estimate of work performed and materials furnished, the Construction Manager shall approve payment to the Contractor for the estimated value of such work, materials, and equipment, less the amount of all prior payments and any liquidated damages. The Contractor will be paid 100 percent, less retainage, of the cost of materials received and properly stored on-site but not incorporated into the work. Payments for materials or equipment stored on the site shall be conditioned upon submission by the Contractor of bills of sale to establish the County's title to such materials or equipment. The Contractor's request for payment shall provide sufficient detail as to the work completed or materials purchased for which payment is requested to permit meaningful review by the Construction Manager.

00700-73 TIME OF PAYMENT

The Contractor will be paid within 45 days following receipt of an approved Progress Estimate. The Contractor expressly agrees that the payment provisions within this Contract shall supersede the rates of interest, payment periods, and contract and subcontract terms provided for under the Georgia Prompt Pay Act, O.C.G.A. §13-11-1 et seq., and that the rates of interest, payment

periods, and contract and subcontract terms provided for under the Prompt Pay Act shall have no application to this Contract. The County shall not be liable for any late payment interest or penalty.

Submittal of Invoices: Invoices shall be submitted as follows:

Via Mail:

Fulton County Government

141 Pryor Street, SW

Suite 7001

Atlanta, Georgia 30303

Attn: Finance Department – Accounts Payable

OR

Via Email:

Email: Accounts.Payable@fultoncountyga.gov

At minimum, original invoices must reference all of the following information:

- 1) Vendor Information
 - a. Vendor Name
 - b. Vendor Address
 - c. Vendor Code
 - d. Vendor Contact Information
 - e. Remittance Address
- 2) Invoice Details
 - a. Invoice Date
 - b. Invoice Number (uniquely numbered, no duplicates)
 - c. Purchase Order Reference Number
 - d. Date(s) of Services Performed
 - e. A written report of the total value of work performed and materials and equipment obtained to the date of submission
- 3) Fulton County Department Information (needed for invoice approval)
 - a. Department Name
 - b. Department Representative Name

00700-74 RETAINAGE

The County shall retain from each progress payment five (5) percent of the estimated value of the work performed. At the substantial completion of the work or as otherwise provided in the contract documents, if the County's authorized contract representative determines that the work is reasonably satisfactory, the County will pay the retainage to the contractor within thirty (30) days of being invoiced and after any other documentation required by the contract documents is provided. If there are any remaining incomplete items at that time, an amount equal to two hundred (200) percent of the value of each item shall be withheld until such items are completed. The retainage of each subcontractor may be released separately as the subcontractor completes his or her work, at the discretion of the owner and with the approval of the contractor.

00700-75 PAYMENT OF SUBCONTRACTORS

The Contractor shall promptly pay each subcontractor upon the receipt of payment from the County. Such payment shall be made from the amount paid to the Contractor pursuant to the subcontractor's work. The Contractor shall also maintain the records of the percentage retained from payments to the Contractor pursuant to such subcontractor's work. The Contractor shall procure agreements from each subcontractor requiring each subcontractor to pay their subcontractors, agents and employees in a similar manner. The County reserves the right to inquire of any subcontractor, supplier, materialmen, or subconsultant, the status of any indebtedness of the Contractor. The County further reserves the right to require the Contractor to designate on each instrument of payment exceeding \$400.00 to subcontractors, suppliers, materialmen, and subconsultants that such payment is on account of the work under this Contract.

00700-76 COUNTY'S RESPONSIBILITIES TO SUBCONTRACTORS

Neither the County nor the Construction Manager shall have any obligation to pay any subcontractor except as otherwise required by law.

00700-77 PROGRESS PAYMENTS - ACCEPTANCE OF WORK

Certification of progress payments, as well as the actual payment thereof, shall not constitute the County's acceptance of work performed pursuant to this agreement.

00700-78 PAYMENTS IN TRUST

All sums paid to the Contractor pursuant to this agreement are hereby declared to constitute trust funds in the hands of the contractor to be applied first to the payment of claims of subcontractors, laborers, and suppliers arising out of the work, to claims for utilities furnished and taxes imposed, and to the payment of premiums on surety and other bonds and on insurance for any other application.

00700-79 JOINT PAYMENTS

The County reserves the right to issue any progress payment or final payment by check jointly to the Contractor and any subcontractor or supplier.

00700-80 RIGHT TO WITHHOLD PAYMENT

The Construction Manager may decline to approve payment and may withhold payment in whole or in part to the extent reasonable and necessary to protect the County against loss due to defective work, probable or actual third party claims, the Contractor's failure to pay subcontractors or materialmen, reasonable evidence that the work will not be completed within the contract time or contract price or damage to the County or any other contractor on the project.

00700-81 CERTIFICATE OF SUBSTANTIAL COMPLETION

Upon the Contractor's submission of a request for a certificate of Substantial Completion, the Construction Manager shall inspect the work and determine whether the work is Substantially Complete. If the work is Substantially Complete, the Construction Manager shall issue a certificate of Substantial Completion of the work which shall establish the date of Substantial Completion, shall state the responsibilities of the County and the Contractor for security, maintenance, heat, utilities, damage to the work and insurance, and shall fix the time within which the Contractor shall complete the items submitted by the Contractor as requiring correction or further work. The certificate of substantial completion of the work shall be submitted to the County and the Contractor for their written acceptance of the responsibilities assigned to them pursuant to such certificate.

If in the sole opinion of the Construction Manager, the work is not substantially complete, the Construction Manager shall notify the Contractor of such, in writing, and outline requirements to be met to achieve Substantial Completion.

00700-82 PAYMENT UPON SUBSTANTIAL COMPLETION

Upon Substantial Completion of the work and upon application by the Contractor and approval by the Construction Manager, the County shall make payment reflecting 100% work completed, less value of work remaining as determined by Construction Manager and any authorized retainage.

00700-83 COMMENCEMENT OF WARRANTIES

Warranties required by this agreement shall commence on the date of final completion of the project as determined under Article 00700-84 unless otherwise provided in the certificate of Substantial Completion.

00700-84 FINAL PAYMENT - WAIVER OF CLAIMS, DISPUTE OF FINAL PAYMENT

The acceptance of the Substantial Completion payment shall constitute a waiver of all claims by the Contractor except those previously made in writing and identified by the Contractor as unsettled at the time of application for payment at Substantial Completion and except for the retainage sums due at final acceptance. Following the Construction Manager's issuance of the certificate of Substantial Completion and the Contractor's completion of the work pursuant to this agreement, the Contractor shall forward to the Construction Manager a written notice that the work is ready for final inspection and acceptance. If after inspection the Construction Manager certifies that the work is complete and issues written notification of such to the Contractor, the Contractor shall forward to the Construction Manager a final application for payment. The Construction Manager shall issue a certificate for payment, which shall approve final payment to the Contractor and shall establish the date of final completion.

In the event the Contractor timely disputes the amount of the final payment, the amount due the Contractor shall be deemed by the Contractor and the County to be an unliquidated sum and no interest shall accrue or be payable on the sum finally determined to be due to the Contractor for any period prior to final determination of such sum, whether such determination be by agreement of the Contractor and the County or by final judgment of the proper court in the event of litigation between the County and the Contractor. The Contractor specifically waives and renounces any and all rights it may have under O.C.G.A. §13-6-13 and agrees that in the event suit is brought by the Contractor against the County for any sum claimed by the Contractor under the Contract or for any extra or additional work, no interest shall be awarded on any sum found to be due from the County to the Contractor in the final judgment entered in such suit. All final judgments shall draw interest at the legal rate, as specified by law.

00700-85 DOCUMENTATION OF COMPLETION OF WORK

Neither the final payment nor the remaining retainage shall become due until the Contractor submits the following documents to the Construction Manager:

An affidavit that all payrolls, bills for materials and equipment, and other indebtedness connected with the work have been paid or otherwise satisfied;

The surety's consent to final payment; and

Any other data reasonably required by the County or Construction Manager establishing payment or satisfaction of all such obligations, including releases, waivers of liens, and documents of satisfaction of debts.

In the event that a subcontractor refuses to furnish a release or waiver as required by the County or Construction Manager, the Contractor may furnish a bond satisfactory to the County to indemnify the County against such loss. In the event that any lien or indebtedness remains unsatisfied after all payments are made, the contractor shall refund to the County all moneys that the County may become compelled to pay in discharging such lien or other indebtedness, including all costs and reasonable attorney's fees.

00700-86 GOVERNING LAW

Each and every provision of this agreement shall be construed in accordance with and governed by Georgia law. The parties acknowledge that this contract is executed in Fulton County, Georgia and that the contract is to be performed in Fulton County, Georgia. Each party hereby consents to the Fulton Superior Court's sole jurisdiction over any dispute which arises as a result of the execution or performance of this agreement, and each party hereby waives any and all objections to venue in the Fulton Superior Court.

00700-87 CHANGES IN THE WORK

CHANGE ORDERS

A Change Order is a written order to the Contractor signed to show the approval and the authorization of the County, issued after execution of the Contract, authorizing a change in the Work and/or an adjustment in the Contract Sum or the Contract Time. Change Orders shall be written using forms designated by the County with Contractor providing supporting documentation as required by the Construction Manager. The Contract Sum and the Contract Time may be changed only by approved Change Order pursuant to Fulton County Code Section 102-420. The amount payable by the Change Order is payment in full for all direct and indirect costs incurred and related to the work under said Change Order, including but not limited to delays, imports, acceleration, disruption and extended overhead. A Change Order signed by the Contractor indicates the Contractor's agreement therewith, including the adjustment in either or both of the Contract Sum or the Contract Time.

The County, without invalidating the Contract, may order changes in the Work within the general scope of the Contract as defined herein. The time allowed for performance of the work and the contract price to be paid to the Contractor may be adjusted accordingly.

The cost or credit to the County resulting from a change in the Work shall be determined in one or more of the following ways:

By mutual acceptance of a lump sum properly itemized and supported by sufficient substantiating data to permit evaluation;

By unit prices stated in the Contract Documents or subsequently agreed upon;

By cost to be determined in a manner agreed upon by the parties and a mutually acceptable fixed or percentage fee; or

By the method provided in Subparagraph A4 below.

If none of the methods set forth in Subparagraphs 3a, 3b, or 3c above is agreed upon, the Contractor, provided a written order signed by the Construction Manager is received, shall promptly proceed with the Work involved. The cost of such Work shall then be determined by the Construction Manager on basis of the reasonable expenditures and savings of those performing the Work attributable to the change. The cost of the change shall include only the items listed in Subparagraph 5a below, and in the case of either a decrease or an increase in the Contract Sum, an allowance for overhead and profit in accordance with the schedules set forth in Subparagraphs 5b and 6 below shall be applied to the cost or credit.

In such case, and also under Subparagraph 3a above, the Contractor shall keep and present, in such form as the Construction Manager may prescribe, an itemized accounting of all actual costs expended, together with appropriate supporting data for inclusion in a Change Order.

All hourly rate charges shall be submitted to the Construction Manager for prior review and approval. All hourly rate charges shall be properly supported as required by the Construction Manager with certified payrolls, or their acceptable equivalent. When authorized to proceed for a given change and actual expenditures have been made prior to execution of a Change Order for the entire change, such actual expenditures may be summarized monthly, and if approved, incorporated into a Change Order. When both additions and credits covering related Work or substitutions are involved in any one change, the allowance for overhead and profit shall be figured on the basis of the net increase or decrease, if any, with respect to that change.

In Subparagraphs 3 and 4 above, the items included in "Cost and "Overhead" shall be based on the following schedule:

Unless otherwise provided in the Contract Documents, "Cost" shall be limited to the following: cost of materials incorporated into the Work, including sales tax and cost of delivery; cost of direct labor (labor cost may include a pro rata share of foreman's account of the change) including social security, old age and unemployment insurance, and fringe benefits required by agreement or custom; workers' or workmen's compensation insurance; rental value of equipment and machinery; costs for preparing Shop Drawings.

Unless otherwise provided in the Contract Documents, "Overhead" shall include the following: bond and insurance premiums including increase and decreases from change in the Work, supervision, superintendence, construction parking, wages of timekeepers, watchmen and clerks, small tools, consumable supplies, expendables, incidentals, general office expense, the cost of additional reproduction for the Contractor's subcontractors beyond that agreed upon in the Contract Documents, construction parking, any additional costs of craft supervision by the Contractor's or subcontractors' superintendents, and overhead charges which would be customary and expended regardless of the change in the Work due to other overlapping activities which are included as part of the original Contract, and all other expenses not included in "Cost" above.

In the event that a change is issued by the County which would require the expenditure of substantial amounts of special supervision (beyond the foreman level) by the Contractor, the Contractor may, at the sole direction of the Construction Manager, be allowed to incorporate these charges into the agreement cost for the change.

In Subparagraphs 3 and 4 above, the allowance for overhead and profit combined, included in the total cost or credit to the County, shall be based on the following schedule:

For the Contractor, for any work performed by the Contractor's own forces, ten (10) percent of the cost.

For the Contractor, for any work performed by a Contractor's subcontractor, five (5) percent of the amount due the subcontractor.

For each subcontractor or sub-subcontractor involved, for any work performed by that subcontractor's or sub-subcontractor's own forces, ten (10) percent of the cost.

For each subcontractor, for work performed by a sub-subcontractor, five (5) percent of the amount due to the sub-subcontractor.

Cost to which overhead and profit is to be applied shall be determined in accordance with Subparagraph 5 above unless modified otherwise.

In order to facilitate checking of quotations for extras or credits, all proposals or bids, except those so minor that their propriety can be seen by inspection, shall be accompanied by a complete itemization of costs, including labor cost, materials and subcontracts. Labor and materials shall be itemized in the manner defined in Subparagraph 4 above. Where major cost items are subcontracts, they shall be itemized also. In no case shall a change be approved without such itemization.

No payment shall be made for any changes to the contract that are not included in a fully executed Change Order.

CONCEALED, UNKNOWN AND DIFFERING CONDITIONS

Should concealed conditions be encountered in the performance of the Work below the surface of the ground, or should concealed or unknown conditions in an existing structure be at variance with the conditions indicated by the Contract Documents, or should unknown physical conditions below the surface of the ground or concealed or unknown conditions in an existing structure of an unusual nature, differing materially from those ordinarily encountered and generally recognized as inherent in work of the character provided for in this Contract, be encountered, the Contract Sum and Contract Time shall be equitably adjusted by Change Order upon request by either party made within twenty (20) days after the first observance of the conditions. No such request for equitable adjustment shall be valid unless the Contractor complies with this (20) days' notice and Subparagraph C.1. below.

The Contractor shall promptly, and before such conditions are disturbed, notify the Construction Manager in writing of any claim of concealed, unknown or differing conditions pursuant to this paragraph. The Construction Manager shall authorize the Engineer to investigate the conditions, and if it is found that such conditions do materially so differ and cause an increase or decrease in the Contractor's cost of, or the time required for, performance of any part of the Work under this Contract, whether or not changed as a result of such conditions, an equitable adjustment shall be recommended to the Construction Manager.

No claim of the Contractor under this clause shall be allowed unless the Contractor has given the notice required in (a) above, prior to disturbing the condition.

No claim by the Contractor for an equitable adjustment shall be allowed if asserted after final payment under this Contract.

Any materially differing site condition as between what is shown on the Drawings and Specifications and actually found on site shall be immediately reported to the Construction Manager in writing prior to the commencement of Work at the site. Failure of the Contractor to notify the Construction Manager in writing of the differing site condition prior to performance of Work at the site shall constitute a waiver of any claim for additional monies. Any Change Order

necessitated by the differing site condition shall be processed as provided under "Changes in the Contract".

REQUESTS FOR ADDITIONAL COST

If the Contractor wishes to request an increase in the Contract Sum, the Contractor shall give the Construction Manager written notice thereof within twenty (20) days after the occurrence of the event, or identification of the conditions, giving rise to such request. This notice shall be given by the Contractor before proceeding to execute the Work, except in an emergency endangering life or property in which case the Contractor shall proceed in accordance with Article 00700-25 and Subparagraph A.4 above. No such request shall be valid unless so made within the twenty (20) days specified above. If the County and the Contractor cannot agree on the amount of the adjustment in the Contract Sum, it shall be determined by the Construction Manager. Any change in the Contract Sum resulting from such claim shall be documented by Change Order.

If the Contractor claims that addition cost is involved because of, but not limited to (1) any written interpretation pursuant to General Condition 00700-17 of this Agreement, (2) any order by the County to stop the Work pursuant to Articles 00700-25 and 00700-37 of this Agreement where the Contractor was not at fault, or any such order by the Construction Manager as the County's agent, or (3) any written order for a minor change in the Work issued pursuant to Paragraph D below, the Contractor shall submit a request for an increase in the Contract Sum as provided in Subparagraph C.1 above. No such claim shall be valid unless the Contractor complies with Subparagraph C.1 above and approved by the County pursuant to Fulton County Code Section 102-420.

MINOR CHANGES IN THE WORK

The Construction Manager may order minor changes in the Work not involving an adjustment in the Contract Price, extension of the time allowed for performance of the work and not inconsistent with the intent of the Contract Documents. Such changes shall be effected by a written Change Directive issued by the Construction Manager, and shall be binding on the County and the Contractor. The Contractor shall carry out such written orders promptly.

BONDS

If any change order results in an increase in the contract price, the contractor shall increase the penal sum of the performance and payment bonds to equal the increased price.

00700-88 DISAGREEMENT WITH ORDERS FOR CHANGE

Contractor's written acceptance of a Change Order or other order for changes shall constitute his final and binding agreement to the provisions thereof and a waiver of all claims in connection therewith, whether direct or consequential in nature. Should Contractor disagree with any order for changes, he may submit a notice of potential claim to the Construction Manager, at such time as the order is set forth in the form of a Change Order. Disagreement with the provisions of an order for changes shall not relieve Contractor of his obligation under Article 00700-87 of this Agreement.

00700-89 NO WAIVER OF REMEDIES

Exercise by the County of any remedy is not exclusive of any other remedy available to County and shall not constitute a waiver of any such other remedies. Failure of the County to exercise any remedy, including breach of contract remedies, shall not preclude the County from exercising such remedies in similar circumstances in the future.

00700-90 LAND AND RIGHTS-OF-WAY

The owner will provide, as indicated in the Contract Documents and prior to Notice to Proceed, the lands upon which the work is to be done, right-of-way for access thereto, and such other lands which are designated for the use of the Contractor. The Contractor shall confine the Contractor's work and all associated activities to the easements and other areas designated for the Contractor's use. The Contractor shall comply with any limits on construction methods and practices which may be required by easement agreements. If, due to some unforeseen reason, the necessary easements are not obtained, the Contractor shall receive an equitable extension of contract time dependent upon the effect on the critical path of the project schedule or the County may terminate the Contract for its convenience.

00700-91 COORDINATION WITH STATE DEPARTMENT OF TRANSPORTATION

No clearing or grading shall be completed by Contractor within the State Department of Transportation (DOT) area under construction. The Contractor must coordinate his construction scheduling with DOT.

If the Contractor begins work before DOT's completion date, he must obtain the approval of DOT before starting work in the area. The state DOT has the right to stop the Contractor's work the DOT area.

The Contractor shall receive no additional compensation or damages resulting from delay or work stoppage from DOT actions or scheduling.

Contractor shall obtain DOT drawings of the DOT, project area for verification of road geometry, storm drains, etc. from Georgia Department of Transportation or Fulton County. The Contractor is responsible for obtaining any pertinent DOT revisions.

I N D E X

SUBJECT	GENERAL CONDITION ARTICLE #
Administration of Contract	17
Applicable Law	7
Assignment	13
Blasting and Excavation	26
Changes	87, 88
Clean Site	29
Codes	4
Commencement of Work	49
Contract Documents	2
Contractor's Representative	66
Defective Work	31, 32
Definitions	3
Delay	51, 52, 54, 55
Extension of Time	52, 53, 54
Familiarity of Time	1, 22
Final Payment	84
Governing Law	86
High Voltage Lines	27
Inclement Weather	53
Indemnification	15
Inspections	23, 61, 62, 68, 69
Interruption	48
Licenses	8
Liquidated Damages	46, 48
New Materials	33, 63
Notices	24
Payment	72, 73, 75
Payment of Subcontractors	75, 76
Payment Upon Substantial Completion	82, 84
Payroll Reports	65
Permits	8
Progress Payments	72, 73, 77, 78, 79, 80

Protection of Work	30, 64
Records Inspection	45
Retainage	11, 74
Safety	25
Scaffolding and Staging	28
Scheduling	70
Service of Process	14
Stop Work Order	37
Subcontractors	67, 76
Substantial Completion	81
Suspension	48
Supervision of Work	16, 66
Surety's Responsibility	17
Taxes	9, 10
Termination for Cause	38, 44, 47
Termination for Convenience	39, 40, 41
Time of the Essence	50
Warranties	33, 34, 35, 36
Work Behind Schedule	56

EXHIBIT A
FINAL AFFIDAVIT

TO FULTON COUNTY, GEORGIA

I, _____, hereby certify that all suppliers of materials, equipment and service, subcontractors, mechanic, and laborers employed by _____ or any of his subcontractors in connection with the design and/or construction of _____ at Fulton County have been paid and satisfied in full as of _____, 20____, and that there are no outstanding obligations or claims of any kind for the payment of which Fulton County on the above-named project might be liable, or subject to, in any lawful proceeding at law or in equity.

Signature

Title

Personally appeared before me this _____ day of _____, 20____.
_____, who under Oath deposes and says that he is
_____ of the firm of _____, that he has read the
above statement and that to the best of his knowledge and belief same is an exact true statement.

Notary Public

My Commission expires

END OF SECTION

PURCHASING FORMS

**STATE OF GEORGIA
COUNTY OF FULTON**

FORM A: GEORGIA SECURITY AND IMMIGRATION CONTRACTOR AFFIDAVIT AND AGREEMENT

By executing this affidavit, the undersigned contractor verifies its compliance with O.C.G.A. 13-10-91, stating affirmatively that the individual, firm or corporation which is engaged in the physical performance of services¹ under a contract with [insert name of prime contractor] Sol Construction LLC on behalf of Fulton County Government has registered with and is participating in a federal work authorization program*,² in accordance with the applicability provisions and deadlines established in O.C.G.A. 13-10-91.

The undersigned further agrees that, should it employ or contract with any subcontractor(s) in connection with the physical performance of services to this contract with Fulton County Government, contractor will secure from such subcontractor(s) similar verification of compliance with O.C.G.A. 13-10-91 on the Subcontractor Affidavit provided in Rule 300-10-01-.08 or a substantially similar form. Contractor further agrees to maintain records of such compliance and provide a copy of each such verification to the Fulton County Government at the time the subcontractor(s) is retained to perform such service.

178057
EEV/Basic Pilot Program* User Identification Number
Sol Construction LLC Juliana Gomez
BY: Authorized Officer of Agent (Insert Contractor Name)

President
Title of Authorized Officer or Agent of Contractor
Juliana Gomez
Printed Name of Authorized Officer or Agent

Sworn to and subscribed before me this 27 day of February, 2024.

Notary Public: K Butterfield

County: Cobb

Commission Expires: 6/27/2026

**Katherine Butterfield
NOTARY PUBLIC
Cobb County, GEORGIA**

¹O.C.G.A. § 13-10-90(4), as amended by Senate Bill 160, provides that "physical performance of services" means any performance of labor or services for a public employer (e.g., Fulton County) using a bidding process (e.g., ITB, RFQ, RFP, etc.) or contract wherein the labor or services exceed \$2,499.99, except for those individuals licensed pursuant to title 26 or Title 43 or by the State Bar of Georgia and is in good standing when such contract is for service to be rendered by such individual.

²[Any of the electronic verification of work authorization programs operated by the United States Department of Homeland Security or any equivalent federal work authorization program operated by the United States Department of Homeland Security to verify information of newly hired employees, pursuant to the Immigration Reform and Control Act of 1986 (IRCA), P.L. 99-603].

RDJE, Inc.

**STATE OF GEORGIA
COUNTY OF FULTON**

FORM B: GEORGIA SECURITY AND IMMIGRATION SUBCONTRACTOR AFFIDAVIT

By executing this affidavit, the undersigned subcontractor verifies its compliance with O.C.G.A. 13-10-91, stating affirmatively that the individual, firm or corporation which is engaged in the physical performance of services³ under a contract with [insert name of prime contractor] Sol Construction, behalf of Fulton County Government has registered with and is participating in a federal work authorization program*,⁴ in accordance with the applicability provisions and deadlines established in O.C.G.A. 13-10-91.

434062

EEV/Basic Pilot Program* User Identification Number

RDJE, Inc.

BY: Authorized Officer of Agent
(Insert Subcontractor Name)

Vice President

Title of Authorized Officer or Agent of Subcontractor

David Warda

Printed Name of Authorized Officer or Agent

Sworn to and subscribed before me,

This 14th day of February, 2024

Amanda K. Simpson
(Notary Public) (Seal)

Commission Expires: September 10, 2027
(Date)



³O.C.G.A. § 13-10-90(4), as amended by Senate Bill 160, provides that "physical performance of services" means any performance of labor or services for a public employer (e.g., Fulton County) using a bidding process (e.g., ITB, RFQ, RFP, etc.) or contract wherein the labor or services exceed \$2,499.99, except for those individuals licensed pursuant to title 26 or Title 43 or by the State Bar of Georgia and is in good standing when such contract is for service to be rendered by such individual.

⁴*[Any of the electronic verification of work authorization programs operated by the United States Department of Homeland Security or any equivalent federal work authorization program operated by the United States Department of Homeland Security to verify information of newly hired employees, pursuant to the Immigration Reform and Control Act of 1986 (IRCA), P.L. 99-603].

Prime Engineering, Inc.**STATE OF GEORGIA
COUNTY OF FULTON****FORM B: GEORGIA SECURITY AND IMMIGRATION SUBCONTRACTOR AFFIDAVIT**

By executing this affidavit, the undersigned subcontractor verifies its compliance with O.C.G.A. 13-10-91, stating affirmatively that the individual, firm or corporation which is engaged in the physical performance of services³ under a contract with [insert name of prime contractor] Sol Construction, LLC behalf of Fulton County Government has registered with and is participating in a federal work authorization program*,⁴ in accordance with the applicability provisions and deadlines established in O.C.G.A. 13-10-91.

48585EEV/Basic Pilot Program* User Identification NumberPrime Engineering, Inc.

BY: Authorized Officer of Agent
(Insert Subcontractor Name)

PresidentTitle of Authorized Officer or Agent of SubcontractorCuong H. DinhPrinted Name of Authorized Officer or Agent

Sworn to and subscribed before me,

This 15th day of February, 2024

(Notary Public)(Seal)

Commission Expires:

COURTNEY LANE LUTZ
NOTARY PUBLIC
Gwinnett County, State of Georgia
My Commission Expires 7/11/2026

(Date)

³O.C.G.A. § 13-10-90(4), as amended by Senate Bill 160, provides that "physical performance of services" means any performance of labor or services for a public employer (e.g., Fulton County) using a bidding process (e.g., ITB, RFQ, RFP, etc.) or contract wherein the labor or services exceed \$2,499.99, except for those individuals licensed pursuant to title 26 or Title 43 or by the State Bar of Georgia and is in good standing when such contract is for service to be rendered by such individual.

⁴[Any of the electronic verification of work authorization programs operated by the United States Department of Homeland Security or any equivalent federal work authorization program operated by the United States Department of Homeland Security to verify information of newly hired employees, pursuant to the Immigration Reform and Control Act of 1986 (IRCA), P.L. 99-603].

2MNext

**STATE OF GEORGIA
COUNTY OF FULTON**

FORM B: GEORGIA SECURITY AND IMMIGRATION SUBCONTRACTOR AFFIDAVIT

By executing this affidavit, the undersigned subcontractor verifies its compliance with O.C.G.A. 13-10-91, stating affirmatively that the individual, firm or corporation which is engaged in the physical performance of services³ under a contract with [insert name of prime contractor] Sol Construction LLC behalf of Fulton County Government has registered with and is participating in a federal work authorization program*,⁴ in accordance with the applicability provisions and deadlines established in O.C.G.A. 13-10-91.

1888756

EEV/Basic Pilot Program* User Identification Number

BY: [Signature]
Authorized Officer of Agent
(Insert Subcontractor Name)

President and CEO

Title of Authorized Officer or Agent of Subcontractor

Subash Reddy Kuchikulla

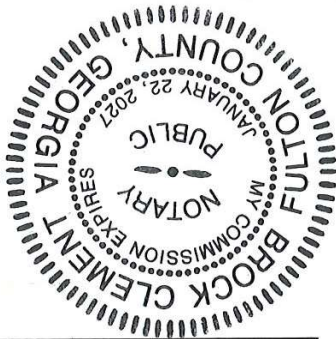
Printed Name of Authorized Officer or Agent

Sworn to and subscribed before me,

This 19th day of February, 2021

[Signature] Brock Clement
(Notary Public) (Seal)

Commission Expires: January 22, 2027
(Date)



³O.C.G.A. § 13-10-90(4), as amended by Senate Bill 160, provides that "physical performance of services" means any performance of labor or services for a public employer (e.g., Fulton County) using a bidding process (e.g., ITB, RFQ, RFP, etc.) or contract wherein the labor or services exceed \$2,499.99, except for those individuals licensed pursuant to title 26 or Title 43 or by the State Bar of Georgia and is in good standing when such contract is for service to be rendered by such individual.

⁴*[Any of the electronic verification of work authorization programs operated by the United States Department of Homeland Security or any equivalent federal work authorization program operated by the United States Department of Homeland Security to verify information of newly hired employees, pursuant to the Immigration Reform and Control Act of 1986 (IRCA), P.L. 99-603].

Austin Brockenbrough & Associates, LLC

**STATE OF GEORGIA
COUNTY OF FULTON**

FORM B: GEORGIA SECURITY AND IMMIGRATION SUBCONTRACTOR AFFIDAVIT

By executing this affidavit, the undersigned subcontractor verifies its compliance with O.C.G.A. 13-10-91, stating affirmatively that the individual, firm or corporation which is engaged in the physical performance of services³ under a contract with [insert name of prime contractor] Sol Construction LLC behalf of Fulton County Government has registered with and is participating in a federal work authorization program*,⁴ in accordance with the applicability provisions and deadlines established in O.C.G.A. 13-10-91.

134916

EEV/Basic Pilot Program* User Identification Number

Hannah J. Bell

BY: Authorized Officer of Agent

(Insert Subcontractor Name) Austin Brockenbrough & Associates, LLC

Civic Market Director

Title of Authorized Officer or Agent of Subcontractor

Hannah J. Bell

Printed Name of Authorized Officer or Agent

Sworn to and subscribed before me,

This 5th day of March, 2024

Suzanne N. Wolfe

(Notary Public)

(Seal)

Commission Expires: August 31, 2026

(Date)



³O.C.G.A. § 13-10-90(4), as amended by Senate Bill 160, provides that "physical performance of services" means any performance of labor or services for a public employer (e.g., Fulton County) using a bidding process (e.g., ITB, RFQ, RFP, etc.) or contract wherein the labor or services exceed \$2,499.99, except for those individuals licensed pursuant to title 26 or Title 43 or by the State Bar of Georgia and is in good standing when such contract is for service to be rendered by such individual.

⁴*[Any of the electronic verification of work authorization programs operated by the United States Department of Homeland Security or any equivalent federal work authorization program operated by the United States Department of Homeland Security to verify information of newly hired employees, pursuant to the Immigration Reform and Control Act of 1986 (IRCA), P.L. 99-603].

CHB

**STATE OF GEORGIA
COUNTY OF FULTON**

FORM B: GEORGIA SECURITY AND IMMIGRATION SUBCONTRACTOR AFFIDAVIT

By executing this affidavit, the undersigned subcontractor verifies its compliance with O.C.G.A. 13-10-91, stating affirmatively that the individual, firm or corporation which is engaged in the physical performance of services³ under a contract with [insert name of prime contractor] Sol Construction LLC behalf of Fulton County Government has registered with and is participating in a federal work authorization program*,⁴ in accordance with the applicability provisions and deadlines established in O.C.G.A. 13-10-91.

462745
EEV/Basic Pilot Program* User Identification Number

Cheryl H Brewer

BY: Authorized Officer of Agent
(Insert Subcontractor Name)

member / manager
Title of Authorized Officer or Agent of Subcontractor

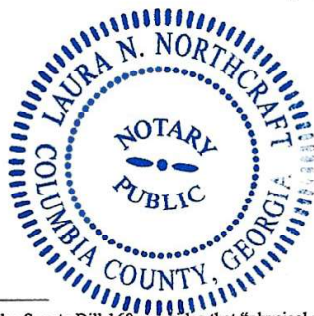
Cheryl H Brewer
Printed Name of Authorized Officer or Agent

Sworn to and subscribed before me,

This 14th day of February, 2024

Laura N Northcraft
(Notary Public) (Seal)

Commission Expires: APR-11-2026
(Date)



³O.C.G.A. § 13-10-90(4), as amended by Senate Bill 160, provides that "physical performance of services" means any performance of labor or services for a public employer (e.g., Fulton County) using a bidding process (e.g., ITB, RFQ, RFP, etc.) or contract wherein the labor or services exceed \$2,499.99, except for those individuals licensed pursuant to title 26 or Title 43 or by the State Bar of Georgia and is in good standing when such contract is for service to be rendered by such individual.

⁴*[Any of the electronic verification of work authorization programs operated by the United States Department of Homeland Security or any equivalent federal work authorization program operated by the United States Department of Homeland Security to verify information of newly hired employees, pursuant to the Immigration Reform and Control Act of 1986 (IRCA), P.L. 99-603].

EDEC, Inc.

**STATE OF GEORGIA
COUNTY OF FULTON**

FORM B: GEORGIA SECURITY AND IMMIGRATION SUBCONTRACTOR AFFIDAVIT

By executing this affidavit, the undersigned subcontractor verifies its compliance with O.C.G.A. 13-10-91, stating affirmatively that the individual, firm or corporation which is engaged in the physical performance of services³ under a contract with [insert name of prime contractor] Sol Construction, LLC behalf of Fulton County Government has registered with and is participating in a federal work authorization program*,⁴ in accordance with the applicability provisions and deadlines established in O.C.G.A. 13-10-91.

632222
EEV/Basic Pilot Program* User Identification Number

Alec Zaychik
BY: Authorized Officer of Agent
(Insert Subcontractor Name)

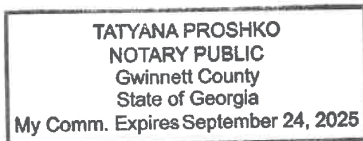
Principal
Title of Authorized Officer or Agent of Subcontractor
Alec Zaychik
Printed Name of Authorized Officer or Agent

Sworn to and subscribed before me,

This 27th day of February, 2024

T. Proshko
(Notary Public) (Seal)

Commission Expires: 9/24/2025
(Date)



³O.C.G.A. § 13-10-90(4), as amended by Senate Bill 160, provides that "physical performance of services" means any performance of labor or services for a public employer (e.g., Fulton County) using a bidding process (e.g., ITB, RFQ, RFP, etc.) or contract wherein the labor or services exceed \$2,499.99, except for those individuals licensed pursuant to title 26 or Title 43 or by the State Bar of Georgia and is in good standing when such contract is for service to be rendered by such individual.

⁴*[Any of the electronic verification of work authorization programs operated by the United States Department of Homeland Security or any equivalent federal work authorization program operated by the United States Department of Homeland Security to verify information of newly hired employees, pursuant to the Immigration Reform and Control Act of 1986 (IRCA), P.L. 99-603].

R2T

**STATE OF GEORGIA
COUNTY OF FULTON**

FORM B: GEORGIA SECURITY AND IMMIGRATION SUBCONTRACTOR AFFIDAVIT

By executing this affidavit, the undersigned subcontractor verifies its compliance with O.C.G.A. 13-10-91, stating affirmatively that the individual, firm or corporation which is engaged in the physical performance of services³ under a contract with **[insert name of prime contractor]** Sol Construction, LLC behalf of **Fulton County Government** has registered with and is participating in a federal work authorization program*,⁴ in accordance with the applicability provisions and deadlines established in O.C.G.A. 13-10-91.

107167

EEV/Basic Pilot Program* User Identification Number

Kimberly Ajy R2T, Inc.
BY: Authorized Officer or Agent
(Insert Subcontractor Name)

President

Title of Authorized Officer or Agent of Subcontractor

Kimberly Ajy, MS

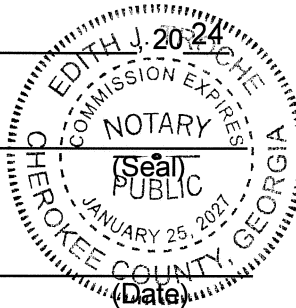
Printed Name of Authorized Officer or Agent

Sworn to and subscribed before me,

This 19th day of February

Edith J. Troche
(Notary Public)

Edith J. Troche



Commission Expires: January 25, 2027

(Date)

³O.C.G.A. § 13-10-90(4), as amended by Senate Bill 160, provides that "physical performance of services" means any performance of labor or services for a public employer (e.g., Fulton County) using a bidding process (e.g., ITB, RFQ, RFP, etc.) or contract wherein the labor or services exceed \$2,499.99, except for those individuals licensed pursuant to title 26 or Title 43 or by the State Bar of Georgia and is in good standing when such contract is for service to be rendered by such individual.

⁴*[Any of the electronic verification of work authorization programs operated by the United States Department of Homeland Security or any equivalent federal work authorization program operated by the United States Department of Homeland Security to verify information of newly hired employees, pursuant to the Immigration Reform and Control Act of 1986 (IRCA), P.L. 99-603].

RDJE

**STATE OF GEORGIA
COUNTY OF FULTON**

FORM B: GEORGIA SECURITY AND IMMIGRATION SUBCONTRACTOR AFFIDAVIT

By executing this affidavit, the undersigned subcontractor verifies its compliance with O.C.G.A. 13-10-91, stating affirmatively that the individual, firm or corporation which is engaged in the physical performance of services³ under a contract with [insert name of prime contractor] Sol Construction, behalf of Fulton County Government has registered with and is participating in a federal work authorization program*,⁴ in accordance with the applicability provisions and deadlines established in O.C.G.A. 13-10-91.

434062

EEV/Basic Pilot Program* User Identification Number

BY: [Signature]
Authorized Officer of Agent
(Insert Subcontractor Name)

RDJE, Inc.

Vice President

Title of Authorized Officer or Agent of Subcontractor

David Warda

Printed Name of Authorized Officer or Agent

Sworn to and subscribed before me,

This 14th day of February, 2024

Amanda K. Simpson
(Notary Public) (Seal)

Commission Expires: September 10, 2027
(Date)



³O.C.G.A. § 13-10-90(4), as amended by Senate Bill 160, provides that "physical performance of services" means any performance of labor or services for a public employer (e.g., Fulton County) using a bidding process (e.g., ITB, RFQ, RFP, etc.) or contract wherein the labor or services exceed \$2,499.99, except for those individuals licensed pursuant to title 26 or Title 43 or by the State Bar of Georgia and is in good standing when such contract is for service to be rendered by such individual.

⁴*[Any of the electronic verification of work authorization programs operated by the United States Department of Homeland Security or any equivalent federal work authorization program operated by the United States Department of Homeland Security to verify information of newly hired employees, pursuant to the Immigration Reform and Control Act of 1986 (IRCA), P.L. 99-603].

**STATE OF GEORGIA
COUNTY OF FULTON**

FORM B: GEORGIA SECURITY AND IMMIGRATION SUBCONTRACTOR AFFIDAVIT

By executing this affidavit, the undersigned subcontractor verifies its compliance with O.C.G.A. 13-10-91, stating affirmatively that the individual, firm or corporation which is engaged in the physical performance of services¹ under a contract with Sol Construction LLC on behalf of Fulton County Government has registered with and is participating in a federal work authorization program², in accordance with the applicability provisions and deadlines established in O.C.G.A. 13-10-91.

196133

EEV/Basic Pilot Program* User Identification Number

[Signature]

BY: Authorized Officer of Agent
(Insert Subcontractor Name)

Principal

Title of Authorized Officer or Agent of Subcontractor

Jonathan L Rucker

Printed Name of Authorized Officer or Agent

Sworn to and subscribed before me,

This 10th day of October, 2025

[Signature]

(Notary Public)

(Seal)



Commission Expires: April 30, 2029

(Date)

¹O.C.G.A. § 13-10-90(4), as amended by Senate Bill 160, provides that "physical performance of services" means any performance of labor or services for a public employer (e.g., Fulton County) using a bidding process (e.g., ITB, RFQ, RFP, etc.) or contract wherein the labor or services exceed \$2,499.99, except for those individuals licensed pursuant to title 26 or Title 43 or by the State Bar of Georgia and is in good standing when such contract is for service to be rendered by such individual.

²*[Any of the electronic verification of work authorization programs operated by the United States Department of Homeland Security or any equivalent federal work authorization program operated by the United States Department of Homeland Security to verify information of newly hired employees, pursuant to the Immigration Reform and Control Act of 1986 (IRCA), P.L. 99-603].

**STATE OF GEORGIA
COUNTY OF FULTON**

FORM B: GEORGIA SECURITY AND IMMIGRATION SUBCONTRACTOR AFFIDAVIT

By executing this affidavit, the undersigned subcontractor verifies its compliance with O.C.G.A. 13-10-91, stating affirmatively that the individual, firm or corporation which is engaged in the physical performance of services¹ under a contract with Sol Construction LLC on behalf of Fulton County Government has registered with and is participating in a federal work authorization program², in accordance with the applicability provisions and deadlines established in O.C.G.A. 13-10-91.

196133

EEV/Basic Pilot Program* User Identification Number

[Signature]

BY: Authorized Officer of Agent
(Insert Subcontractor Name)

Principal

Title of Authorized Officer or Agent of Subcontractor

Jonathan L Rucker

Printed Name of Authorized Officer or Agent

Sworn to and subscribed before me,

This 10th day of October, 2025

[Signature]

(Notary Public)

(Seal)



Commission Expires: April 30, 2029

(Date)

¹O.C.G.A. § 13-10-90(4), as amended by Senate Bill 160, provides that "physical performance of services" means any performance of labor or services for a public employer (e.g., Fulton County) using a bidding process (e.g., ITB, RFQ, RFP, etc.) or contract wherein the labor or services exceed \$2,499.99, except for those individuals licensed pursuant to title 26 or Title 43 or by the State Bar of Georgia and is in good standing when such contract is for service to be rendered by such individual.

²*[Any of the electronic verification of work authorization programs operated by the United States Department of Homeland Security or any equivalent federal work authorization program operated by the United States Department of Homeland Security to verify information of newly hired employees, pursuant to the Immigration Reform and Control Act of 1986 (IRCA), P.L. 99-603].

FORM B: GEORGIA SECURITY AND IMMIGRATION SUBCONTRACTOR AFFIDAVIT

Instructions:

In the event that your company is awarded the contract for this project and will be utilizing the services of any subcontractor(s) in connection with the physical performance of services pursuant to this contract, the following affidavit must be completed by such subcontractor(s). Your company must provide a copy of each such affidavit to Fulton County Government, Department of Purchasing & Contract Compliance with the proposal submittal.

All subcontractor affidavit(s) shall become a part of the contract and all subcontractor(s) affidavits shall be maintained by your company and available for inspection by Fulton County Government at any time during the term of the contract. All subcontractor(s) affidavit(s) shall become a part of any contractor/subcontractor agreement(s) entered into by your company.

**STATE OF GEORGIA
COUNTY OF FULTON**

FORM B: GEORGIA SECURITY AND IMMIGRATION SUBCONTRACTOR AFFIDAVIT

By executing this affidavit, the undersigned subcontractor verifies its compliance with O.C.G.A. 13-10-91, stating affirmatively that the individual, firm or corporation which is engaged in the physical performance of services¹ under a contract with Sol Construction LLC on behalf of Fulton County Government has registered with and is participating in a federal work authorization program*,² in accordance with the applicability provisions and deadlines established in O.C.G.A. 13-10-91.

469741

EEV/Basic Pilot Program* User Identification Number

GLOBAL CONTROL SYSTEMS, INC.

BY: Authorized Officer of Agent
(Insert Subcontractor Name)

Principal / Project Manager

Title of Authorized Officer or Agent of Subcontractor

Kishor V. Gandhi

Printed Name of Authorized Officer or Agent

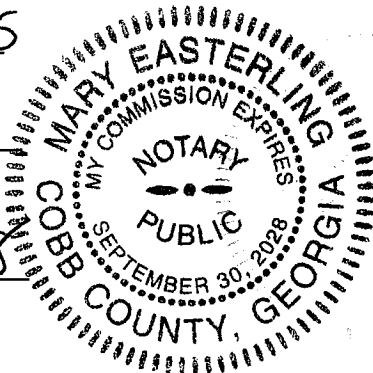
Sworn to and subscribed before me,

This 8th day of October, 2025

Mary Easterling
(Notary Public)

(Seal)

Commission Expires: September 30, 2028
(Date)



¹O.C.G.A. § 13-10-90(4), as amended by Senate Bill 160, provides that "physical performance of services" means any performance of labor or services for a public employer (e.g., Fulton County) using a bidding process (e.g., ITB, RFQ, RFP, etc.) or contract wherein the labor or services exceed \$2,499.99, except for those individuals licensed pursuant to title 26 or Title 43 or by the State Bar of Georgia and is in good standing when such contract is for service to be rendered by such individual.

²[Any of the electronic verification of work authorization programs operated by the United States Department of Homeland Security or any equivalent federal work authorization program operated by the United States Department of Homeland Security to verify information of newly hired employees, pursuant to the Immigration Reform and Control Act of 1986 (IRCA), P.L. 99-603].

**STATE OF GEORGIA
COUNTY OF FULTON**

FORM B: GEORGIA SECURITY AND IMMIGRATION SUBCONTRACTOR AFFIDAVIT

By executing this affidavit, the undersigned subcontractor verifies its compliance with O.C.G.A. 13-10-91, stating affirmatively that the individual, firm or corporation which is engaged in the physical performance of services¹ under a contract with Sol Construction LLC on behalf of Fulton County Government has registered with and is participating in a federal work authorization program*,² in accordance with the applicability provisions and deadlines established in O.C.G.A. 13-10-91.

1127922

EEV/Basic Pilot Program* User Identification Number

AMTECH DRIVES INC

BY: Authorized Officer of Agent
(Insert Subcontractor Name)

NIRAJ THAKER

Title of Authorized Officer or Agent of Subcontractor

Printed Name of Authorized Officer or Agent

Sworn to and subscribed before me,

This 7 day of OCTOBER, 2025

(Notary Public)

**A VELLARA
NOTARY PUBLIC
DEKALB COUNTY, GEORGIA
My Commission Expires 04/10/2029**

Commission Expires: 04/10/2029

(Date)

¹O.C.G.A. § 13-10-90(4), as amended by Senate Bill 160, provides that "physical performance of services" means any performance of labor or services for a public employer (e.g., Fulton County) using a bidding process (e.g., ITB, RFQ, RFP, etc.) or contract wherein the labor or services exceed \$2,499.99, except for those individuals licensed pursuant to title 26 or Title 43 or by the State Bar of Georgia and is in good standing when such contract is for service to be rendered by such individual.

²[Any of the electronic verification of work authorization programs operated by the United States Department of Homeland Security or any equivalent federal work authorization program operated by the United States Department of Homeland Security to verify information of newly hired employees, pursuant to the Immigration Reform and Control Act of 1986 (IRCA), P.L. 99-603].

**STATE OF GEORGIA
COUNTY OF FULTON**

FORM B: GEORGIA SECURITY AND IMMIGRATION SUBCONTRACTOR AFFIDAVIT

By executing this affidavit, the undersigned subcontractor verifies its compliance with O.C.G.A. 13-10-91, stating affirmatively that the individual, firm or corporation which is engaged in the physical performance of services¹ under a contract with Sol Construction LLC on behalf of Fulton County Government has registered with and is participating in a federal work authorization program*,² in accordance with the applicability provisions and deadlines established in O.C.G.A. 13-10-91.

134916

EEV/Basic Pilot Program* User Identification Number

Keith Stanley
BY: Authorized Officer of Agent
(Insert Subcontractor Name)

Director of Operations
Title of Authorized Officer or Agent of Subcontractor

Keith Stanley
Printed Name of Authorized Officer or Agent

Sworn to and subscribed before me,

This 13 day of October, 2025

[Signature]
(Notary Public)

(Seal)

Commission Expires: 02/28/2029
(Date)

Jacob C Cole
Commonwealth of Virginia
Notary Public
Commission: 7944009
My Commission Expires: 02/28/2029

¹O.C.G.A. § 13-10-90(4), as amended by Senate Bill 160, provides that "physical performance of services" means any performance of labor or services for a public employer (e.g., Fulton County) using a bidding process (e.g., ITB, RFQ, RFP, etc.) or contract wherein the labor or services exceed \$2,499.99, except for those individuals licensed pursuant to title 26 or Title 43 or by the State Bar of Georgia and is in good standing when such contract is for service to be rendered by such individual.

²*[Any of the electronic verification of work authorization programs operated by the United States Department of Homeland Security or any equivalent federal work authorization program operated by the United States Department of Homeland Security to verify information of newly hired employees, pursuant to the Immigration Reform and Control Act of 1986 (IRCA), P.L. 99-603].

FORM D: GEORGIA PROFESSIONAL LICENSE CERTIFICATION

NOTE: Please complete this form for the work your firm will perform on this project.

Contractor's Name: East Electrical Contractors, Inc.

Performing work as: Prime Contractor _____ Subcontractor/Sub-Consultant ✓

Professional License Type: Electrical Contractor-Non Restricted

Professional License Number: EN218897

Expiration Date of License: 06/30/2026

I certify that the above information is true and correct and that the classification noted is applicable to the Bid for this Project.

Signed:

A handwritten signature in black ink, appearing to be 'M. J. S.', written over a horizontal line.

Date: 10-8-25

(ATTACH COPY OF LICENSE)

STATE OF GEORGIA
BRAD RAFFENSPERGER, Secretary of State
State Construction Industry Licensing Board
Electrical Contractor- Non Restricted
LICENSE NO. EN218897

Charles Mercer Sanders
3443 Jacksonville Rd
Tallapoosa GA 30176

EXPIRATION DATE - 06/30/2026
Active

2480873

A pocket-sized license card is below. Above is an enlarged copy of your pocket card.
Please make note of the expiration date on your license. It is your responsibility to renew your license before it expires. Please notify the Board if you have a change of address.
Wall certificates suitable for framing are available at cost, see board fee schedule. To order a wall certificate, please order from the web site - www.sos.state.ga.us/plb.
Please refer to Board Rules for any continuing education requirements your profession may require.

Georgia State Board of Professional Licensing
237 Coliseum Drive
Macon GA 31217
Phone: (404) 424-9966
www.sos.ga.gov/plb

Charles Mercer Sanders
3443 Jacksonville Rd
Tallapoosa GA 30176

STATE OF GEORGIA
BRAD RAFFENSPERGER, Secretary of State
State Construction Industry Licensing Board
Electrical Contractor- Non Restricted
LICENSE NO. EN218897

Charles Mercer Sanders
3443 Jacksonville Rd
Tallapoosa GA 30176

EXPIRATION DATE - 06/30/2026
Active

Form C: OFFEROR'S DISCLOSURE FORM AND QUESTIONNAIRE

1. Please provide the names and business addresses of each of the Offeror's firm's officers and directors.

For the purposes of this form, the term "Offeror" means an entity that responds to a solicitation for a County contract by either submitting a proposal in response to a Request for Proposal or a Request for Qualification or a Bid in response to an Invitation to Bid. Describe accurately, fully and completely, their respective relationships with said Offeror, including their ownership interests and their anticipated role in the management and operations of said Offeror.

Sol Construction LLC 4120 Presidential Pky Ste 115 Atl GA 30340

Ph-770-455-1822 Fax- 800-996-0385

Juliana Gomez: 404-213-4294

2. Please describe the general development of said Offeror's business during the past five (5) years, or such shorter period of time that said Offeror has been in business.

Sol Construction typically engages in projects constructing water and wastewater infrastructure as well as concrete and streetscape projects. Over the last five years Sol has been building the concrete construction part of the company as well as increasing the size of water and wastewater projects we construct.

3. Please state whether any employee, agent or representative of said Offeror who is or will be directly involved in the subject project has or had within the last five (5) years: (i) directly or indirectly had a business relationship with Fulton County; (ii) directly or indirectly received revenues from Fulton County; or (iii) directly or indirectly receives revenues from the result of conducting business on Fulton County property or pursuant to any contract with Fulton County. Please describe in detail any such relationship.

No employee, agent or representative of Sol Construction who is or will be directly involved in the subject project has or had any directly or indirectly has a relationship with Fulton County.

Sol Construction as a company has participated in the following projects in Fulton County as a General Contractor in the last five years

-Sol Construction is currently engaged in the Misc Constuction- Wastewater System

-Services- On Call Call Contract with Fulton County. Gloria Villegas is the project manager and Ricky Snow has acted as superintendent on parts of the project.

-Flow Meter Vaults as Camp Creek: past project Sol Construction completed for Fulton County

-JCEC Fulton CO Screen Install: past project Sol Construction completed for Fulton County

LITIGATION DISCLOSURE:

Failure to fully and truthfully disclose the information required, may result in the disqualification of your bid or proposal from consideration or termination of the Contract, once awarded.

1. Please state whether any of the following events have occurred in the last five (5) years with respect to said Offeror. If any answer is yes, explain fully the following:
 - (a) whether a petition under the federal bankruptcy laws or state insolvency laws was filed by or against said Offeror, or a receiver fiscal agent or similar officer was appointed by a court for the business or property of said Offeror;
 Circle One: YES ☐ NO ☒
 - (b) whether Offeror was subject of any order, judgment, or decree not subsequently reversed, suspended or vacated by any court of competent jurisdiction, permanently enjoining said Offeror from engaging in any type of business practice, or otherwise eliminating any type of business practice; and
 Circle One: YES ☐ NO ☒
 - (c) whether said Offeror's business was the subject of any civil or criminal proceeding in which there was a final adjudication adverse to said Offeror, which directly arose from activities conducted by the business unit or corporate division of said Offeror which submitted a bid or proposal for the subject project. If so please explain.
 Circle One: YES ☐ NO ☒
2. Have you or any member of your firm or team to be assigned to this engagement ever been indicted or convicted of a criminal offense within the last five (5) years?
 Circle One: YES ☐ NO ☒
3. Have you or any member of your firm or team been terminated (for cause or otherwise) from any work being performed for Fulton County or any other Federal, State or Local Government?
 Circle One: YES ☐ NO ☒
4. Have you or any member of your firm or team been involved in any claim or litigation adverse to Fulton County or any other federal, state or local government, or private entity during the last three (3) years?
 Circle One: YES ☐ NO ☒
5. Has any Offeror, member of Offeror's team, or officer of any of them (with respect to any matter involving the business practices or activities of his or her employer), been notified within the five (5) years preceding the date of this offer that any of them are the target of a criminal investigation, grand jury investigation, or civil enforcement proceeding?
 Circle One: YES ☐ NO ☒

If you have answered "YES" to any of the above questions, please indicate the name(s) of the person(s), the nature, and the status and/or outcome of the information, indictment, conviction, termination, claim

or litigation, the name of the court and the file or reference number of the case, as applicable. Any such information should be provided on a separate page, attached to this form and submitted with your proposal.

NOTE: If any response to any question set forth in this questionnaire has been disclosed in any other document, a response may be made by attaching a copy of such disclosure. (For example, said Offeror's most recent filings with the Securities and Exchange Commission ("SEC") may be provided if they are responsive to certain items within the questionnaire.) However, for purposes of clarity, Offeror should correlate its responses with the exhibits by identifying the exhibit and its relevant text.

Disclosures must specifically address, completely respond and comply with all information requested and fully answer all questions requested by Fulton County. Such disclosure must be submitted at the time of the bid or proposal submission and included as a part of the bid/proposal submitted for this project. Disclosure is required for Offerors, joint venture partners and first-tier subcontractors.

Failure to provide required disclosure, submit officially signed and notarized documents or respond to any and all information requested/required by Fulton County can result in the bid/proposal declared as non-responsive. This document must be completed and included as a part of the bid/proposal package along with other required documents.

[SIGNATURES ON NEXT PAGE]

Under penalty of perjury, I declare that I have examined this questionnaire and all attachments hereto, if applicable, to the best of my knowledge and belief, and all statements contained hereto are true, correct, and complete.

On this 27 day of February, 2024

Sol Construction LLC 2/27/2024
(Legal Name of Proponent) (Date)

[Signature] 2/27/2024
(Signature of Authorized Representative) (Date)

President
(Title)

Sworn to and subscribed before me,

This 27 day of February, 2024

Katherine Butterfield
(Notary Public) (Seal)

**Katherine Butterfield
NOTARY PUBLIC
Cobb County, GEORGIA**

Commission Expires 6/27/2026
(Date)



A pocket-sized license card is below. Above is an enlarged copy of your pocket card.

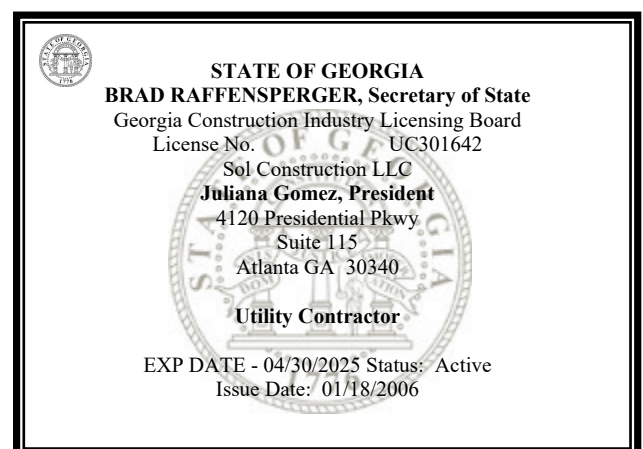
Please make note of the expiration date on your license. It is your responsibility to renew your license before it expires. Please notify the Board if you have a change of address.

Wall certificates suitable for framing are available at cost, see board fee schedule. To order a wall certificate, please order from the web site – www.sos.ga.gov/plb.

Please refer to Board Rules for any continuing education requirements your profession may require.

Georgia State Board of Professional Licensing
237 Coliseum Drive
Macon GA 31217
Phone: (404) 424-9966
www.sos.ga.gov/plb

Sol Construction LLC
4120 Presidential Pkwy
Suite 115
Atlanta GA 30340



FORM D: GEORGIA PROFESSIONAL LICENSE CERTIFICATION

NOTE: Please complete this form for the work your firm will perform on this project.

Contractor's Name: Cheryl H. Brewer

Performing work as: Prime Contractor _____ Subcontractor/Sub-Consultant ✓

Professional License Type: Certified General Real Property Appraiser

Professional License Number: 6418

Expiration Date of License: 4/30/25

I certify that the above information is true and correct and that the classification noted is applicable to the Bid for this Project.

Signed: Cheryl H Brewer

Date: 2/28/24

(ATTACH COPY OF LICENSE)

COMMONWEALTH of VIRGINIA

Department of Professional and Occupational Regulation

9960 Mayland Drive, Suite 400, Richmond, VA 23233

Telephone: (804) 367-8500

EXPIRES ON

12-31-2025

NUMBER

0407000031

BOARD FOR ARCHITECTS, PROFESSIONAL ENGINEERS, LAND SURVEYORS, CERTIFIED INTERIOR DESIGNERS
AND LANDSCAPE ARCHITECTS
BUSINESS ENTITY REGISTRATION

PROFESSIONS: LS, ENG, ARC



AUSTIN BROCKENBROUGH & ASSOCIATES
1011 BOULDER SPRINGS DR
SUITE 200
RICHMOND, VA 23225



Status can be verified at <http://www.dpor.virginia.gov>

Kishore S. Thota
Kishore S. Thota, Director

(SEE REVERSE SIDE FOR PRIVILEGES AND INSTRUCTIONS)

DPOR-LIC (02/2017)



A pocket-sized license card is below. Above is an enlarged copy of your pocket card.

Please make note of the expiration date on your license. It is your responsibility to renew your license before it expires. Please notify the Board if you have a change of address.

Wall certificates suitable for framing are available at cost, see board fee schedule. To order a wall certificate, please order from the web site – www.sos.ga.gov/plb.

Please refer to Board Rules for any continuing education requirements your profession may require.

Georgia State Board of Professional Licensing
237 Coliseum Drive
Macon GA 31217
Phone: (404) 424-9966
www.sos.ga.gov/plb

EDEC, Inc.
4120 Chattahoochee Trace
Suite A
Duluth GA 30097



FORM D: GEORGIA PROFESSIONAL LICENSE CERTIFICATION

NOTE: Please complete this form for the work your firm will perform on this project.

Contractor's Name: **Engineered Systems & Services, LLC**

Performing work as: Prime Contractor _____ Subcontractor/Sub-Consultant **X**

Professional License Type: **Engineering**

Professional License Number: **PEF005372**

Expiration Date of License: **06/30/2024**

I certify that the above information is true and correct and that the classification noted is applicable to the Bid for this Project.

Signed: 

Date: **February 27, 2024**

(ATTACH COPY OF LICENSE)

FORM D: GEORGIA PROFESSIONAL LICENSE CERTIFICATION

NOTE: Please complete this form for the work your firm will perform on this project.

Contractor's Name: **Engineered Systems & Services, LLC**

Performing work as: Prime Contractor _____ Subcontractor/Sub-Consultant **X**

Professional License Type: **Engineering**

Professional License Number: **PEF005372**

Expiration Date of License: **06/30/2024**

I certify that the above information is true and correct and that the classification noted is applicable to the Bid for this Project.

Signed: 

Date: **February 27, 2024**

(ATTACH COPY OF LICENSE)

FORM D: GEORGIA PROFESSIONAL LICENSE CERTIFICATION

NOTE: Please complete this form for the work your firm will perform on this project.

Contractor's Name: Prime Engineering

Performing work as: Prime Contractor _____ Subcontractor/Sub-Consultant X

Professional License Type: Engineer Firm , Land Surveyor Firm

Professional License Number: PEF000998 LSF000113

Expiration Date of License: 6/30/2024

I certify that the above information is true and correct and that the classification noted is applicable to the Bid for this Project.

Signed:

Cuong H. Dinh

Date:

2/27/2024

(ATTACH COPY OF LICENSE)

FORM D: GEORGIA PROFESSIONAL LICENSE CERTIFICATION

NOTE: Please complete this form for the work your firm will perform on this project.

Contractor's Name: Sol Construction LLC

Performing work as: Prime Contractor ☒ Subcontractor/Sub-Consultant ☐

Professional License Type: UC

Professional License Number: 301642

Expiration Date of License: 4/30/2025

I certify that the above information is true and correct and that the classification noted is applicable to the Bid for this Project.

Signed: 

Date: 02/28/2024

(ATTACH COPY OF LICENSE)



A pocket-sized license card is below. Above is an enlarged copy of your pocket card.

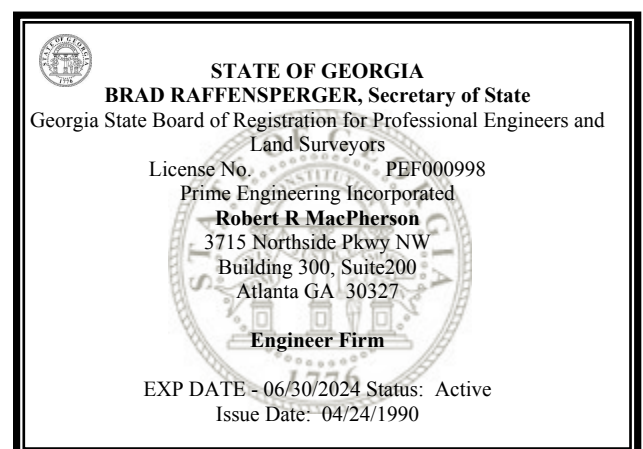
Please make note of the expiration date on your license. It is your responsibility to renew your license before it expires. Please notify the Board if you have a change of address.

Wall certificates suitable for framing are available at cost, see board fee schedule. To order a wall certificate, please order from the web site – www.sos.ga.gov/plb.

Please refer to Board Rules for any continuing education requirements your profession may require.

Georgia State Board of Professional Licensing
237 Coliseum Drive
Macon GA 31217
Phone: (404) 424-9966
www.sos.ga.gov/plb

Prime Engineering Incorporated
3715 Northside Pkwy NW
Building 300, Suite200
Atlanta GA 30327



FORM D: GEORGIA PROFESSIONAL LICENSE CERTIFICATION

NOTE: Please complete this form for the work your firm will perform on this project.

Contractor's Name: R2T, Inc.

Performing work as: Prime Contractor _____ Subcontractor/Sub-Consultant ✓

Professional License Type: Engineering Firm

Professional License Number: PEF004653

Expiration Date of License: 06/30/2024

I certify that the above information is true and correct and that the classification noted is applicable to the Bid for this Project.

Signed: 

Date: February 28, 2024

(ATTACH COPY OF LICENSE)

Form C: OFFEROR'S DISCLOSURE FORM AND QUESTIONNAIRE

1. Please provide the names and business addresses of each of the Offeror's firm's officers and directors.

For the purposes of this form, the term "Offeror" means an entity that responds to a solicitation for a County contract by either submitting a proposal in response to a Request for Proposal or a Request for Qualification or a Bid in response to an Invitation to Bid. Describe accurately, fully and completely, their respective relationships with said Offeror, including their ownership interests and their anticipated role in the management and operations of said Offeror.

Sol Construction LLC
4120 Presidential Pkwy Ste 115
Atlanta, GA 30340
Ph:770-455-1822
Juliana Gomez, President
Jose Villegas: Vicepresident

2. Please describe the general development of said Offeror's business during the past five (5) years, or such shorter period of time that said Offeror has been in business.

Sol Construction engages in projects constructing water and wastewater infrastructure as well as concrete streetscape projects. Over the last five years Sol has been building the concrete construction part of the company as well as increasing the size of water and wastewater projects we construct.

3. Please state whether any employee, agent or representative of said Offeror who is or will be directly involved in the subject project has or had within the last five (5) years: (i) directly or indirectly had a business relationship with Fulton County; (ii) directly or indirectly received revenues from Fulton County; or (iii) directly or indirectly receives revenues from the result of conducting business on Fulton County property or pursuant to any contract with Fulton County. Please describe in detail any such relationship.

No employee, agent, or representative of Sol Construction who is or will be directly involved in the subject project has had, or currently has, any direct or indirect relationship with Fulton County during the last five years.

Sol Construction has participated as a General Contractor in the last five years in the following projects:

- 2025 Standby Miscellaneous Construction Wastewater System Services
- Progressive D/B Campbellton PS and Force Main
- 2022 Standby Miscellaneous Construction Wastewater System Services

LITIGATION DISCLOSURE:

Failure to fully and truthfully disclose the information required, may result in the disqualification of your bid or proposal from consideration or termination of the Contract, once awarded.

1. Please state whether any of the following events have occurred in the last five (5) years with respect to said Offeror. If any answer is yes, explain fully the following:
 - (a) whether a petition under the federal bankruptcy laws or state insolvency laws was filed by or against said Offeror, or a receiver fiscal agent or similar officer was appointed by a court for the business or property of said Offeror;

Circle One: YES NO
 - (b) whether Offeror was subject of any order, judgment, or decree not subsequently reversed, suspended or vacated by any court of competent jurisdiction, permanently enjoining said Offeror from engaging in any type of business practice, or otherwise eliminating any type of business practice; and

Circle One: YES NO
 - (c) whether said Offeror's business was the subject of any civil or criminal proceeding in which there was a final adjudication adverse to said or Offeror, which directly arose from activities conducted by the business unit or corporate division of said Offeror which submitted a bid or proposal for the subject project. If so please explain.

Circle One: YES NO
2. Have you or any member of your firm or team to be assigned to this engagement ever been indicted or convicted of a criminal offense within the last five (5) years?

Circle One: YES NO
3. Have you or any member of your firm or team been terminated (for cause or otherwise) from any work being performed for Fulton County or any other Federal, State or Local Government?

Circle One: YES NO
4. Have you or any member of your firm or team been involved in any claim or litigation adverse to Fulton County or any other federal, state or local government, or private entity during the last three (3) years?

Circle One: YES NO
5. Has any Offeror, member of Offeror's team, or officer of any of them (with respect to any matter involving the business practices or activities of his or her employer), been notified within the five (5) years preceding the date of this offer that any of them are the target of a criminal investigation, grand jury investigation, or civil enforcement proceeding?

Circle One:

YES

NO

If you have answered "YES" to any of the above questions, please indicate the name(s) of the person(s), the nature, and the status and/or outcome of the information, indictment, conviction, termination, claim or litigation, the name of the court and the file or reference number of the case, as applicable. Any such information should be provided on a separate page, attached to this form and submitted with your proposal.

NOTE: If any response to any question set forth in this questionnaire has been disclosed in any other document, a response may be made by attaching a copy of such disclosure. (For example, said Offeror's most recent filings with the Securities and Exchange Commission ("SEC") may be provided if they are responsive to certain items within the questionnaire.) However, for purposes of clarity, Offeror should correlate its responses with the exhibits by identifying the exhibit and its relevant text.

Disclosures must specifically address, completely respond and comply with all information requested and fully answer all questions requested by Fulton County. Such disclosure must be submitted at the time of the bid or proposal submission and included as a part of the bid/proposal submitted for this project. Disclosure is required for Offerors, joint venture partners and first-tier subcontractors.

Failure to provide required disclosure, submit officially signed and notarized documents or respond to any and all information requested/required by Fulton County can result in the bid/proposal declared as non-responsive. This document must be completed and included as a part of the bid/proposal package along with other required documents.

[SIGNATURES ON NEXT PAGE]

Under penalty of perjury, I declare that I have examined this questionnaire and all attachments hereto, if applicable, to the best of my knowledge and belief, and all statements contained hereto are true, correct, and complete.

On this 7th day of October, 2025

Sol Construction LLLCL

10/7/2025

(Legal Name of Proponent)

(Date)



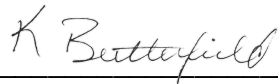
(Signature of Authorized Representative) (Date)

President

(Title)

Sworn to and subscribed before me,

This 7th day of October, 2025



(Notary Public)

(Seal)

**Katherine Butterfield
NOTARY PUBLIC
Cobb County, GEORGIA**

Commission Expires 6/27/2026

(Date)

FORM D: GEORGIA PROFESSIONAL LICENSE CERTIFICATION

NOTE: Please complete this form for the work your firm will perform on this project.

Contractor's Name: Sol Construction LLLC

Performing work as: Prime Contractor XX Subcontractor/Sub-Consultant _____

Professional License Type: **U**tility Contractor

Professional License Number: 3301642

Expiration Date of License: 4/30/2027

I certify that the above information is true and correct and that the classification noted is applicable to the Bid for this Project.

Signed: 

Date: 10/7/2025

(ATTACH COPY OF LICENSE)



A pocket-sized license card is below. Above is an enlarged copy of your pocket card.

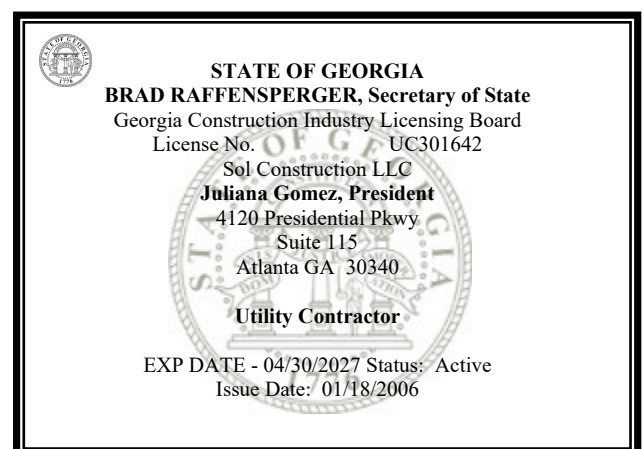
Please make note of the expiration date on your license. It is your responsibility to renew your license before it expires. Please notify the Board if you have a change of address.

Wall certificates suitable for framing are available at cost, see board fee schedule. To order a wall certificate, please order from the web site – www.sos.ga.gov/plb.

Please refer to Board Rules for any continuing education requirements your profession may require.

Georgia State Board of Professional Licensing
237 Coliseum Drive
Macon GA 31217
Phone: (404) 424-9966
www.sos.ga.gov/plb

Sol Construction LLC
4120 Presidential Pkwy
Suite 115
Atlanta GA 30340



FORM D: GEORGIA PROFESSIONAL LICENSE CERTIFICATION

NOTE: Please complete this form for the work your firm will perform on this project.

Contractor's Name: Materials Managers and Engineers, Inc. (2MNEXT)

Performing work as: Prime Contractor _____ Subcontractor/Sub-Consultant ✓

Professional License Type: Engineer Firm

Professional License Number: PEF005927

Expiration Date of License: 06/30/2026

I certify that the above information is true and correct and that the classification noted is applicable to the Bid for this Project.

Signed:



Date: 10/14/2025

(ATTACH COPY OF LICENSE)



Licensee Details

Licensee Information

Full Name	
Materials Managers and Engineers, Inc.	
Street Address	Location
3715 Northside Pa Bldg 300 Suite 200	Atlanta, GA 30327

Primary Source License Information

License No *	Profession	License Type
PEF005927	Engineers / Land Surveyors	Engineer Firm
Issue Date	Licensure Method *	License Status
12/02/2010	Application	Active
	Expiration Date	Date of Last Renewal
	06/30/2026	06/20/2024

Associated Licenses

Search...

Filters

Columns

Full Name

License Type

No Rows

0 to 0 of 0

Page 0 of 0

Public Documents

Filters

Columns

Document Name

Upload Date

Docu

No Rows



Public Lookup

License Search



0 to 0 of 0

Page 0 of 0

FORM D: GEORGIA PROFESSIONAL LICENSE CERTIFICATION

NOTE: Please complete this form for the work your firm will perform on this project.

Contractor's Name: Materials Managers and Engineers, Inc. (2MNEXT)

Performing work as: Prime Contractor _____ Subcontractor/Sub-Consultant ✓

Professional License Type: Engineer Firm

Professional License Number: PEF005927

Expiration Date of License: 06/30/2026

I certify that the above information is true and correct and that the classification noted is applicable to the Bid for this Project.

Signed:



Date: 10/14/2025

(ATTACH COPY OF LICENSE)



Licensee Details

Licensee Information

Full Name	
Materials Managers and Engineers, Inc.	
Street Address	Location
3715 Northside Pa Bldg 300 Suite 200	Atlanta, GA 30327

Primary Source License Information

License No *	Profession	License Type
PEF005927	Engineers / Land Surveyors	Engineer Firm
Issue Date	Licensure Method *	License Status
12/02/2010	Application	Active
	Expiration Date	Date of Last Renewal
	06/30/2026	06/20/2024

Associated Licenses

Search...

Filters

Columns

Full Name

License Type

No Rows

0 to 0 of 0

Page 0 of 0

Public Documents

Filters

Columns

Document Name

Upload Date

Docu

No Rows



Public Lookup

License Search



0 to 0 of 0

Page 0 of 0

FORM D: GEORGIA PROFESSIONAL LICENSE CERTIFICATION

NOTE: Please complete this form for the work your firm will perform on this project.

Contractor's Name: **STEPHEN MINTUN**

Performing work as: Prime Contractor _____ Subcontractor/Sub-Consultant **X**

Professional License Type: **PROFESSIONAL ENGINEER**

Professional License Number: **PE054918**

Expiration Date of License: **12/31/2025**

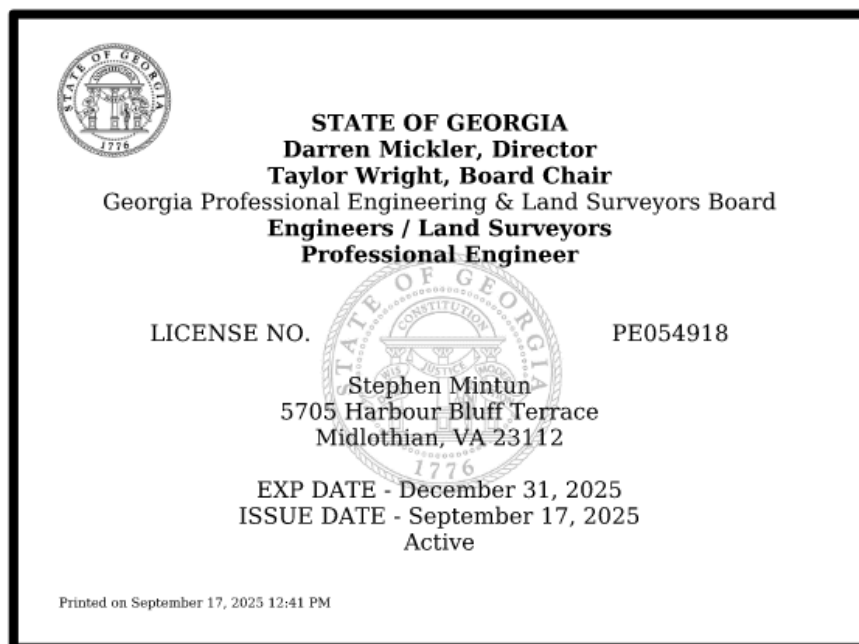
I certify that the above information is true and correct and that the classification noted is applicable to the Bid for this Project.

Signed:



Date: **10/14/2025**

(ATTACH COPY OF LICENSE)



FORM D: GEORGIA PROFESSIONAL LICENSE CERTIFICATION

NOTE: Please complete this form for the work your firm will perform on this project.

Contractor's Name: **STEPHEN MINTUN**

Performing work as: Prime Contractor _____ Subcontractor/Sub-Consultant **X**

Professional License Type: **PROFESSIONAL ENGINEER**

Professional License Number: **PE054918**

Expiration Date of License: **12/31/2025**

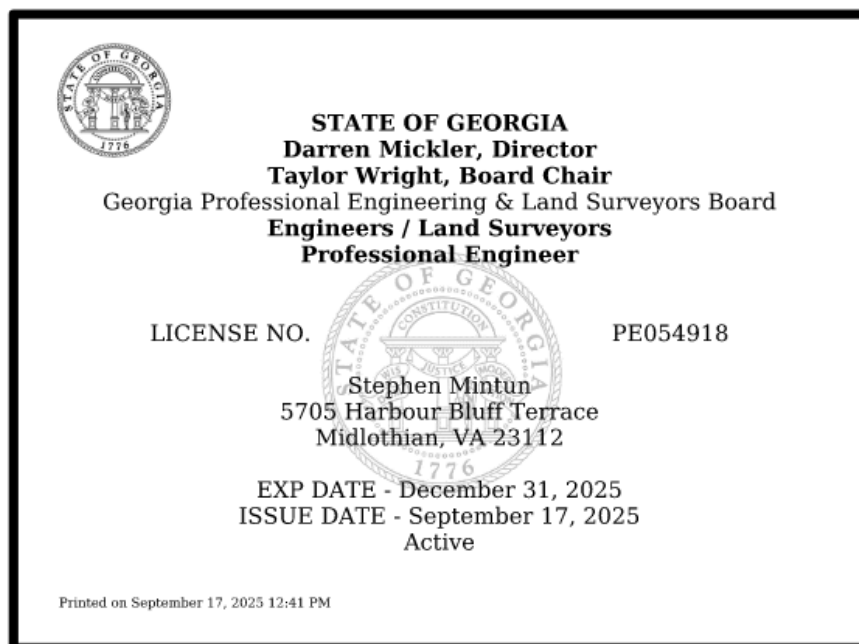
I certify that the above information is true and correct and that the classification noted is applicable to the Bid for this Project.

Signed:



Date: **10/14/2025**

(ATTACH COPY OF LICENSE)



FORM D: GEORGIA PROFESSIONAL LICENSE CERTIFICATION

NOTE: Please complete this form for the work your firm will perform on this project.

Contractor's Name: EDEC, Inc.

Performing work as: Prime Contractor _____ Subcontractor/Sub-Consultant X

Professional License Type: Engineers/Land Surveyors Engineer Firm

Professional License Number: PEF006157

Expiration Date of License: June 30, 2026

I certify that the above information is true and correct and that the classification noted is applicable to the Bid for this Project.

Signed:



Date: October 13, 2025

(ATTACH COPY OF LICENSE)

Your License Pocket Card

See your pocket-sized license card below.

Please make note of the expiration date on your license. It is your responsibility to renew your license before it expires. Please request a demographic change through the portal if you have a change of address.

Wall certificates suitable for framing are available at cost, see board fee schedule. To order a wall certificate, please order from the [Licensing Portal](https://gapelsb.evokeplatform.com/app/licensingPortal) at gapelsb.evokeplatform.com/app/licensingPortal

Please refer to Board Rules for any continuing education requirements your profession may require.

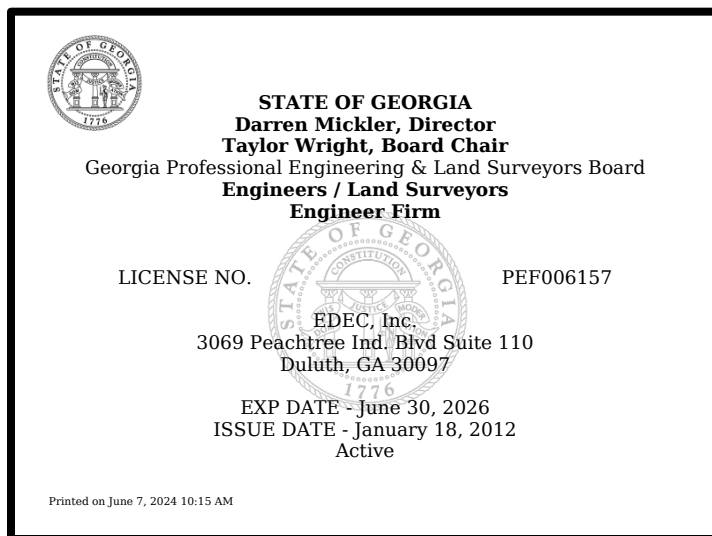
Georgia Professional Engineers & Land Surveyors Board

237 Coliseum Drive

Macon-Bibb County, GA 31217

Phone: (470) 355-4505

Email: pels@sos.ga.gov



FORM D: GEORGIA PROFESSIONAL LICENSE CERTIFICATION

NOTE: Please complete this form for the work your firm will perform on this project.

Contractor's Name: Engineered Systems & Services, LLC

Performing work as: Prime Contractor _____ Subcontractor/Sub-Consultant X

Professional License Type: Engineering

Professional License Number: PEF005372

Expiration Date of License: 06/30/2026

I certify that the above information is true and correct and that the classification noted is applicable to the Bid for this Project.

Signed:



Date:

10/14/25

(ATTACH COPY OF LICENSE)



STATE OF GEORGIA
Darren Mickler, Director
Taylor Wright, Board Chair
Georgia Professional Engineering & Land Surveyors Board
Engineers / Land Surveyors
Engineer Firm

LICENSE NO.

PEF005372

Engineered Systems & Services, LLC
2950 Horizon Park Drive Suite B
Suwanee, GA 30024

EXP DATE - June 30, 2026
ISSUE DATE - May 14, 2008
Active

Printed on June 26, 2024 10:51 PM

FORM D: GEORGIA PROFESSIONAL LICENSE CERTIFICATION

NOTE: Please complete this form for the work your firm will perform on this project.

Contractor's Name: CHB Acquisition Services, LLC

Performing work as: Prime Contractor _____ Subcontractor/Sub-Consultant X

Professional License Type: Certified General Real Property Appraiser

Professional License Number: 6418

Expiration Date of License: 4/30/26

I certify that the above information is true and correct and that the classification noted is applicable to the Bid for this Project.

Signed:

A handwritten signature in blue ink, reading "Cheryl H. Brewer", is written over a light blue rectangular background.

Date: October 13, 2025

(ATTACH COPY OF LICENSE)

STATE OF GEORGIA
REAL ESTATE APPRAISERS BOARD

CHERYL HENDRICK BREWER

6418

IS AUTHORIZED TO TRANSACT BUSINESS IN GEORGIA AS A
CERTIFIED GENERAL REAL PROPERTY APPRAISER

THE PRIVILEGE AND RESPONSIBILITIES OF THIS APPRAISER CLASSIFICATION SHALL CONTINUE IN EFFECT AS LONG AS THE APPRAISER PAYS REQUIRED APPRAISER FEES AND COMPLIES WITH ALL OTHER REQUIREMENTS OF THE OFFICIAL CODE OF GEORGIA ANNOTATED, CHAPTER 43-39-A. THE APPRAISER IS SOLELY RESPONSIBLE FOR THE PAYMENT OF ALL FEES ON A TIMELY BASIS.

D. SCOTT MURPHY
Chairperson

JEANMARIE HOLMES
Vice Chairperson

JEFF A. LAWSON
WILLIAM A. MURRAY
KEITH STONE

1236754710677312

CHERYL HENDRICK BREWER

6418
Status ACTIVE

END OF RENEWAL
04/30/2026

CERTIFIED GENERAL REAL PROPERTY
APPRAISER

THIS LICENSE EXPIRES IF YOU FAIL TO PAY
RENEWAL FEES OR IF YOU FAIL TO COMPLETE ANY
REQUIRED EDUCATION IN A TIMELY MANNER.

State of Georgia
Real Estate Commission
Suite 1000 - International Tower
229 Peachtree Street, N.E.
Atlanta, GA 30303-1605



LYNN DEMPSEY
Real Estate Commissioner

1236754710677312

CHERYL HENDRICK BREWER

6418
Status ACTIVE

END OF RENEWAL
04/30/2026

CERTIFIED GENERAL REAL PROPERTY
APPRAISER

THIS LICENSE EXPIRES IF YOU FAIL TO PAY
RENEWAL FEES OR IF YOU FAIL TO COMPLETE ANY
REQUIRED EDUCATION IN A TIMELY MANNER.

State of Georgia
Real Estate Commission
Suite 1000 - International Tower
229 Peachtree Street, N.E.
Atlanta, GA 30303-1605



LYNN DEMPSEY
Real Estate Commissioner

1236754710677312

BREWER, CHERYL HENDRICK
29 W GIBSON STREET
P O BOX 632
WARRENTON, GA 30828

FORM D: GEORGIA PROFESSIONAL LICENSE CERTIFICATION

NOTE: Please complete this form for the work your firm will perform on this project.

Contractor's Name: CHB Acquisition Services, LLC

Performing work as: Prime Contractor _____ Subcontractor/Sub-Consultant X

Professional License Type: Broker's license

Professional License Number: 305947

Expiration Date of License: 4/30/28

I certify that the above information is true and correct and that the classification noted is applicable to the Bid for this Project.

Signed: 

Date: October 13, 2025

(ATTACH COPY OF LICENSE)

STATE OF GEORGIA
REAL ESTATE COMMISSION

CHERYL HENDRICK BREWER

305947

IS AUTHORIZED TO TRANSACT BUSINESS IN GEORGIA AS A LICENSED
BROKER

THE PRIVILEGE AND RESPONSIBILITIES OF THIS LICENSURE SHALL CONTINUE IN EFFECT AS LONG AS THE LICENSEE
PAYS REQUIRED LICENSE FEES AND COMPLIES WITH ALL OTHER REQUIREMENTS OF THE OFFICIAL CODE OF
GEORGIA ANNOTATED, CHAPTER 43-40. THE LICENSEE IS SOLELY RESPONSIBLE FOR THE PAYMENT OF ALL FEES ON
A TIMELY BASIS.

JERRY WARSHAW
Chairperson

STEVE GRAVES
Vice Chairperson

EDWARD L. DOLLAR
DEANN GOLDEN
CEDRIC MATHENY
BRENDA THOMPSON

1236754710677314

BREWER, CHERYL HENDRICK
29 W GIBSON STREET
P O BOX 632
WARRENTON, GA 30828

CHERYL HENDRICK BREWER

305947

BROKER

CHB ACQUISITION SERVICES LLC

FIRM NO. H-65288

THIS LICENSE EXPIRES IF YOU FAIL TO
PAY RENEWAL FEES OR IF YOU FAIL
TO COMPLETE ANY REQUIRED
EDUCATION IN A TIMELY MANNER.

State of Georgia
Real Estate Commission
Suite 1000 - International Tower
229 Peachtree Street, N.E.
Atlanta, GA 30303-1605

ORIGINALLY LICENSED

05/15/2006

END OF RENEWAL
04/30/2028

Assigned to Firm
10/26/2012



LYNN DEMPSEY
Real Estate Commissioner

1236754710677314

CHERYL HENDRICK BREWER

305947

BROKER

CHB ACQUISITION SERVICES LLC

FIRM NO. H-65288

THIS LICENSE EXPIRES IF YOU FAIL TO
PAY RENEWAL FEES OR IF YOU FAIL
TO COMPLETE ANY REQUIRED
EDUCATION IN A TIMELY MANNER.

State of Georgia
Real Estate Commission
Suite 1000 - International Tower
229 Peachtree Street, N.E.
Atlanta, GA 30303-1605

ORIGINALLY LICENSED

05/15/2006

END OF RENEWAL
04/30/2028

Assigned to Firm
10/26/2012



LYNN DEMPSEY
Real Estate Commissioner

1236754710677314

FORM D: GEORGIA PROFESSIONAL LICENSE CERTIFICATION

NOTE: Please complete this form for the work your firm will perform on this project.

Contractor's Name: R2T, Inc.

Performing work as: Prime Contractor _____ Subcontractor/Sub-Consultant _____

Professional License Type: Professional Engineer

Professional License Number: PEF004653

Expiration Date of License: 06/30/2026

I certify that the above information is true and correct and that the classification noted is applicable to the Bid for this Project.

Signed:

A handwritten signature in blue ink that reads "Kimberly Ajay".

Date: 10/14/2025

(ATTACH COPY OF LICENSE)

Your License Pocket Card

See your pocket-sized license card below.

Please make note of the expiration date on your license. It is your responsibility to renew your license before it expires. Please request a demographic change through the portal if you have a change of address.

Wall certificates suitable for framing are available at cost, see board fee schedule. To order a wall certificate, please order from the [Licensing Portal](https://gapelsb.evokeplatform.com/app/licensingPortal) at gapelsb.evokeplatform.com/app/licensingPortal

Please refer to Board Rules for any continuing education requirements your profession may require.

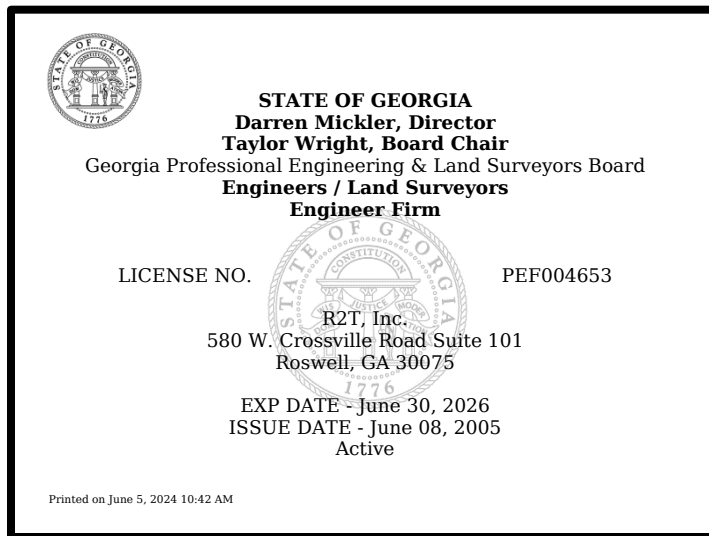
Georgia Professional Engineers & Land Surveyors Board

237 Coliseum Drive

Macon-Bibb County, GA 31217

Phone: (470) 355-4505

Email: pels@sos.ga.gov



FORM D: GEORGIA PROFESSIONAL LICENSE CERTIFICATION

NOTE: Please complete this form for the work your firm will perform on this project.

Contractor's Name: East Electrical Contractors, Inc.

Performing work as: Prime Contractor _____ Subcontractor/Sub-Consultant ✓

Professional License Type: Electrical Contractor-Non Restricted

Professional License Number: EN218897

Expiration Date of License: 06/30/2026

I certify that the above information is true and correct and that the classification noted is applicable to the Bid for this Project.

Signed:

A handwritten signature in black ink, appearing to be 'M. J. S.', written over a horizontal line.

Date: 10-8-25

(ATTACH COPY OF LICENSE)

STATE OF GEORGIA
BRAD RAFFENSPERGER, Secretary of State
State Construction Industry Licensing Board
Electrical Contractor- Non Restricted
LICENSE NO. EN218897

Charles Mercer Sanders
3443 Jacksonville Rd
Tallapoosa GA 30176

EXPIRATION DATE - 06/30/2026
Active

2480873

A pocket-sized license card is below. Above is an enlarged copy of your pocket card.
Please make note of the expiration date on your license. It is your responsibility to renew your license before it expires. Please notify the Board if you have a change of address.
Wall certificates suitable for framing are available at cost, see board fee schedule. To order a wall certificate, please order from the web site - www.sos.state.ga.us/plb.
Please refer to Board Rules for any continuing education requirements your profession may require.

Georgia State Board of Professional Licensing
237 Coliseum Drive
Macon GA 31217
Phone: (404) 424-9966
www.sos.ga.gov/plb

Charles Mercer Sanders
3443 Jacksonville Rd
Tallapoosa GA 30176

STATE OF GEORGIA
BRAD RAFFENSPERGER, Secretary of State
State Construction Industry Licensing Board
Electrical Contractor- Non Restricted
LICENSE NO. EN218897

Charles Mercer Sanders
3443 Jacksonville Rd
Tallapoosa GA 30176

EXPIRATION DATE - 06/30/2026
Active

FORM D: GEORGIA PROFESSIONAL LICENSE CERTIFICATION

NOTE: Please complete this form for the work your firm will perform on this project.

Contractor's Name: CHB Acquisition Services, LLC

Performing work as: Prime Contractor _____ Subcontractor/Sub-Consultant X

Professional License Type: Broker's license

Professional License Number: 305947

Expiration Date of License: 4/30/28

I certify that the above information is true and correct and that the classification noted is applicable to the Bid for this Project.

Signed:

A handwritten signature in blue ink, reading "Cheryl H. Brewer", is written over a light blue rectangular background.

Date: October 13, 2025

(ATTACH COPY OF LICENSE)

STATE OF GEORGIA
REAL ESTATE COMMISSION

CHERYL HENDRICK BREWER

305947

IS AUTHORIZED TO TRANSACT BUSINESS IN GEORGIA AS A LICENSED
BROKER

THE PRIVILEGE AND RESPONSIBILITIES OF THIS LICENSURE SHALL CONTINUE IN EFFECT AS LONG AS THE LICENSEE
PAYS REQUIRED LICENSE FEES AND COMPLIES WITH ALL OTHER REQUIREMENTS OF THE OFFICIAL CODE OF
GEORGIA ANNOTATED, CHAPTER 43-40. THE LICENSEE IS SOLELY RESPONSIBLE FOR THE PAYMENT OF ALL FEES ON
A TIMELY BASIS.

JERRY WARSHAW
Chairperson

STEVE GRAVES
Vice Chairperson

EDWARD L. DOLLAR
DEANN GOLDEN
CEDRIC MATHENY
BRENDA THOMPSON

1236754710677314

BREWER, CHERYL HENDRICK
29 W GIBSON STREET
P O BOX 632
WARRENTON, GA 30828

CHERYL HENDRICK BREWER

305947

BROKER

CHB ACQUISITION SERVICES LLC

FIRM NO. H-65288

THIS LICENSE EXPIRES IF YOU FAIL TO
PAY RENEWAL FEES OR IF YOU FAIL
TO COMPLETE ANY REQUIRED
EDUCATION IN A TIMELY MANNER.

State of Georgia
Real Estate Commission
Suite 1000 - International Tower
229 Peachtree Street, N.E.
Atlanta, GA 30303-1605

ORIGINALLY LICENSED

05/15/2006

END OF RENEWAL
04/30/2028

Assigned to Firm
10/26/2012



LYNN DEMPSEY
Real Estate Commissioner

1236754710677314

CHERYL HENDRICK BREWER

305947

BROKER

CHB ACQUISITION SERVICES LLC

FIRM NO. H-65288

THIS LICENSE EXPIRES IF YOU FAIL TO
PAY RENEWAL FEES OR IF YOU FAIL
TO COMPLETE ANY REQUIRED
EDUCATION IN A TIMELY MANNER.

State of Georgia
Real Estate Commission
Suite 1000 - International Tower
229 Peachtree Street, N.E.
Atlanta, GA 30303-1605

ORIGINALLY LICENSED

05/15/2006

END OF RENEWAL
04/30/2028

Assigned to Firm
10/26/2012



LYNN DEMPSEY
Real Estate Commissioner

1236754710677314

FORM D: GEORGIA PROFESSIONAL LICENSE CERTIFICATION

NOTE: Please complete this form for the work your firm will perform on this project.

Contractor's Name: R2T, Inc.

Performing work as: Prime Contractor _____ Subcontractor/Sub-Consultant _____

Professional License Type: Professional Engineer

Professional License Number: PEF004653

Expiration Date of License: 06/30/2026

I certify that the above information is true and correct and that the classification noted is applicable to the Bid for this Project.

Signed:

A handwritten signature in blue ink that reads "Kimberly Ajay".

Date: 10/14/2025

(ATTACH COPY OF LICENSE)

Your License Pocket Card

See your pocket-sized license card below.

Please make note of the expiration date on your license. It is your responsibility to renew your license before it expires. Please request a demographic change through the portal if you have a change of address.

Wall certificates suitable for framing are available at cost, see board fee schedule. To order a wall certificate, please order from the [Licensing Portal](https://gapelsb.evokeplatform.com/app/licensingPortal) at gapelsb.evokeplatform.com/app/licensingPortal

Please refer to Board Rules for any continuing education requirements your profession may require.

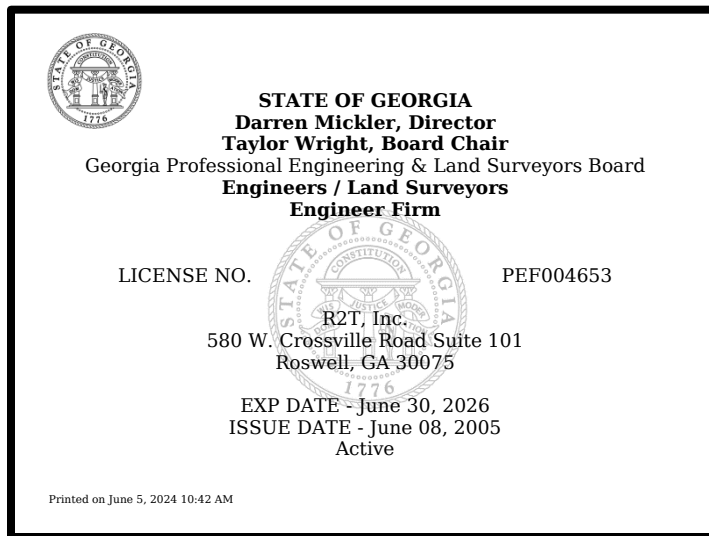
Georgia Professional Engineers & Land Surveyors Board

237 Coliseum Drive

Macon-Bibb County, GA 31217

Phone: (470) 355-4505

Email: pels@sos.ga.gov



FORM D: GEORGIA PROFESSIONAL LICENSE CERTIFICATION

NOTE: Please complete this form for the work your firm will perform on this project.

Contractor's Name: R2T, Inc.

Performing work as: Prime Contractor _____ Subcontractor/Sub-Consultant _____

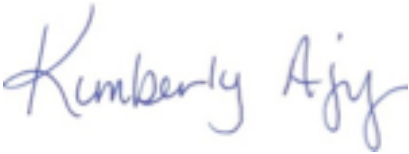
Professional License Type: Professional Engineer

Professional License Number: PEF004653

Expiration Date of License: 06/30/2026

I certify that the above information is true and correct and that the classification noted is applicable to the Bid for this Project.

Signed:

A handwritten signature in blue ink that reads "Kimberly Ajay".

Date: 10/14/2025

(ATTACH COPY OF LICENSE)

Your License Pocket Card

See your pocket-sized license card below.

Please make note of the expiration date on your license. It is your responsibility to renew your license before it expires. Please request a demographic change through the portal if you have a change of address.

Wall certificates suitable for framing are available at cost, see board fee schedule. To order a wall certificate, please order from the [Licensing Portal](https://gapelsb.evokeplatform.com/app/licensingPortal) at gapelsb.evokeplatform.com/app/licensingPortal

Please refer to Board Rules for any continuing education requirements your profession may require.

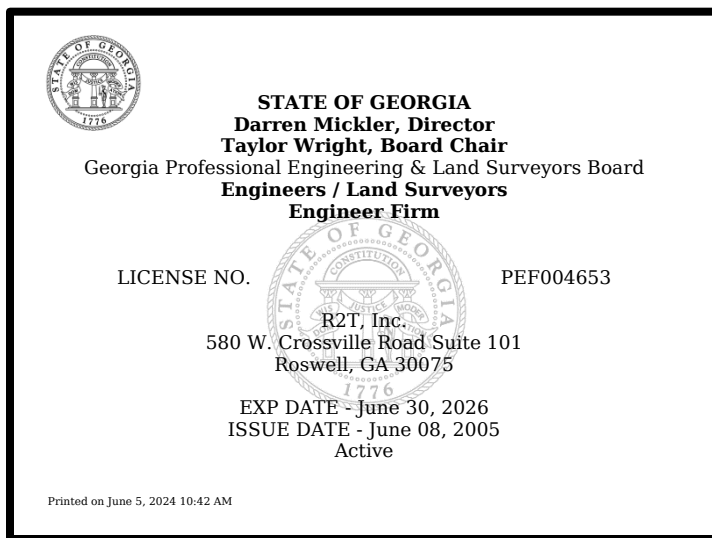
Georgia Professional Engineers & Land Surveyors Board

237 Coliseum Drive

Macon-Bibb County, GA 31217

Phone: (470) 355-4505

Email: pels@sos.ga.gov



FORM D: GEORGIA PROFESSIONAL LICENSE CERTIFICATION

NOTE: Please complete this form for the work your firm will perform on this project.

Contractor's Name: East Electrical Contractors, Inc.

Performing work as: Prime Contractor _____ Subcontractor/Sub-Consultant ✓

Professional License Type: Electrical Contractor-Non Restricted

Professional License Number: EN218897

Expiration Date of License: 06/30/2026

I certify that the above information is true and correct and that the classification noted is applicable to the Bid for this Project.

Signed:

A handwritten signature in black ink, appearing to be 'M. J. S.', written over a horizontal line.

Date: 10-8-25

(ATTACH COPY OF LICENSE)

STATE OF GEORGIA
BRAD RAFFENSPERGER, Secretary of State
State Construction Industry Licensing Board
Electrical Contractor- Non Restricted
LICENSE NO. EN218897

Charles Mercer Sanders
3443 Jacksonville Rd
Tallapoosa GA 30176

EXPIRATION DATE - 06/30/2026
Active

2480873

A pocket-sized license card is below. Above is an enlarged copy of your pocket card.
Please make note of the expiration date on your license. It is your responsibility to renew your license before it expires. Please notify the Board if you have a change of address.
Wall certificates suitable for framing are available at cost, see board fee schedule. To order a wall certificate, please order from the web site - www.sos.state.ga.us/plb.
Please refer to Board Rules for any continuing education requirements your profession may require.

Georgia State Board of Professional Licensing
237 Coliseum Drive
Macon GA 31217
Phone: (404) 424-9966
www.sos.ga.gov/plb

Charles Mercer Sanders
3443 Jacksonville Rd
Tallapoosa GA 30176

STATE OF GEORGIA
BRAD RAFFENSPERGER, Secretary of State
State Construction Industry Licensing Board
Electrical Contractor- Non Restricted
LICENSE NO. EN218897

Charles Mercer Sanders
3443 Jacksonville Rd
Tallapoosa GA 30176

EXPIRATION DATE - 06/30/2026
Active

FORM D: GEORGIA PROFESSIONAL LICENSE CERTIFICATION

NOTE: Please complete this form for the work your firm will perform on this project.

Contractor's Name: East Electrical Contractors, Inc.

Performing work as: Prime Contractor _____ Subcontractor/Sub-Consultant ✓

Professional License Type: Electrical Contractor-Non Restricted

Professional License Number: EN218897

Expiration Date of License: 06/30/2026

I certify that the above information is true and correct and that the classification noted is applicable to the Bid for this Project.

Signed:

A handwritten signature in black ink, appearing to be 'M. J. S.', written over a horizontal line.

Date:

10-8-25

(ATTACH COPY OF LICENSE)

STATE OF GEORGIA
BRAD RAFFENSPERGER, Secretary of State
State Construction Industry Licensing Board
Electrical Contractor- Non Restricted
LICENSE NO. EN218897

Charles Mercer Sanders
3443 Jacksonville Rd
Tallapoosa GA 30176

EXPIRATION DATE - 06/30/2026
Active

2480873

A pocket-sized license card is below. Above is an enlarged copy of your pocket card.
Please make note of the expiration date on your license. It is your responsibility to renew your license before it expires. Please notify the Board if you have a change of address.
Wall certificates suitable for framing are available at cost, see board fee schedule. To order a wall certificate, please order from the web site - www.sos.state.ga.us/plb.
Please refer to Board Rules for any continuing education requirements your profession may require.

Georgia State Board of Professional Licensing
237 Coliseum Drive
Macon GA 31217
Phone: (404) 424-9966
www.sos.ga.gov/plb

Charles Mercer Sanders
3443 Jacksonville Rd
Tallapoosa GA 30176

STATE OF GEORGIA
BRAD RAFFENSPERGER, Secretary of State
State Construction Industry Licensing Board
Electrical Contractor- Non Restricted
LICENSE NO. EN218897

Charles Mercer Sanders
3443 Jacksonville Rd
Tallapoosa GA 30176

EXPIRATION DATE - 06/30/2026
Active

FORM D: GEORGIA PROFESSIONAL LICENSE CERTIFICATION

NOTE: Please complete this form for the work your firm will perform on this project.

Contractor's Name: Prime Engineering, Inc.

Performing work as: Prime Contractor _____ Subcontractor/Sub-Consultant X

Professional License Type: Engineering Consultant

Professional License Number: GA PE018112

Expiration Date of License: December 31, 2025

I certify that the above information is true and correct and that the classification noted is applicable to the Bid for this Project.

Signed:

A handwritten signature in blue ink, appearing to read "Robert R. Mathison".

Date: October 7, 2025

(ATTACH COPY OF LICENSE)

Your License Pocket Card

See your pocket-sized license card below.

Please make note of the expiration date on your license. It is your responsibility to renew your license before it expires. Please request a demographic change through the portal if you have a change of address.

Wall certificates suitable for framing are available at cost, see board fee schedule. To order a wall certificate, please order from the [Licensing Portal](https://gapelsb.evokeplatform.com/app/licensingPortal) at gapelsb.evokeplatform.com/app/licensingPortal

Please refer to Board Rules for any continuing education requirements your profession may require.

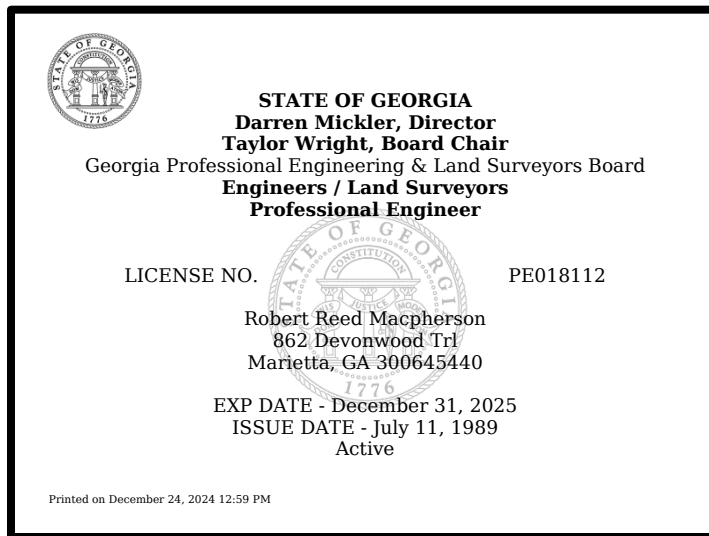
Georgia Professional Engineers & Land Surveyors Board

229 Peachtree Street Northeast, International Tower, Suite 1875

Atlanta, GA 30308

Phone: (404) 693-5754

Email: info@pels.ga.gov





CITY OF ATLANTA

55 Trinity Avenue SW

PROFESSIONAL LICENSE CERTIFICATE

VALID ONLY WHEN OCCUPATION
REGISTRATION TAX REQUIREMENTS ARE PAID

Issued To: Prime Engineering Incorporated
Mailing Address: No address listed under the contact
License Number: LPR-142431-2020
Issued Date: 2/11/2025
Expiration Date: 12/31/2025

License Type: Professional Occupational Tax Certificate
Classification: Engineer
Fees Paid: \$400.00

Mohamed Balla

Mohamed Balla, Chief Financial Officer

DISPLAY THIS CERTIFICATE IN A CONSPICUOUS PLACE AT BUSINESS LOCATION. NOT VALID IF BUSINESS LOCATION DOES NOT COMPLY TO CITY ZONING REQUIREMENTS. NOT VALID UNLESS ACCOMPANIED BY STATE OF GEORGIA LICENSE(S), IF REQUIRED. CERTIFICATE NOT TRANSFERABLE IF BUSINESS TERMINATES OR CHANGES OWNERSHIP DURING CERTIFICATE PERIOD. CALL THE BUSINESS LICENSE OFFICE AT 404-330-6270. THIS CERTIFICATE IS SUBJECT TO ALL APPLICABLE ORDINANCES AND LAWS.b>

TO BE POSTED IN A CONSPICUOUS PLACE

FORM D: GEORGIA PROFESSIONAL LICENSE CERTIFICATION

NOTE: Please complete this form for the work your firm will perform on this project.

Contractor's Name: RDJE, INC.

Performing work as: Prime Contractor _____ Subcontractor/Sub-Consultant ✓

Professional License Type: Georgia Utility Contractor

Professional License Number: UC-302155

Expiration Date of License: 4/30/27

I certify that the above information is true and correct and that the classification noted is applicable to the Bid for this Project.

Signed: 

Date: 10/7/25

(ATTACH COPY OF LICENSE)



STATE OF GEORGIA
BRAD RAFFENSPERGER, Secretary of State
Georgia Construction Industry Licensing Board
LICENSE NO. UC302155

RDJE Inc
Ronny Dale Jones
679 Highway 29 South
Suite A
Newnan GA 30263
Utility Contractor

EXP DATE - 04/30/2027 Status: Active
Issue Date: 06/02/2011

A pocket-sized license card is below. Above is an enlarged copy of your pocket card.

Please make note of the expiration date on your license. It is your responsibility to renew your license before it expires. Please notify the Board if you have a change of address.

Wall certificates suitable for framing are available at cost, see board fee schedule. To order a wall certificate, please order from the web site – www.sos.ga.gov/plb.

Please refer to Board Rules for any continuing education requirements your profession may require.

Georgia State Board of Professional Licensing
237 Coliseum Drive
Macon GA 31217
Phone: (404) 424-9966
www.sos.ga.gov/plb

RDJE Inc
679 Highway 29 South
Suite A
Newnan GA 30263



STATE OF GEORGIA
BRAD RAFFENSPERGER, Secretary of State
Georgia Construction Industry Licensing Board
License No. UC302155

RDJE Inc
Ronny Dale Jones
679 Highway 29 South
Suite A
Newnan GA 30263
Utility Contractor

EXP DATE - 04/30/2027 Status: Active
Issue Date: 06/02/2011

GUARANTEED MAXIMUM PRICE

CAMPBELLTON PUMP STATION AND FORCE MAIN
ESTIMATED COST OF WORK
GMP BASED ON 80% DESIGN

					80% DESIGN ESTIMATE - 4-25-25								
Line #	COST-CODE	DESCRIPTION	UNIT	QTY	U. PRICE	EXTENSION	LABOR COST	MATERIAL COST	DIRECT SUB COST	EQUIPMENT COST	U. PRICE	TOTAL COST	GMP Estimate 5-7-25
0010	00 10 40	DESIGN AND CONSTRUCTION DOCUMENTS	LS	1	\$351,416	\$351,416							
0020		Project Management	LS	1	\$0	\$0	\$0	\$0	\$45,697	\$0	\$45,697	\$45,697	
0030		New wet well	LS	1	\$0	\$0	\$0	\$0	\$66,343	\$0	\$66,343	\$66,343	
0040		Force Main	LS	1	\$0	\$0	\$0	\$0	\$193,036	\$0	\$193,036	\$193,036	
0050		Permitting	LS	1	\$0	\$0	\$0	\$0	\$46,340	\$0	\$46,340	\$46,340	
0070	02 20 00	SURVEYING AND CONSTRUCTION STAKING	LS	1	\$140,090	\$140,090							
0080		Force Main Staking	LS	1	\$0	\$0	\$0	\$0	\$82,595	\$0	\$82,595	\$82,595	
0090		Pump Station Staking	LS	1	\$0	\$0	\$0	\$0	\$25,195	\$0	\$25,195	\$25,195	
0100		As-built	LS	1	\$0	\$0	\$0	\$0	\$32,300	\$0	\$32,300	\$32,300	
0130	01 31 13	EOR CONSTRUCTION SERVICES	LS	1	\$439,665	\$439,665							
0140		Project Management CEI Services	LS	1	\$0	\$0	\$0	\$0	\$114,990	\$0	\$114,990	\$114,990	
0150		CEI Services	LS	1	\$0	\$0	\$0	\$0	\$324,675	\$0	\$324,675	\$324,675	
0190	01 31 00	CONSTRUCTION PROJECT MANAGEMENT AND GCs	LS	1	\$1,162,026	\$1,162,026							
0200		Project Management	Month	18	\$0	\$0	\$53,907	\$5,123	\$0	\$4,147	\$63,177	\$1,137,181	
0210		Temporary Office	Month	12	\$0	\$0	\$0	\$0	\$0	\$1,587	\$1,587	\$19,045	
0220		Office supplies	Month	18	\$0	\$0	\$0	\$322	\$0	\$0	\$322	\$5,800	
0250	01 41 26	PERMITTING FEES	LS	1	\$11,500	\$11,500							
0260		for utility work and LDP	LS	1	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	
0270		City of Chattahoochee Hills: LDP, Building Permit	LS	1	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	
0280		State buffer variance	LS	1	\$0	\$0	\$0	\$0	\$3,500	\$0	\$3,500	\$3,500	
0290		DOT GUPS	LS	1	\$0	\$0	\$0	\$0	\$4,000	\$0	\$4,000	\$4,000	
0300		CORPS Wetlands: Natiowide permit	LS	1	\$0	\$0	\$0	\$0	\$4,000	\$0	\$4,000	\$4,000	
0310	01 42 23	TESTING AND SPECIAL INSPECTIONS	LS	1	\$106,566	\$106,566							
0320		Site Concrete Testing	LS	1	\$0	\$0	\$920	\$0	\$21,300	\$0	\$22,220	\$22,220	
0330		Site Density Testing	LS	1	\$0	\$0	\$920	\$0	\$43,600	\$0	\$44,520	\$44,520	
0340		Reinforcing Steel Inspection	LS	1	\$0	\$0	\$920	\$0	\$7,500	\$0	\$8,420	\$8,420	
0350		Subgrade evaluations (1/2 day)	LS	1	\$0	\$0	\$460	\$0	\$2,500	\$0	\$2,960	\$2,960	
0360		Mass concrete testing	LS	1	\$0	\$0	\$920	\$0	\$7,950	\$0	\$8,870	\$8,870	
0370		Soil Proctor	LS	1	\$0	\$0	\$460	\$0	\$5,000	\$0	\$5,460	\$5,460	
0380		Wet Well Testing	LS	1	\$0	\$0	\$11,961	\$2,155	\$0	\$0	\$14,116	\$14,116	
0390	01 51 13	TEMPORARY POWER	LS	1	\$110,934	\$110,934							
0400		Greystone Power (8 months)	Month	8	\$0	\$0	\$0	\$0	\$1,200	\$0	\$1,200	\$9,600	
0410		Generator power (3 months)	Month	3	\$0	\$0	\$2,990	\$0	\$0	\$11,263	\$14,254	\$42,761	
0420		Fuel for two generators	Month	3	\$0	\$0	\$0	\$19,524	\$0	\$0	\$19,524	\$58,573	
0450	01 52 16	SAFETY / SAFETY OFFICER	Month	18	\$4,241	\$76,334	\$3,528	\$713	\$0	\$0	\$4,241	\$76,334	
0500		0	0	0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	
0510	01 53 00	EXCAVATION ACCESS	LS	1	\$33,767	\$33,767							
0520		Access to wet well pit	Month	6	\$0	\$0	\$3,239	\$0	\$0	\$2,388	\$5,628	\$33,767	
0570	01 55 13	TEMPORARY ACCESS ROAD	LS	1	\$193,665	\$193,665							
0580		Build access road for delivery trucks and dump trucks	LF	6700	\$0	\$0	\$1	\$4	\$0	\$9	\$14	\$93,576	
0590		Maintenance of access road during construction for 18 months	LF	6700	\$0	\$0	\$5	\$9	\$0	\$1	\$15	\$100,089	

					80% DESIGN ESTIMATE - 4-25-25								GMP Estimate 5-7-25
Line #	COST-CODE	DESCRIPTION	UNIT	QTY	U. PRICE	EXTENSION	LABOR COST	MATERIAL COST	DIRECT SUB COST	EQUIPMENT COST	U. PRICE	TOTAL COST	
0630	01 56 26	SITE SECURITY	LS	1	\$37,147	\$37,147							
0640		Temporary fence to secure site	LF	6000	\$0	\$0	\$0	\$0	\$6	\$0	\$6	\$37,147	
0690		PUMP STATION											
0700	03 30 53	PUMP STATION CAST-IN-PLACE CONCRETE	CY	209	\$712	\$148,680							
0710		Furnish and install formwork	LS	1	\$0	\$0	\$14,017	\$19,207	\$0	\$0	\$33,224	\$33,224	
0720		Furnish and install reinforcing steel	TON	7	\$0	\$0	\$2,820	\$2,354	\$0	\$0	\$5,174	\$38,576	
0730		CIP Concrete for slabs and pads	CY	209	\$0	\$0	\$168	\$269	\$0	\$3	\$439	\$91,748	
0760	03 31 00	WET WELL CAST-IN-PLACE CONCRETE	CY	1556	\$1,096	\$1,704,961							
0770		Furnish and install formwork	LS	1	\$0	\$0	\$146,435	\$68,478	\$0	\$0	\$214,913	\$214,913	
0780		Furnish and install reinforcing steel	TON	242.9	\$0	\$0	\$650	\$1,137	\$0	\$550	\$2,337	\$567,668	
0790		CIP Concrete for wet well	CY	1556	\$0	\$0	\$220	\$309	\$0	\$7	\$536	\$833,513	
0800		Xypex	CY	1556	\$0	\$0	\$0	\$57	\$0	\$0	\$57	\$88,852	
0820	03 40 00	PRECAST CONCRETE	LS	1	\$135,780	\$135,780							
0830		Supply and Install precast concrete sewer Manhole Base	EA	2	\$0	\$0	\$2,990	\$3,453	\$0	\$2,994	\$9,437	\$18,875	
0840		Supply and Install precast concrete sewer Manhole Riser	VF	43	\$0	\$0	\$209	\$725	\$1,086	\$232	\$2,251	\$96,790	
0850		Supply and Install precast stormwater structures	LS	1	\$0	\$0	\$8,970	\$3,873	\$0	\$7,271	\$20,115	\$20,115	
0880	05 00 00	MISCELLANEOUS METALS	LS	1	\$174,937	\$174,937							
0890		Aluminum Access Hatches for Pumps	EA	4	\$0	\$0	\$3,545	\$3,460	\$0	\$1,191	\$8,196	\$32,784	
0900		72X36 Alum. Access Hatches for Wet Well	EA	2	\$0	\$0	\$2,127	\$2,193	\$0	\$428	\$4,748	\$9,496	
0910		36X36 Alum. Access Hatches for Wet Well	EA	2	\$0	\$0	\$1,418	\$1,229	\$0	\$428	\$3,076	\$6,151	
0920		Generator vendor provided Aluminum Stairs and landing	LS	1	\$0	\$0	\$5,317	\$17,779	\$0	\$3,906	\$27,002	\$27,002	
0930		Pipe Supports	LS	1	\$0	\$0	\$10,635	\$29,694	\$5,600	\$857	\$46,785	\$46,785	
0940		Monorail Frame Structure	LS	1	\$0	\$0	\$0	\$0	\$42,930	\$0	\$42,930	\$42,930	
0950		48X24 Stainless Steel Bar Grating for slide gates	EA	3	\$0	\$0	\$1,182	\$1,796	\$0	\$286	\$3,263	\$9,789	
0960	09 91 00	PAINTING	LS	1	\$27,000	\$27,000							
0970		Paint exposed pipe and monorail steel structure	LS	1	\$0	\$0	\$0	\$0	\$27,000	\$0	\$27,000	\$27,000	
1020	09 97 23	CONCRETE COATING	SF	13192	\$0	\$0							
1030		Coating concrete inside Wet Well with Tnemec Epoxytec	SF	13192	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	
1080	10 00 00	SPECIALTIES	LS	1	\$19,159	\$19,159							
1090		Supply and install SST cabinet and fire extinguisher	EA	1	\$0	\$0	\$2,990	\$634	\$0	\$0	\$3,624	\$3,624	
1100		Supply and install eye/face wash station	EA	1	\$0	\$0	\$2,990	\$3,549	\$0	\$0	\$6,539	\$6,539	
1110		eye/face wash	LS	1	\$0	\$0	\$1,495	\$0	\$7,500	\$0	\$8,995	\$8,995	
1140	10 14 00	SIGNAGE	LS	1	\$7,091	\$7,091							
1150		signs	LS	1	\$0	\$0	\$4,485	\$2,605	\$0	\$0	\$7,091	\$7,091	
1200	22 13 29	SUBMERSIBLE CHOPPER PUMPS	EA	2	\$159,964	\$319,928							
1210		Purchase and install chopper pumps	EA	2	\$0	\$0	\$8,970	\$138,025	\$0	\$3,394	\$150,390	\$300,780	
1220		Grout and install anchors for pump bases	EA	2	\$0	\$0	\$2,990	\$2,099	\$0	\$0	\$5,089	\$10,178	
1230		Startup	EA	1	\$0	\$0	\$8,970	\$0	\$0	\$0	\$8,970	\$8,970	
1260	26 00 00	ELECTRICAL, VFDS AND ATS	LS	1	\$1,254,485	\$1,254,485							
1270		Supply and Install Electrical work and components	EA	1	\$0	\$0	\$0	\$0	\$1,250,000	\$0	\$1,250,000	\$1,250,000	
1280		Power service coordination	EA	1	\$0	\$0	\$4,485	\$0	\$0	\$0	\$4,485	\$4,485	
1320	26 32 13	GENERATOR	LS	1	\$168,151	\$168,151							
1330		Purchase and install 450kW generator	EA	1	\$0	\$0	\$4,871	\$153,476	\$0	\$3,715	\$162,061	\$162,061	
1340		Startup	EA	1	\$0	\$0	\$2,435	\$2,155	\$1,500	\$0	\$6,090	\$6,090	
1380	31 10 00	CLEARING	LS	1	\$47,547	\$47,547							
1390		Clearing, removal of trees and stumps	ACRE	2	\$0	\$0	\$460	\$0	\$23,314	\$0	\$23,774	\$47,547	

					80% DESIGN ESTIMATE - 4-25-25								GMP Estimate 5-7-25
Line #	COST-CODE	DESCRIPTION	UNIT	QTY	U. PRICE	EXTENSION	LABOR COST	MATERIAL COST	DIRECT SUB COST	EQUIPMENT COST	U. PRICE	TOTAL COST	
1440	31 22 00	GRADING	LS	1	\$64,592	\$64,592							
1450		Rough grading around ww, floodplain and wet well pit	CY	17406	\$0	\$0	\$1	\$0	\$1	\$2	\$4	\$64,592	
1460	31 23 00	SITE EXCAVATION	LS	1	\$128,510	\$128,510							
1470		Cut for final site grading including driveway	CY	12626.5	\$0	\$0	\$2	\$0	\$2	\$2	\$6	\$74,699	
1480		Fill for final site grading including driveway	CY	17405	\$0	\$0	\$1	\$0	\$1	\$1	\$3	\$53,811	
1490	31 23 16	STRUCTURAL EXCAVATION	LS	1	\$1,108,414	\$1,108,414							
1500		Dirt excavation	CY	4025	\$0	\$0	\$3	\$0	\$10	\$50	\$62	\$250,979	
1510		Install shoring and support System	LF	30	\$0	\$0	\$1,287	\$0	\$18,000	\$555	\$19,841	\$595,244	
1520		Rock excavation	CY	1200	\$0	\$0	\$64	\$0	\$21	\$55	\$141	\$169,373	
1530		Backfill around the completed wet well structure	CY	730	\$0	\$0	\$59	\$0	\$0	\$68	\$127	\$92,818	
1550	31 23 19	DEWATERING	LS	1	\$88,895	\$88,895							
1560		Installation and operation of six (6) dewatering wells	LS	1	\$0	\$0	\$0	\$3,771	\$38,000	\$0	\$41,771	\$41,771	
1570		Installation of discharge piping	LS	1	\$0	\$0	\$0	\$0	\$9,000	\$0	\$9,000	\$9,000	
1580		Monitoring and maintenance of dewatering system	LS	1	\$0	\$0	\$38,124	\$0		\$0	\$38,124	\$38,124	
1610	31 25 00	PUMP STATION EROSION CONTROL	SF	87120	\$2	\$184,251							
1620		Water Quality Monitoring	Month	18	\$0	\$0	\$0	\$0	\$500	\$0	\$500	\$9,000	
1630		Install Silt Fence	LF	1125	\$0	\$0	\$0	\$0	\$3	\$0	\$3	\$3,578	
1640		Install Temp Construction Entrance	EA	2	\$0	\$0	\$0	\$0	\$2,572	\$0	\$2,572	\$5,144	
1650		Install Temp grassing (four times)	ACRE	8	\$0	\$0	\$0	\$0	\$1,298	\$0	\$1,298	\$10,384	
1660		Install Temp mulching (four times)	ACRE	8	\$0	\$0	\$0	\$0	\$993	\$0	\$993	\$7,944	
1670		Install Concrete Washdown	EA	2	\$0	\$0	\$0	\$0	\$2,500	\$0	\$2,500	\$5,000	
1680		Install Slope Stabilization	SY	5310	\$0	\$0	\$0	\$0	\$1	\$0	\$1	\$6,851	
1690		Install Permanent grassing	ACRE	2	\$0	\$0	\$0	\$0	\$1,775	\$0	\$1,775	\$3,550	
1700		Erosion Control Maintenance	LS	1	\$0	\$0	\$39,600	\$0	\$93,201	\$0	\$132,801	\$132,801	
1710	32 14 00	PUMP STATION SITE IMPROVEMENTS	SF	13910	\$9	\$119,926							
1720		Supply and Install Pump Station Pavers	SF	13910	\$0	\$0	\$3	\$5	\$0	\$1	\$9	\$119,926	
1770	32 14 00	ACCESS ROAD	SF	6200	\$11	\$66,379							
1780		Supply and install access road pavers	SF	6200	\$0	\$0	\$3	\$5	\$0	\$2	\$11	\$66,379	
1830	32 30 00	BOLLARDS	EA	30	\$1,064	\$31,930							
1840		Supply, install and paint 8" diam x 42" tall fixed Bollards	EA	30	\$0	\$0	\$399	\$600	\$65	\$0	\$1,064	\$31,930	
1890	32 31 00	FENCE	LF	608	\$59	\$36,000							
1900		rolling gate	LF	608	\$0	\$0	\$0	\$0	\$59	\$0	\$59	\$36,000	
1950	32 90 00	LANDSCAPING	LS	1	\$141,850	\$141,850							
1960		Furnish & install trees (Size: 1")	EA	184	\$0	\$0	\$187	\$345	\$35	\$25	\$592	\$108,918	
1970		Soil preparation	LS	1	\$0	\$0	\$5,731	\$6,683	\$0	\$0	\$12,414	\$12,414	
1980		Fertilization, mulching and watering	LS	1	\$0	\$0	\$11,711	\$8,807	\$0	\$0	\$20,519	\$20,519	
2010	33 21 00	WATER WELL	LS	1	\$45,439	\$45,439							
2020		6" water well (10 HP - 100GPM)	LS	1	\$0	\$0	\$3,261	\$0	\$42,178	\$0	\$45,439	\$45,439	
2070	33 70 00	PERMANENT POWER	LS	1	\$65,931	\$65,931							
2080		Power service	LS	1	\$0	\$0	\$4,681	\$0	\$61,250	\$0	\$65,931	\$65,931	
2130	33 30 00	INFLUENT GRAVITY SEWER	LS	1	\$189,833	\$189,833							
2140		Install bedding for gravity sewer pipe	TON	78	\$0	\$0	\$77	\$86	\$0	\$96	\$259	\$20,208	
2150		Purchase and Install HDPE DR 17 Gravity Sewer Pipe	LF	225	\$0	\$0	\$153	\$77	\$0	\$448	\$679	\$152,664	
2160		Testing for Pipe	LF	225	\$0	\$0	\$53	\$0	\$22	\$0	\$75	\$16,961	

					80% DESIGN ESTIMATE - 4-25-25								GMP Estimate 5-7-25
Line #	COST-CODE	DESCRIPTION	UNIT	QTY	U. PRICE	EXTENSION	LABOR COST	MATERIAL COST	DIRECT SUB COST	EQUIPMENT COST	U. PRICE	TOTAL COST	
2190	33 34 00	WET WELL AND YARD PIPING	LS	1	\$841,538	\$841,538							
2200		Purchase and Install Wet Well Piping	LF	158	\$0	\$0	\$151	\$26	\$0	\$290	\$468	\$73,887	
2210		Purchase and Install Yard piping	LF	753	\$0	\$0	\$127	\$171	\$0	\$40	\$339	\$255,084	
2220		Purchase and install valves	EA	17	\$0	\$0	\$1,055	\$11,274	\$0	\$118	\$12,448	\$211,612	
2230		Purchase and install fittings	LS	1	\$0	\$0	\$23,921	\$223,325	\$0	\$2,675	\$249,921	\$249,921	
2240		Heat trace and insulate water line at Hose Bib	LS	1	\$0	\$0	\$2,990	\$0	\$7,500	\$0	\$10,490	\$10,490	
2250		Testing Pipe	LF	465	\$0	\$0	\$51	\$0	\$0	\$0	\$51	\$23,921	
2260		Backfill	LS	1	\$0	\$0	\$14,951	\$0	\$0	\$1,672	\$16,623	\$16,623	
2270	35 20 16.26	SLUICE GATES	LS	1	\$126,359	\$126,359							
2280		Supply and install 24"x36" Stainless Steel slide gates	EA	2	\$0	\$0	\$8,746	\$20,855	\$1,625	\$6,920	\$38,147	\$76,293	
2290		Supply and install 24"x24" Stainless Steel sluice gate	EA	1	\$0	\$0	\$9,419	\$25,485	\$3,250	\$5,932	\$44,085	\$44,085	
2300		Startup	LS	1	\$0	\$0	\$5,980	\$0	\$0	\$0	\$5,980	\$5,980	
2330	40 90 00	INSTRUMENTATION AND SCADA	LS	1	\$285,010	\$285,010							
2340		with Remote SCADA, Security Camera Systems and	LS	1	\$0	\$0	\$17,941	\$4,849	\$257,220	\$0	\$280,010	\$280,010	
2350		Startup, training and O& Manuals	LS	1	\$0	\$0	\$0	\$0	\$5,000	\$0	\$5,000	\$5,000	
2390	41 22 00	HOIST CRANE	LS	1	\$31,349	\$31,349	\$0	\$0	\$0	\$0	\$0	\$0	
2400		Supply and Install 3-Ton electrical hoist	EA	1	\$0	\$0	\$2,990	\$22,359	\$3,200	\$0	\$28,549	\$28,549	
2410		Supply and Install light fixture for monorail	EA	1	\$0	\$0	\$0	\$2,799	\$0	\$0	\$2,799	\$2,799	
2450	44 31 16	ODOR CONTROL	LS	1	\$422,976	\$422,976							
2460		Supply and install radial flow odor control system	EA	1	\$0	\$0	\$11,961	\$393,255	\$0	\$6,519	\$411,735	\$411,735	
2470		Startup and testing	EA	1	\$0	\$0	\$4,485	\$4,256	\$2,500	\$0	\$11,241	\$11,241	
2510	46 41 00	MIXING SYSTEM	LS	1	\$54,107	\$54,107							
2520		Supply and install Wet well mixing system	EA	4	\$0	\$0	\$3,364	\$8,299	\$0	\$0	\$11,663	\$46,653	
2530		Supply and install mixer with fiberglass enclosure	EA	1	\$0	\$0	\$1,495	\$5,959	\$0	\$0	\$7,454	\$7,454	
2570		FORCE MAIN											
2580	31 10 00	CLEARING	LF	8600	\$24	\$206,400	\$0	\$0	\$24	\$0	\$24	\$206,400	
2690	31 25 00	EROSION CONTROL	LS	1	\$207,600	\$207,600	\$0	\$0	\$0	\$0	\$0	\$0	
2700		Straw, Hay, Mulch, Seed FM	SF	263867	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$79,160	
2710		Straw, Hay, Mulch, Seed Gravity Sewer	SF	20000	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$6,000	
2720		Silt Fence (Double Row)	LS	19288	\$0	\$0	\$0	\$5	\$0	\$0	\$5	\$96,440	
2730		Construction Exit	EA	6	\$0	\$0	\$1,027	\$1,548	\$0	\$676	\$3,250	\$19,500	
2740		Stone Check Dam	EA	10	\$0	\$0	\$215	\$272	\$0	\$164	\$650	\$6,500	
2750	32 12 00	ASPHALT ROADWAY REPLACEMENT	SF	18300	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	
2810	32 15 00	10" GRAVEL ROADWAY REPLACEMENT	SY	7578	\$33	\$250,074	\$5	\$24	\$0	\$5	\$33	\$250,074	
2870	33 05 13	MANHOLE W/ PLUG VALVE	EA	4	\$64,608	\$258,432	\$6,684	\$47,439	\$0	\$10,485	\$64,608	\$258,432	
2930	33 05 13	MANHOLE W/ ARV	EA	7	\$21,318	\$149,226	\$5,177	\$7,211	\$0	\$8,930	\$21,318	\$149,226	
2990	33 05 13	FORCE MAIN DISCHARGE MANHOLE	EA	1	\$35,250	\$35,250	\$8,245	\$12,777	\$4,394	\$9,835	\$35,250	\$35,250	
3050	33 05 13	60" DIA MANHOLES	EA	5	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	
3110	33 05 13	DOGHOUSE MANHOLE SMH 1	EA	1	\$59,423	\$59,423	\$9,486	\$29,083	\$3,681	\$17,173	\$59,423	\$59,423	
3170	33 05 23	FORCE MAIN JACK AND BORE- ROCK	LF	400	\$2,271	\$908,400	\$0	\$240	\$2,031	\$0	\$2,271	\$908,400	
3230	33 05 23	FORCE MAIN JACK AND BORE- DIRT	LF	130	\$1,143	\$148,590	\$0	\$111	\$0	\$1,032	\$1,143	\$148,590	
3290	33 05 23	GRAVITY SEWER 48" JACK AND BORE	LF	125	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	
3300		ARV and manhole (change GS to FM)	EA	1	\$21,318	\$21,318	\$5,177	\$7,211	\$0	\$8,930	\$21,318	\$21,318	
3350	33 31 00	36" HDPE GRAVITY SEWER PIPING	LF	974	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	
3410	33 31 00	GRAVITY SEWER TESTING	LF	974	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	
3420		Air Testing/CCTV	LF	974	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	
3470	33 34 00	CONNECT FORCE MAIN AT STA 09+63	EA	1	\$11,569	\$11,569	\$4,183	\$1,071	\$0	\$6,314	\$11,569	\$11,569	
3530	33 34 00	FORCE MAIN PIPING	LS	1	\$5,169,462	\$5,169,462	\$0	\$0	\$0	\$0	\$0	\$0	\$0
3540		24" HDPE DR11 DIPS	LF	19962	\$0	\$0	\$56	\$123	\$0	\$73	\$251	\$5,010,462	-\$5,010,462

					80% DESIGN ESTIMATE - 4-25-25								GMP Estimate 5-7-25
Line #	COST-CODE	DESCRIPTION	UNIT	QTY	U. PRICE	EXTENSION	LABOR COST	MATERIAL COST	DIRECT SUB COST	EQUIPMENT COST	U. PRICE	TOTAL COST	
3550		HDPE Fittings	LF	19288	\$0	\$0	\$1	\$6	\$0	\$1	\$8	\$159,000	
3560		18" HDPE DR11 DIPS	LF	19962	\$0	\$0	\$46	\$113	\$0	\$63	\$221	\$4,411,602	\$4,411,602
3590	33 34 00	FORCE MAIN TESTING	LF	19288	\$2	\$29,288	\$1	\$1	\$0	\$0	\$2	\$29,288	
3650	33 34 00	MARKER BALLS	EA	246	\$155	\$38,064	\$45	\$63	\$0	\$48	\$155	\$38,064	
3710	33 34 00	PROGRAMMABLE LOCATOR WAND	EA	1	\$5,895	\$5,895	\$0	\$5,895	\$0	\$0	\$5,895	\$5,895	
3770	33 41 00	54" STORM DRAIN	LF	80	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	
3830		COST OF WORK				18,203,107.90							-598,860.00
3840		INSURANCE			0.25%	\$45,507.77							-\$1,497.15
3850		BOND			0.75%	\$136,523.31							-\$4,491.45
3860		MATERIAL ESCALATION			1.50%	\$273,046.62							-\$8,982.90
3870		CONSTRUCTION CONTINGENCY			2.00%	\$364,062.16							-\$11,977.20
3880		FEE			9.00%	\$1,638,279.71							-\$53,897.40
3890		SUBTOTAL				20,660,527.47							-679,706.10
3900		OWNER CONTINGENCY			2.00%	\$364,062.16							-\$11,977.20
3910		INCLUDING OWNER CONTIGENCY				21,024,589.62							-691,683.30
3920									Total GMP 5-7-25 INCLUDING OWNER CONTINGENCY				\$20,332,906

SCOPE OF WORK AND TECHNICAL SPECIFICATIONS

Scope of Work: The Campbellton Road Pump Station and Force Main Project will construct one (1) new pump station and approximately twenty thousand linear feet (3.8 miles) of force main pipeline to serve portions of the Cities of Chattahoochee Hills and South Fulton. The new pump station and force main pipeline will direct untreated wastewater from this section of South Fulton County to existing facilities, directing that flow to the Camp Creek WRF via the Deep Creek Pump Station. The initial design of the project was awarded to the Sol Construction with Prime Engineering as the primary sub-consultant on July 10, 2024, BOC (Agenda Item No. 24-0484) under the Progressive Design-Build model. The Sol Construction with Prime Engineering as the primary sub-consultant has provided a Guaranteed Maximum Price (GMP) for the construction of the project based on the 80% design documents. The total GMP for the project in the amount of \$20,332,908 has been reviewed by Public Works staff. The \$20,332,906.00 GMP includes \$728,124.32 (3.4%) in contractor and owner contingencies to address unforeseen construction elements during the construction of the pump stations and installation of the force main pipeline.

Submittal Review & Transmittal



Date: 08/15/2025

Project: Progressive Design/Build Services for Campbellton Pump Station and Force Main

To:

Cherise Smith
Fulton County
7472 Cochran Rd,
College Park, GA 30349
Phone: (404) 583-5503

From:

Gloria Villegas
Sol Construction LLC
4120 Presidential Parkway, Suite 115
Atlanta, GA 30340
Phone: (770) 990-7057 Fax: (770) 455-1822

Vendor/Subcontractor:	Sol Construction LLC	Contact:	Gloria Villegas
Specification #:	N/A	Tel:	(770) 990-7057
Specification Title:	N/A	Review By:	Maria Arroyo

Submittal #	Description	Copies	Comments
26.1	80% Design Specifications	email	

Review by Sol

☐ **Approved**

☒ **Approved as noted**

☐ **Rejected**

Comments: 80% Specifications with comments addressed by Prime Engineering. Response to comments are included in submittal attachments.

Reviewer Comments:

Sol Construction LLC

4120 Presidential Parkway, Suite 115 Atlanta, GA 30340
www.solconstructionllc.com

TECHNICAL SPECIFICATIONS

INDEX

01 11 00	SUMMARY OF WORK
01 11 10	GEOTECHNICAL INFORMATION
01 11 55	CONSTRUCTION STAKING
01 11 80	ENVIRONMENTAL CONDITIONS
01 14 13	INSPECTION OF WORK
01 14 16	OCCUPANCY
01 22 00	MEASUREMENT AND PAYMENT
01 30 10	PROJECT MANAGEMENT AND COORDINATION
01 31 19	PROJECT MEETINGS
01 32 00	CONSTRUCTION PROGRESS DOCUMENTATION
01 32 16	CONSTRUCTION SCHEDULES
01 32 33	CONSTRUCTION VIDEOS AND PHOTOGRAPHS
01 33 00	SUBMITTALS
01 33 23	SHOP DRAWINGS, PRODUCT DATA AND SAMPLES
01 35 00	UNIQUE REQUIREMENTS
01 35 29	HEALTH, SAFETY AND EMERGENCY RESPONSE PROCEDURES
01 35 43	ENVIRONMENTAL PROCEDURES
01 40 00	QUALITY REQUIREMENTS
01 40 10	MATERIALS TESTING
01 42 00	CODES AND STANDARDS
01 45 29	TESTING AND LABORATORY SERVICES
01 50 10	TEMPORARY FACILITIES AND CONTROLS
01 56 16	DUST CONTROL
01 56 33	JOB SITE SECURITY
01 58 00	PROJECT IDENTIFICATION AND SIGNS
01 62 00	MATERIAL AND EQUIPMENT
01 65 00	TRANSPORTATION AND HANDLING
01 66 00	STORAGE AND PROTECTION
01 70 00	EXECUTION AND CLOSEOUT REQUIREMENTS

01 71 33	PROTECTION AND MAINTENANCE OF PROPERTY AND WORK
01 74 00	CLEANING AND WASTE MANAGEMENT
01 75 16	FACILITY STARTUP
01 77 00	CLOSEOUT PROCEDURES
01 78 23	OPERATION AND MAINTENANCE DATA
01 78 36	WARRANTIES
01 78 39	RECORD DOCUMENTS
01 79 00	DEMONSTRATION AND TRAINING
01 99 90	REFERENCE FORMS
02 22 21	DEMOLITION
03 30 00	CAST-IN-PLACE CONCRETE
03 99 99	LINING FOR CONCRETE WASTEWATER STRUCTURES WITH ULTRA-HIGH BUILD STRUCTURAL EPOXY
05 12 00	STRUCTURAL STEEL FRAMING
08 31 23	FLOOR ACCESS DOORS
09 90 00	PAINTING
10 44 16	FIRE EXTINGUISHERS
11 90 00	WET WELL MIXING
22 05 29	PIPE HANGERS AND SUPPORTS
22 13 29	SUBMERSIBLE WASTEWATER PUMPS
23 05 13	COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT
23 05 29	HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT
23 05 53	IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT
23 05 93	TESTING, ADJUSTING, AND BALANCING FOR ODOR CONTROL
26 05 02	BASIC ELECTRICAL REQUIREMENTS
26 05 04	BASIC ELECTRICAL MATERIALS AND METHODS
26 05 05	CONDUCTORS
26 05 26	GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS
26 05 29	HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS
26 05 33	RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS
26 05 43	UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS
26 05 53	IDENTIFICATION FOR ELECTRICAL SYSTEMS

26 05 72	OVERCURRENT PROTECTIVE DEVICE SHORT CIRCUIT STUDY
26 05 73	OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY
26 05 74	OVERCURRENT PROTECTIVE DEVICE ARC FLASH STUDY
26 08 00	COMMISSIONING OF ELECTRICAL SYSTEMS
26 09 23	LOW VOLTAGE SWITCHBOARD
26 22 13	LOW VOLTAGE DISTRIBUTION TRANSFORMERS
26 24 16	PANELBOARDS
26 27 26	WIRING DEVICES
26 29 23	VARIABLE FREQUENCY DRIVES (VFDs) WITH BYPASS REDUCED VOLTAGE SOFT STARTER (RVSS)
26 32 13	ENGINE DRIVEN GENERATOR SETS
31 10 00	SITE PREPARATION
31 11 10	CLEARING AND GRUBBING
31 20 00	EARTHWORK
31 23 00	TRENCH EXCAVATION AND BACKFILL
31 25 00	EROSION AND SEDIMENTATION CONTROL
32 12 16	REMOVING AND REPLACING PAVEMENT
32 14 33	PERMEABLE PLASTIC PAVING
32 31 13	CHAIN LINK FENCES AND GATES
32 73 00	WETLANDS PROTECTION
32 91 13	SOIL PREPARATION
32 92 10	TREE REMOVAL AND PROTECTION
32 92 19	SEEDING
32 93 00	PLANTS
33 05 23	BORE AND JACK CASINGS
33 05 73	POLYETHYLENE MANHOLES
33 10 00	WATER UTILITIES
33 11 15	VALVES AND APPERTENANCES
33 30 00	SEWER AND ACCESSORIES
33 31 00	HIGH DENSITY POLYETHYLENE (HDPE) PIPE AND FITTINGS
33 32 00	PVC PIPE AND FITTINGS
33 33 00	DUCTILE IRON PIPE AND FITTINGS

33 41 13	REINFORCED CONCRETE PIPE FOR STORM DRAINS
34 41 16	TRAFFIC CONTROL
35 22 27	STAINLESS STEEL SLUICE AND SLIDE GATES
40 13 19	FIBERGLASS REINFORCED PLASTIC DUCTWORK
40 41 13	INSULATION FOR OUTDOOR PIPING
40 70 00	INSTRUMENTATION DEVICES
40 71 13	ELECTROMAGNETIC FLOWMETERS
40 90 00	INSTRUMENTATION AND CONTROL FOR PROCESS SYSTEMS
40 94 03	PROGRAMMABLE LOGIC CONTROLLER SUBSYSTEM (PLCS)
44 13 16	CARBON ADSORPTION ODOR CONTROL SYSTEM
APPENDIX A	REPORT OF GEOTECHNICAL EXPLORATION
APPENDIX B	SEISMIC REPORT

SECTION 01 11 00

SUMMARY OF WORK

PART 1 – GENERAL

1.01. SUMMARY

- A. Section includes:
 - 1. Project information.
 - 2. Work covered by Contract Documents
 - 3. Work by Owner
 - 4. Future Work
 - 5. Purchase contracts.
 - 6. Owner-furnished products.
 - 7. Contractor-furnished, Owner-installed products
 - 8. Access to site
 - 9. Coordination with occupants
 - 10. Work restrictions
 - 11. Coordination with third parties
 - 12. Specification and drawing conventions
 - 13. Alteration of quantities

1.02. PROJECT INFORMATION

- A. Project Identification: Campbellton Road Pump Station and Force Main
 - 1. Project Location: Cascade Palmetto Highway
- B. Owner: Fulton County
 - 2. Owner's Representative: Timothy Mullen, Engineering Administrator
- C. Engineer: Prime Engineering, Inc. (404)-425-7100

1.03. WORK COVERED BY CONTRACT DOCUMENTS

- A. The work of the Project is defined by the Contact Documents and consists of the following:

1. The work will consist of providing all labor, equipment and materials necessary for the construction and installation of a new sanitary sewer pump station and force main line within Fulton County.
 - a. Clearing and grubbing, civil/site work, etc.
 - b. Installation of new influent lift station, 116 LF of 16-inch, 429 LF of 24-inch, and 975 LF of 36-inch HDPE gravity sewer line and 18,837 LF of 24-inch HDPE force main.
 - c. Miscellaneous valving and piping
 - d. Odor control
 - e. Electrical work and controls
 - f. Diesel generator
 - g. Ground water well, hose bib, and eye wash
 - h. Air release and plug valves in manholes along force main route.
2. All work shall be in conformance with the Contract Documents, Drawings, and Fulton County Standards and Specifications, and the relevant government agencies Standards and Specifications.
3. Project will be constructed as a design-build contract.

1.04. WORK BY OWNER

- A. General: Cooperate fully with Owner so work may be carried out smoothly, without interfering with or delaying work under this Contract or work by Owner. Coordinate the Work of this Contract with work performed by Owner.
 1. None
- B. Preceding Work: Owner will perform the following construction operations at Project site. Those operations are scheduled to be substantially complete before work under this Contract begins.
 1. None
- C. Concurrent Work: Owner will perform the following construction operations at Project site. Those operations will be conducted simultaneously with work under this Contract.
 1. Contractor will install overhead and underground power and communications.

D. Subsequent Work: Owner will perform the following additional work at site after Substantial Completion. Completion of that work will depend on successful completion of preparatory work under this Contract.

1. None

1.05. FUTURE WORK

A. The Contract Documents include requirements that will allow Owner to carry out future work following completion of this Project; provide for the following future work:

1. Future 24-inch gravity sewer.

1.06. PURCHASE CONTRACTS

A. General: Contractor to negotiate purchase contracts with suppliers of material and equipment to be incorporated into the Work. Include costs for purchasing, receiving, handling, storage if required, and installation of material and equipment in the Contract Sum, unless otherwise noted.

B. Purchase Contracts Information:

1. None.

1.07. OWNER-FURNISHED PRODUCTS

A. Owner will furnish products indicated. The Work includes receiving, unloading, handling, storing, protecting, and installing Owner-furnished products.

B. Owner-Furnished Products:

1. Flow Meter.

1.08. CONTRACTOR-FURNISHED, OWNER-INSTALLED PRODUCTS

A. Contractor shall furnish all products indicated in the bid and contract documents. The Work includes unloading, handling, storing, and protecting Contractor-furnished products as directed and turning them over to Owner at Project closeout.

B. Contractor-Furnished, Owner-Installed Products:

1. None

1.09. ACCESS TO SITE

A. General: Contractor shall have full use of Project site for construction operations period as indicated on Drawings by the Contract limits and as indicated by requirements of this Section.

1. Roadways, Driveways, Entrances: Keep roadways and driveway entrances clear and available for owner's use. Do not use these areas for parking or storage of materials.

- a. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on site.

1.10. COORDINATION WITH OCCUPANTS

A. Partial Owner Occupancy:

- 1. Site is undeveloped, or located within existing roads or road right of ways. Contractor to coordinate with various property owners along the route in order to keep driveway access available to residents.

1.11. WORK RESTRICTIONS

A. Work Restrictions, General: Comply with restrictions on construction operations.

- 1. Comply with limitations on use of public streets and other requirements of authorities having jurisdiction.

B. On-Site Work Hours

1. Fulton County

- a. Monday through Friday: 7:00 a.m. to 5:00 p.m.
- b. Saturday: Same as weekdays except force main along any public streets shall not begin work until 8:00 a.m.
- c. Sunday: No work is to be done

2. City of Chattahoochee Hills

- a. Monday through Friday: 7:00 a.m. to 7:00 p.m.
- b. Saturday: 9:00 a.m. to 5 p.m.
- c. Sunday: No work is to be done

3. City of South Fulton

- a. Monday through Friday: 7:30 a.m. to 7:30 p.m.
- b. Saturday: 8:30 a.m. to 5 p.m.
- c. Sunday: No work is to be done

4. Hours for Utility Shutdowns: To be coordinated with utility owner

- 5. Contractor shall contact the owner when working hours are extended beyond normal business hours or when weekend construction is expected to occur. Provide 48 hours advance notification.

C. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after providing temporary utility services according to requirements indicated:

1. None.

D. Noise, Vibration, and Odors: Coordinate operations that may result in high levels of noise and vibration, odors, or other disruption to Owner occupancy or adjacent properties with Owner. Operations must be in compliance with noise ordinance within jurisdiction. Obtain Construction Manager's written permission before proceeding with disruptive operations.

E. Controlled Substances: Use of alcohol, tobacco products and other controlled substances on the Project site is not permitted.

F. Comply with Owner's requirements for I-9, drug and background screening of Contractor personnel working on Project site.

1.12. COORDINATION WITH THIRD PARTIES

A. The Contractor shall coordinate the work with third parties (such as power, natural gas, or telephone companies) in areas where such parties may have rights to underground property or facilities.

B. The Contractor shall request from involved third parties maps or other descriptive information as to the nature and location of such underground facilities or property. The Contractor shall make all necessary investigations to determine the existence and location of underground utilities.

C. The Contractor will be held responsible for any damage to and for maintenance and protection of existing utilities and structures whether or not if the utility has been located by the owner. The Contractor shall contact the utility owners and the individual property owners for the location of the utilities within the area of Work.

D. The Contractor shall coordinate the work with owners of private and public property where access is required for the performance of the work. Legal access will be acquired and provided by the Owner.

1.13. SPECIFICATION AND DRAWING CONVENTIONS

A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:

1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.

2. Specification requirements are to be performed by Contractor unless specifically stated otherwise.

B. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.

C. Drawing Coordination: Requirements for materials and products identified on the Drawings are described in detail in the Specifications. One or more of the following are used on the Drawings to identify materials and products:

1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
2. Abbreviations: Materials and products are identified by abbreviations scheduled on Drawings.
3. Keynoting: Materials and products are identified by reference keynotes referencing Specification Section numbers found in this Project Manual.

1.14. ALTERATION OF QUANTITIES

A. The Owner reserves the right to alter the quantities of work to be performed or to extend or shorten the improvements at any time when and as found necessary, and the Contractor shall perform the work as altered, increased or decreased.

1. Payment for such increased or decreased quantity will be made in accordance with the Instructions to Progressive Design-Build Contractor.
2. No allowance will be made for any change in anticipated profits nor shall such changes be considered as waiving or invalidating any conditions or provisions of the Contract and Bond.

PART 2 – MATERIALS

(NOT USED)

PART 3 – EXECUTION

(NOT USED)

END OF SECTION

SECTION 01 11 10

GEOTECHNICAL INFORMATION

PART 1 – GENERAL

1.01. SCOPE

A. The following geotechnical report document is available for review in Appendix A of these contract documents:

Report of Subsurface Exploration and Geotechnical Engineering Evaluation

Report of Geotechnical Exploration (01/08/2025)

Prepared by:

2MNext

B. The following seismic report is available for review in Appendix B of these contract documents:

Seismic Investigation

Results of Seismic Refraction Investigation (01/30/2025)

Prepared by: Geowave Solutions, Inc.

Interpretations, evaluations, and conclusions as to the nature of the geotechnical materials, the difficulties of making and maintaining the required excavations, and the difficulties of doing other work affected by geotechnical conditions shall be the sole responsibility of the Contractor. At no additional cost to the Owner, the Contractor may conduct, with Owner's approval, other investigations and tests it deems appropriate.

PART 2 – MATERIALS

(NOT USED)

PART 3 – EXECUTION

(NOT USED)

END OF SECTION

SECTION 01 11 55

CONSTRUCTION STAKING

PART 1 – GENERAL

1.01 SCOPE

A. Construction staking shall include all of the surveying work required to layout the Work and control the location of the finished Project. The Contractor shall have the full responsibility for constructing the Project to the correct horizontal and vertical alignment, as shown on the Drawings, as specified, or as ordered by the Owner. The Contractor shall assume all costs associated with rectifying work constructed in the wrong location.

B. From the information shown on the Drawings and the information to be provided as indicated under Project Conditions below, the Contractor shall:

1. Be responsible for setting reference points and/or offsets, establishment of baselines, and all other layout, staking, and all other surveying required for the construction of the Project.
2. Safeguard all reference points, stakes, grade marks, horizontal and vertical control points, and shall bear the cost of re-establishing same if disturbed.
3. Stake out the permanent and temporary easements or the limits of construction to ensure that the Work is not deviating from the indicated limits.
4. Be responsible for all damage done to reference points, baselines, center lines and temporary bench marks, and shall be responsible for the cost of re-establishment of reference points, baselines, center lines and temporary bench marks as a result of the operations.
5. Ensure station numbers are visible for pipeline installation so construction manager can field verify.

C. Baselines shall be defined as the line to which the location of the Work is referenced including, but not limited to, edge of pavement, road centerline, property line, right of way or survey line.

D. Record Drawing surveys shall be performed in accordance with Section 01 78 39 of these Specifications.

1.02 PROJECT CONDITIONS

A. The Drawings provide the location and/or coordinates of principal components of the Project. The alignment of some components of the Project may be indicated in the Specifications. The Owner may order changes to the location of some of the

components of the Project or provide clarification to questions regarding the correct alignment.

B. The survey points, control points, and baseline to be provided to the Contractor shall be limited to only that information which can be found on the Project site by the Contractor.

C. A topographic survey is included on the Drawings.

1.03 QUALITY ASSURANCE

A. The Contractor shall furnish documentation, prepared by a surveyor currently registered in the State of Georgia, confirming that staking is being done to the horizontal and vertical alignment shown in the Contract Documents. This requires that the Contractor hire, at the Contractor's own expense, a currently registered surveyor, acceptable to the Owner, to provide ongoing construction staking or confirmation of such.

B. Any deviations from the Drawings shall be confirmed by the Owner prior to construction of that portion of the Project.

C. Quantities for payments measured under this Contract shall be certified by the registered surveyor.

1.04 SANITARY SEWERS

A. Staking Precision: The precision of construction staking required shall be that which the correct location of the sanitary sewer, manholes and other appurtenances can be established for construction and verified by the Owner.

B. Reference Points

1. Reference points shall be placed, at or no more than three feet, from the outside of the construction easement or right of way. The location of the reference points shall be recorded in a log with a copy provided to the Owner for use, prior to verifying reference point locations.

2. Distances shall be accurately measured to 0.01 foot.

3. The Contractor shall give the Owner reasonable notice that reference points are set. The reference point locations must be verified by the Owner prior to commencing clearing and grubbing operations.

PART 2 – MATERIALS

(NOT USED)

PART 3 – EXECUTION

(NOT USED)

END OF SECTION

SECTION 01 11 80

ENVIRONMENTAL CONDITIONS

PART 1 – GENERAL

1.01 ENVIRONMENTAL CONDITIONS

A. This section describes the environmental conditions which have been observed at the site of the Work and which may reasonably be anticipated throughout the life of the project.

1.02 CLIMATE CONDITIONS

A. The site of the Work is at an elevation of approximately 700 feet to 850 feet above mean sea level.

B. Climate conditions are described as follows:

Description	Range of Conditions
Winter	Cool and damp
Summer	Hot and humid
Relative humidity, percent	
Indoors	20 to 90
Average outdoors	20 to 100
Air temperature, degrees F	
Outdoors	15 to 105
Indoors	30 to 105
Barometric pressure, inches, mercury	29.1 to 31.0

1.03 ADDITIONAL CONDITIONS

A. Additional conditions which may be applicable are specified in other sections.

PART 2 – MATERIALS

(NOT USED)

PART 3 – EXECUTION

(NOT USED)

END OF SECTION

SECTION 01 14 13

INSPECTION OF WORK

PART 1 – GENERAL

1.01 ENGINEER'S INSPECTION (SHALL ALSO APPLY TO OWNER)

- A. The Engineer shall have the right of access to and inspection of the work at all times. Materials, equipment and products shall be subject to the Engineer's review as specified herein.
- B. The Engineer is responsible for general surveillance of the work on behalf of the Owner. The Engineer is not responsible for construction means, methods, sequences, or procedures or for safety precautions and programs in connection with the work. The Engineer is not responsible for supervision of the work and shall not give instruction to the Contractor's personnel as to methods of execution of the work. The Engineer is not responsible for the Contractor's failure to carry out the work in accordance with the Contract Documents.

1.02 CONTRACTOR'S DUTIES

- A. The Contractor is responsible for all materials, equipment, methods, and procedures in execution of the work.
- B. The Contractor shall correct to the satisfaction of the Engineer any work or material found to be defective or of deficient quality. Such corrections shall be made by the Contractor at no additional expense to the Owner.

1.03 RIGHT OF ENTRY

- A. Any government representative or other individual identified by the Owner shall have access to the work wherever it is in preparation or progress. The Contractor shall provide proper facilities for such access and inspection.

END OF SECTION

SECTION 01 14 16

OCCUPANCY

PART 1 – GENERAL

1.01 PARTIAL OCCUPANCY BY OWNER

A. Whenever, in the opinion of the Construction Manager, any section or portion of the Work or any structure is in suitable condition, it may be put into use upon the written order of the Construction Manager and such usage will not be held in any way as an acceptance of said Work or structure, or any part thereof, or as a waiver of any of the provisions of these Specifications and the Contract.

B. Pending final completion and acceptance of the Work, all necessary repairs and replacements, due to defective materials or workmanship or operations of the Contractor, for any section of the Work so put into use shall be performed by the Contractor at Contractor's own expense.

PART 2 – MATERIALS

(NOT USED)

PART 3 – EXECUTION

(NOT USED)

END OF SECTION

SECTION 01 22 00

MEASUREMENT AND PAYMENT

PART 1 - GENERAL

1.01 PAYMENTS

A. This Section identifies each Measurement for Payment outlined in the Proposal and describes the methods by which payments shall be based.

1.02 PAYMENT ITEMS

A. Lump Sum Bid Items:

1. THE MAJORITY OF THIS PROJECT SHALL BE BID AS A "PROGRESSIVE DESIGN-BUILD", unless specified as a separate bid item or as Owner Directed Allowance. Lump sum bid items shall include furnishing all labor, equipment, and materials necessary for construction of the work as described in the specifications and shown on the Drawings as indicated in the Bid Proposal. Alterations to the Construction Contract will be based on negotiated additions or deletions to the Base Contract, and the Progressive Design-Build Contractor shall receive no additional compensation for times covered under this scope. The Contractor shall be paid for actual work performed.
2. The Contractor shall submit to Fulton County for approval a Schedule of Values and a Schedule of Work that breaks down itemized costs associated with the work. The Schedule of Values will be used for completed work verification and payment purposes on the monthly Payment Applications.
3. The Owner shall withhold as retainage 5% of the Payments requested up until final completion of the project and all Punch list items are resolved.
4. Owner reserves the right to reject the Contractor's measure of work-in-place which involves the use of established unit prices, and at Owner's expense to have the work measured by independent surveyor acceptable to the Contractor.
5. For work items included in the technical specifications and not listed herein, such work shall be considered part of or incidental to its related work.
6. When actual field conditions differ from assumed design conditions and result in a reduction in materials, equipment, and appurtenances to be installed, a negative adjustment will be made to the Contract. If items are provided on the bid form these items will be used for adjustment.
7. The Contractor shall furnish all labor, materials, machinery, equipment, tools, apparatus, services, and other necessary supplies to perform all work

Section 4
Scope of Work and Technical Specifications
SECTION 01 22 00-2 MEASUREMENT AND PAYMENT

shown on the Drawings and/or described in the Specifications and Summary of Work at the price listed in the Bid Form. The Work shall be complete-in-place and ready for operation.

8. Any cost associated with initial testing and startup of new equipment shall be the responsibility of the Contractor.

9. The Contractor shall become familiar with the terms and conditions of the Bidding Documents and with local conditions affecting the performance and costs of the Work at the place where the Work is to be completed, and has fully inspected the site in all particulars informing himself fully regarding all conditions pertaining to the Work site.

1.03 OWNER ALLOWANCES

A. Owner directed allowances shall be pre-approved in writing by the assigned Fulton County Construction Manager. As many as 3 quotes may be requested by the County on any one of these items. Work performed under Owner directed allowances and not performed by the Prime Contractor or the Prime Contractor's immediate subcontractor can have a 10% markup for administrative costs when billed under this item. Any Work performed under and cost related to The Owner Allowances Section must be pre-approved in writing by the assigned Fulton County Construction Manager. No payment shall be made for work done without preauthorization and approval.

END OF SECTION

SECTION 01 30 10

PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes administrative provisions for coordinating construction operations on the Project including, but not limited to, the following:

1. Administrative and supervisory personnel.
2. Project meetings.

1.02 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.03 COORDINATION

A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations, included in different Sections that depend on each other for proper installation, connection, and operation.

B. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.

1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.

C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities and activities of other contractors to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:

1. Preparation of Contractor's Construction Schedule.
2. Preparation of the Schedule of Values.
3. Installation and removal of temporary facilities and controls.
4. Delivery and processing of submittals.
5. Progress meetings.
6. Pre-installation conferences.
7. Startup and adjustment of systems.

8. Project closeout activities.

1.04 ADMINISTRATIVE AND SUPERVISORY PERSONNEL

A. General: In addition to Project superintendent, provide other administrative and supervisory personnel as required for proper performance of the Work.

1. Include special personnel required for coordination of operations with other contractors.

1.05 PROJECT MEETINGS

A. General: Schedule and conduct meetings and conferences at Project site, unless otherwise indicated.

1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Engineer of scheduled meeting dates and times.
2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
3. Minutes: Contractor shall record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Engineer, within one (1) week of the meeting. At that time any comments, corrections to be noted by participants before Owner approving final minutes.

B. Preconstruction Conference: Owner/Engineer shall schedule a preconstruction conference before starting construction, at a time convenient to Owner, Contractor, and Engineer, but no later than twenty (20) days after execution of the Agreement. Hold the conference at Project site or another convenient location. Conduct the meeting to review responsibilities and personnel assignments.

1. Attendees: Authorized representatives of Owner, Construction Manager, Engineer, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.

2. Agenda: Discuss items of significance that could affect progress.

C. Progress Meetings: Conduct progress meetings at monthly intervals (unless changed during Preconstruction Meeting).

1. Attendees: In addition to representatives of Owner and Engineer, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities

Section 4
Scope of Work and Technical Specifications
SECTION 01 30 10-3 PROJECT MANAGEMENT AND COORDINATION

shall be represented at these meetings. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.

2. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.

a. Contractor's Construction Schedule

b. Review present and future needs of each entity present, including the following:

- 1) Interface requirements.
- 2) Sequence of operations.
- 3) Status of submittals.
- 4) Deliveries.
- 5) Access.
- 6) Site utilization.
- 7) Temporary facilities and controls.
- 8) Work hours.
- 9) Safety hazards and risks.
- 10) Progress cleaning.
- 11) Quality and work standards.
- 12) Status of correction of deficient items.
- 13) Field observations.
- 14) Requests for interpretations (RFIs).
- 15) Status of proposal requests.
- 16) Pending changes.
- 17) Status of Change Orders.
- 18) Pending claims and disputes.
- 19) Documentation of information for payment requests

D. Coordination Meetings: Conduct Project coordination meetings prior to any major facility shutdown, tie-ins, or major equipment startup. Project coordination meetings are

Section 4
Scope of Work and Technical Specifications
SECTION 01 30 10-4 PROJECT MANAGEMENT AND COORDINATION

in addition to specific meetings held for other purposes, such as progress meetings and pre-installation conferences.

1. Attendees: In addition to representatives of Owner and Engineer, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
2. Agenda: Review and correct or approve minutes of the previous coordination meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to the status of the Project.
 - a. Interface requirements.
 - b. Sequence of operations.
 - c. Status of submittals.
 - d. Deliveries.
 - e. Access.
 - f. Site utilization.
 - g. Temporary facilities and controls.
 - h. Work hours.
 - i. Hazards and risks.
 - j. Quality and work standards.
 - k. Change Orders.
 - l. Safety.
3. Reporting: Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.

PART 2 PRODUCTS

(NOT USED)

PART 3 EXECUTION

(NOT USED)

END OF SECTION

SECTION 01 31 19
PROJECT MEETINGS

PART 1 - GENERAL

1.01 SCOPE

A. Work under this Section includes all scheduling and administering of pre-construction and progress meetings as herein specified and necessary for the proper and complete performance of this Work.

B. Scheduling and Administration by Engineer

1. Prepare agenda
2. Make physical arrangements for the meetings
3. Preside at meetings
4. Record minutes and include significant proceedings and decisions
5. Distribute copies of the minutes to attendees

1.02 PRE-CONSTRUCTION CONFERENCE

A. The Engineer shall schedule the pre-construction conference prior to the issuance of the Notice to Proceed.

B. Representatives of the following parties are to be in attendance at the meeting:

1. Owner
2. Design Team
3. Contractor and superintendent
4. Major subcontractors

C. The agenda for the pre-construction conference shall consist of the following as a minimum:

1. Distribute and discuss a list of major subcontractors and a tentative construction schedule
2. Critical work sequencing
3. Designation of responsible personnel and emergency telephone numbers
4. Processing of field decisions and change orders
5. Adequacy of distribution of Contract Documents

6. Schedule of submittal of shop drawings, product data and samples
7. Pay request format, submittal cutoff date, pay date and retainage
8. Procedures for maintaining record documents
9. Use of premises, including office and storage areas and Owner's requirements
10. Major equipment deliveries and priorities
11. Safety and first aid procedures
12. Security procedures
13. Housekeeping procedures
14. Workhours
15. Project Safety

1.03 PROJECT COORDINATION MEETINGS

- A. Schedule regular monthly meetings as directed by the Engineer.
- B. Hold called meetings as progress of the work dictates.
- C. The meetings shall be held at the location indicated in the notice.
- D. Representatives of the following parties are to be in attendance at the meetings:
 1. Engineer
 2. Contractor and superintendent
 3. Major subcontractors as pertinent to the agenda
 4. Owner's representative as appropriate
- E. The minimum agenda for progress meetings shall consist of the following:
 1. Review and approve minutes of previous meetings
 2. Review work progress since last meeting
 3. Note field observations, problems and decisions
 4. Identify problems which impede planned progress
 5. Review off-site fabrication problems
 6. Review Contractor's corrective measures and procedures to regain plan schedule

Section 4
Scope of Work and Technical Specifications
SECTION 01 31 19-3 PROJECT MEETINGS

7. Review Contractor's revision to the construction schedule as outlined in the Supplementary Conditions
8. Review submittal schedule; expedite as required to maintain schedule
9. Maintenance of quality and work standards
10. Review changes proposed by the Owner for their effect on the construction schedule and completion date
11. Complete other current business

PART 2 - PRODUCTS

(Not Used)

PART 3 - EXECUTION

(Not Used)

END OF SECTION

SECTION 01 32 00

CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:

1. Contractor's Construction Schedule.
2. Submittals Schedule.
3. Field condition reports.
4. Special reports.
5. Schedule of Values.

1.02 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.03 SUBMITTALS

A. Submittals Schedule: Arrange the following information in a tabular format:

- B. Scheduled date for first submittal.
- C. Specification Section number and title.
- D. Description of the Work covered.

1. Contractor's Construction Schedule: Submit three (3) opaque copies of the initial schedule, large enough to show the entire schedule for the entire construction period.
2. Field Condition Reports: Submit two (2) copies at the time of discovery of differing conditions.

E. Special Reports: Submit two (2) copies at the time of an unusual event.

1.04 COORDINATION

A. Coordinate preparation and processing of schedules and reports with the performance of construction activities and with the scheduling and reporting of separate contractors.

B. Coordinate the Contractor's Construction Schedule with the Schedule of Values, list of subcontracts, Submittals Schedule, progress reports, payment requests, and other required schedules and reports.

1. Secure time commitments for performing critical elements of the work from parties involved.
2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

PART 2 - PRODUCTS

2.01 SUBMITTALS SCHEDULE

A. Preparation: Submit a schedule of submittals, arranged in chronological order by dates required by the construction schedule. Include time required for review, resubmittal, ordering, manufacturing, fabrication, and delivery when establishing dates.

1. Coordinate Submittals Schedule with the list of subcontracts, the Schedule of Values, and the Contractor's Construction Schedule.
2. Initial Submittal: Submit concurrently with the preliminary bar-chart schedule. Include submittals required and the submittal schedule during the first 90 days of construction. List those required to maintain the orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.
 - a. At the Owner's request, show submittals on the Preliminary Construction Schedule instead of tabulating them separately.
3. Final Submittal: Submit concurrently with the first complete submittal of the Contractor's Construction Schedule 30 days after the issuance of the Notice to Proceed.

2.02 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

A. Time Frame: Extend schedule from the date established in the Notice to Proceed to the date of Final Completion.

B. Milestones: Include milestones indicated in the Contract Documents in the schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and Final Completion, and the following interim milestones:

1. Major Equipment Deliveries
2. Shutdowns and Tie-ins
3. Administrative
4. Submittals

Section 4
Scope of Work and Technical Specifications
SECTION 01 32 00-3 CONSTRUCTION PROGRESS DOCUMENTATION

5. Procurement
6. Construction (by sequences)
7. Allowances

2.03 SPECIAL REPORTS

- A. General: Submit special reports directly to the Construction Manager & Engineer within one day of an occurrence. Distribute copies of the report to parties affected by the occurrence.
- B. Reporting Unusual Events: When an event of an unusual and significant nature occurs at the Project site, whether or not related directly to the Work, prepare and submit a special report. List chain of events, persons participating, response by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Engineer and Owner in advance when these events are known or predictable.

PART 3 - EXECUTION

3.01 CONTRACTOR'S CONSTRUCTION SCHEDULE

- A. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one week before each regularly scheduled progress meeting.
 1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
 2. As the Work progresses, indicate Actual Completion percentage for each activity.
- B. Distribution: Distribute copies of the approved schedule to the Engineer, Owner, and other parties identified by the Contractor with a need-to-know responsibility.
 1. When revisions are made, distribute updated schedules to the same parties. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in the performance of construction activities.

END OF SECTION

SECTION 01 32 16

CONSTRUCTION SCHEDULES

PART 1 – GENERAL

1.01 SCOPE

- A. The work under this Section includes preparing, furnishing, distributing, and periodic updating of the construction schedules as specified herein.
- B. The purpose of the schedule is to demonstrate that the Contractor can complete the overall Project within the Contract Time and meet all required interim milestones.
- C. The schedule also provides a basis for determining the progress status of each phase and the Project relative to specific dates and completion time.

1.02 DESCRIPTION

- A. The Contractor shall provide a graphic construction schedule prepared by the critical path method of analysis. The critical path schedule shall be prepared from estimates of the required duration and sequence for each item of work and function to be performed.
- B. A general guide for preparing such a schedule is contained in "The Use of CPM in Construction, A Manual for Contractors," published by the Associated General Contractors of America.
- C. Tabulation and analysis of the work schedule shall be performed by computer using a commercially available critical path software program. In addition to the capability to produce tabular reports, the computer software shall plot the construction schedule after the Contractor has produced it in draft form as required by paragraph 1.03 Submittals.
- D. The schedule shall depict all significant construction activities and all items of work listed in the breakdown of contract prices submitted by the Contractor in accordance with the General Conditions of the Contract Documents. The dependencies between activities shall be indicated so that it may be established what effect the progress of any one activity has on the schedule.
- E. No activity on the schedule shall have a duration longer than 21 days or assigned value greater than \$100,000, except activities comprising only fabrication, and delivery may extend for more than 21 days. Activities which exceed these limits shall be divided into more detailed components. The schedule duration of each activity shall be based on the work being performed during the normal 40-hour workweek with allowances made for legal holidays and normal weather conditions.

1.03 SUBMITTALS

- A. Overall Project Schedule (OPS)
 - 1. Submit the schedule within 10 days after date of the Notice to Proceed.
 - 2. The OPS schedule shall identify various critical project milestones, in order to address the public and activities within the project's area.
 - 3. The Construction Manager will review the schedule and return it within 10 days after receipt.
 - 4. If required, resubmit within 10 days after receipt of a returned copy.
- B. Near Term Schedule (NTS)
 - 1. Submit the first Near Term Schedule within 10 days of the Notice to Proceed.
 - 2. The Construction Manager will review the schedule and return it within 10 days after receipt.
- C. Submit an update of the OPS and NTS with each progress payment request.
- D. Submit the number of copies required by the Contractor, plus four copies to be retained by the Construction Manager.

1.04 APPROVAL

- A. Approval of the Contractor's detailed construction program and revisions thereto shall in no way relieve the Contractor of any of Contractor's duties and obligations under the Contract.
- B. Approval is limited to the format of the schedule and does not in any way indicate approval of, or concurrence with, the Contractor's means, methods and ability to carry out the work.

1.05 OVERALL PROJECT SCHEDULE (OPS)

- A. The Contractor shall submit to the Construction Manager for approval a detailed Overall Project Schedule of the Contractor's proposed operations for the duration of the Project. The OPS shall be in the form of a Gantt/bar chart. Primavera P6 shall be used to produce this Gantt/bar chart.
- B. Gantt/Bar Chart Schedule
 - 1. Each activity with a duration of five or more days shall be identified by a separate bar. Activities with a duration of more than 21 days shall be sub-divided into separate activities.

2. The schedule shall include activities for shop drawing preparation and review, fabrication, delivery, and installation of major or critical path materials and equipment items. .
3. The schedule shall show the proposed start and completion date for each activity. A separate listing of activity start and stop dates and working day requirements shall be provided unless the information is shown in text form on the Gantt/bar chart.
4. The schedule shall identify the Notice to Proceed date, the Contract Completion date, major milestone dates, and a critical path.
5. The schedule shall be printed on a maximum 11 x 17-inch size paper. If the OPS needs to be shown on multiple sheets, a simplified, one page, summary bar chart showing the entire Project shall be provided.
6. The schedule shall have a horizontal time scale based on calendar days and shall identify the Monday of each week.
7. The schedule shall show the precedence relationship for each activity.

1.06 NEAR TERM SCHEDULE (NTS)

- A. The Contractor shall develop and refine a detailed Near Term Schedule showing the day to day activities with committed completion dates which must be performed during the upcoming 30 day period. The detailed schedule shall represent the Contractor's best approach to the Work which must be accomplished to maintain progress consistent with the Overall Project Schedule.
- B. The Near Term Schedule shall be in the form of Gantt/bar chart and shall include a written narrative description of all activities to be performed and describe corrective action to be taken for items that are behind schedule.

1.07 SCHEDULE REVISIONS

- A. Revisions to the accepted critical path construction schedule may be made only with written approval of the Owner.
- B. Changes in timing for activities which are not on the critical path may be modified with written agreement of the Contractor and Construction Manager.
- C. A change affecting the contract value of any activity, the timing of any activity on the critical path, the completion time and specific dates as specified in the Contract Documents, and work sequencing may be made only in accordance with applicable provisions of the General Conditions of the Contract Documents.

1.08 UPDATING

Section 4
Scope of Work and Technical Specifications
SECTION 01 32 16-4 CONSTRUCTION SCHEDULES

- A. Project status review and update shall be provided each month as specified in the General Conditions of the Contract Documents.
- B. Show all changes occurring since previous submission of the updated schedule.
- C. Indicate progress of each activity and show actual completion dates.
- D. The Contractor shall be prepared to provide a narrative report at the Project Coordination Meetings. The report shall include the following:
 - 1. A description of the overall Project status and comparison to the OPS.
 - 2. Identify activities which are behind schedule and describe corrective action to be taken.
 - 3. A description of changes or revisions to the Project and their effect on the OPS.
 - 4. A description of the Near Term Schedule of the activities to be completed during the next 30 days. The report shall include a description of all activities requiring participation by the Construction Manager and/or Owner.

PART 2 – MATERIALS

(NOT USED)

PART 3 – EXECUTION

(NOT USED)

END OF SECTION

SECTION 01 32 33

CONSTRUCTION VIDEOS AND PHOTOGRAPHS

PART 1 – GENERAL

1.01 SCOPE

- A. The Contractor shall furnish all equipment and labor materials required to provide the Owner with digital construction videos and photographs of the Project.
- B. Videos and photographs shall be provided on a virus free flash drive.
- C. Photograph and video files shall become the property of the Owner and none of the photographs herein shall be published without express permission of the Owner.

1.02 PRE-CONSTRUCTION VIDEOS AND PHOTOGRAPHS

- A. The Contractor shall provide preconstruction photographs and videos prior to commencement of work on the site. The documentation shall be digital and shall indicate the date, name of project, direction in which the images were taken (by compass point), vantage point and the location where the images were taken. Video identification to show name of project, date of video recording, description of vantage point, indicating location, direction (by compass point) and elevation.
- B. A minimum of 50 photographs shall be taken prior to construction including a video of the entire route.
- C. Before construction may start, digital copies of the documentation shall be delivered on a flash drive to the Owner.
- D. The Contractor shall document the entire area of proposed construction and site entries and access roads from multiple perspectives, including existing gravel and paved roads.
- E. All conditions which might later be subject to disagreement shall be shown in sufficient detail to provide a basis for decisions.
- F. The pre-construction photographs shall be submitted to the Owner within 28 calendar days after the date of receipt by the Contractor of Notice to Proceed.

1.03 PROGRESS PHOTOGRAPHS AND SUBMITTALS

- A. The Contractor shall provide digital construction images showing the progress of the work on a monthly basis.
- B. Starting immediately after the date of the preconstruction documentation and continuing as long as the work is in progress, construction photographs shall be taken.

Section 4
Scope of Work and Technical Specifications
SECTION 01 32 33-2 CONSTRUCTION VIDEOS AND PHOTOGRAPHS

- C. Photographs shall be taken to document completely the ongoing work, points of site entry and access roads.
- D. A minimum of 20 photographs shall be taken each month including a video of the route.
- E. Additional photographs shall be taken and be of such subjects as may be directed by the Owner.
- F. All photographs shall indicate the date, job title and brief description of the image(s), including the location and direction the image was taken.
- G. A final set of aerial photographs shall be taken once all grassing has been established.
- H. Photographs should be provided on a virus free flash drive with each payment application. In addition, one hard copy of each photograph shall be submitted. Failure to include photographs may be cause for rejection of the payment request.
- I. If software is used to organize, store and describe the photos, a copy of the software and all relevant updates shall be supplied to both the Owner and the Owner by the Contractor, at no additional cost to Owner.
- J. Progress photograph and video files shall be provided on flash drive as well as hard copies for photographs.
- K. The file name of each photograph shall at a minimum contain the date the photograph was taken. All photographs shall be labeled to indicate date, time taken, and description of work shown.

1.04 COMPLETION DIGITAL PHOTOGRAPHS AND VIDEO

- A. Following completion of the work, photographs and videos shall be made showing the same areas and features as in the pre-construction photographs.
- B. The Contractor shall provide one (1) set of completion photographs after Substantial Completion has been achieved.
- C. The photographs shall be digital, and shall indicate the date, name of project, direction in which the photograph was taken and the location where the photograph was taken.
- D. A minimum of 50 photographs shall be taken at project completion including a video of the entire pipeline route.
- E. Before Final Completion and acceptance of the project, digital copies of the photographs shall be delivered on a flash drive to the Owner.
- F. The Contractor shall photograph all of the constructed work, the entire area of construction and all site entries and access roads from multiple perspectives.

Section 4
Scope of Work and Technical Specifications
SECTION 01 32 33-3 CONSTRUCTION VIDEOS AND PHOTOGRAPHS

G. Post construction photographs and videos with date stamp shall be provided prior to final acceptance of the Project.

PART 2 – MATERIALS

(NOT USED)

PART 3 – EXECUTION

(NOT USED)

END OF SECTION

SECTION 01 33 00

SUBMITTALS

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.

B. Verification of Submitted Material: Verify field measurements, field construction criteria, catalog numbers, and similar data, including those by subcontractors, prior to submission.

1. Contractor's responsibility for errors and omissions in submittals is not relieved by Engineer's review of submittals.

2. By approving and submitting shop drawings, samples, or other product data, Contractor represents that he has determined and verified all field measurements, field construction criteria, materials, catalog numbers, and similar data. Further, the Contractor represents that he has checked and coordinated submittals with the requirements of the project and the Contract Documents.

C. Deviations: Notify the Engineer and Construction Manager, in writing at the time of submission, of deviations in submittals from the requirements of the Contract Documents, and submit written justification of the proposed deviations in letter form as an attachment to the appropriate submittal. Deviations must be pre-approved by the Construction Manager.

D. Begin no work that requires submittals until return of submittals with Engineer's stamp and initials or signature indicating "No Exceptions Taken", "Make Corrections Noted", or "Note Markings".

E. Project work, materials, fabrication, and installation shall conform to the final reviewed and returned submittal.

1.02 DEFINITIONS

A. Action Submittals: Written and graphic information and physical samples that require Engineer's responsive action.

B. Informational Submittals: Written and graphic information and physical samples that do not require Engineer's responsive action. Submittals may be rejected for not complying with requirements.

PART 2 - PRODUCTS

2.01 ACTION SUBMITTALS

- A. General: Prepare and submit Action Submittals required by individual Specification Sections.
- B. All submittals shall be sent to Fulton County Construction Project Manager via designated software. All Submittals will be processed to Engineer for review and approval.
- C. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
 - 1. If information must be specially prepared for submittal because standard printed data are not suitable for use, submit as Shop Drawings, not as Product Data.
 - 2. Mark each copy of each submittal to show which products and options are applicable.
 - 3. Include the following information, as applicable:
 - a. Manufacturer's written recommendations.
 - b. Manufacturer's product specifications.
 - c. Manufacturer's installation instructions.
 - d. Standard color charts.
 - e. Manufacturer's catalog cuts.
 - f. Wiring diagrams showing factory-installed wiring.
 - g. Printed performance curves.
 - h. Operational range diagrams.
 - i. Mill reports.
 - j. Standard product operation and maintenance manuals.
 - k. Compliance with specified referenced standards.
 - l. Testing by recognized testing agency.
 - m. Application of testing agency labels and seals.
 - n. Notation of coordination requirements.
 - o. Include a marked up copy of each relevant specification(s) indicating compliance or exception to each part of the specification.
 - 4. Submit Product Data before or concurrent with Samples.

5. Number of Copies: The Contractor shall submit to the Engineer enough copies for his/her use plus three (3) additional copies for the Engineer to distribute to the Owner and Field Representative.

D. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.

1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:

- a. Dimensions.
- b. Identification of products.
- c. Fabrication and installation drawings.
- d. Roughing-in and setting diagrams.
- e. Wiring diagrams showing field-installed wiring, including power, signal, and control wiring.
- f. Shopwork manufacturing instructions.
- g. Templates and patterns.
- h. Schedules.
- i. Design calculations.
- j. Compliance with specified standards.
- k. Notation of coordination requirements.
- l. Notation of dimensions established by field measurement.
- m. Relationship to adjoining construction clearly indicated.
- n. Seal and signature of professional engineer if specified.
- o. Wiring Diagrams: Differentiate between manufacturer-installed and field-installed wiring.

2. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches but no larger than 24 by 36 inches.

E. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.

1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
2. Identification: Attach label on unexposed side of Samples that includes the following:
 - a. Generic description of Sample.
 - b. Product name and name of manufacturer.
 - c. Sample source.
 - d. Number and title of appropriate Specification Section.
3. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
 - a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
 - b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of the Contractor.
4. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.
 - a. Number of Samples: Submit 3 full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from the manufacturer's product line. The Engineer will return submittal with options selected.
5. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from the same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
 - a. Number of samples: Submit one Sample to be retained at the Project site.

- 1) Submit a single Sample where assembly details, workmanship, fabrication, techniques, connections, operation and other similar characteristics are to be demonstrated

PART 3 - EXECUTION

3.01 SUBMITTAL PROCEDURES

- A. General: Electronic copies of CAD Drawings of the Contract Drawings will not be provided by the Engineer for Contractor's use in preparing submittals.
- B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
- C. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
- D. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.
- E. Engineer reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
- F. Submittals Schedule: Make all submittals far enough in advance of scheduled dates for installation so as to provide time for reviews, securing necessary approvals, possible revision and resubmittal, and placing orders and securing delivery.
- G. For each submittal for review, allow 14 days excluding delivery time to and from Contractor.
- H. Resubmittal Review: Allow the same amount of days for review of each resubmittal as for the initial review.
- I. Sequential Review: Where sequential review of submittals by Engineer, Owner, or other parties is indicated, allow 21 days for initial review of each submittal.
- J. Identify variations in Contract Documents and product or system limitations that may be detrimental to successful performance of completed Work.
- K. Submittal Identification numbering system: The Contractor shall utilize and shop drawing submittal identification numbering system in the following manner:
 1. Each submittal shall be sequentially numbered beginning with one (1) through the last submittal number. Re-submittals shall list the prior submittal number followed by "Rev" and the revision number.
 2. The next six (6) to nine (9) digits shall be the applicable Specification section number.

3. The next submittal identification shall be the submittal title.
 4. A typical submittal number would be as follows:
 - a. "10-312316.13-Excavation Protection Plan" – Initial Submittal
 - b. "10Rev1-312316.13-Excavation Protection Plan" – First Resubmittal
 5. Requests for information (RFIs) shall utilize the identification numbering system as shop drawings except RFIs will have a separate sequential numbering system.
- L. Identification: Place a cover page or title block on each submittal for identification.
1. Indicate name of firm or entity that prepared each submittal on cover page or title block.
 2. Submittal identification number.
 3. Provide a space to record Contractor's review and approval markings and action taken by Engineer.
 4. Include the following information on stamp for processing and recording action taken:
 - a. Project name.
 - b. Date.
 - c. Name and address of Engineer.
 - d. Name and Address of Contractor.
 - e. Name of manufacturer.
 - f. Other necessary identification.
- M. When revised for resubmission, identify changes made since previous submission.
- N. Resubmittals: Make resubmittals in the same form and number of copies as the initial submittal.
1. Resubmit submittals until they are marked:
 - a. "No Exceptions Taken"
 - b. "Make Corrections Noted"
 - c. "Note Markings"

d. "Amend and Resubmit"

O. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities.

P. Use for Construction: Use only final submittals with mark indicating action taken by Engineer as noted above.

Q. Submittals not requested will not be recognized nor processed.

R. Incomplete Submittals: Engineer will not review. Complete submittals for each item are required. Delays resulting from incomplete submittals are not the responsibility of Engineer or Owner.

END OF SECTION

SECTION 01 33 23

SHOP DRAWINGS, PRODUCT DATA AND SAMPLES

PART 1 – GENERAL

1.01 SCOPE

A. Work under this Section includes submittal to the Construction Manager of shop drawings, product data and samples required by the various sections of these Specifications.

B. Submittal Contents: The submittal contents required are specified in each section.

C. Definitions: Submittals are categorized as follows:

1. Shop Drawings

a. Shop drawings shall include technical data, drawings, diagrams, procedure and methodology, performance curves, schedules, templates, patterns, test reports, calculations, instructions, measurements and similar information as applicable to the specific item for which the shop drawing is prepared.

b. Provide newly prepared information, on reproducible sheets, with graphic information at accurate scale (except as otherwise indicated) or appropriate number of prints hereof, with name or preparer (firm name) indicated.

c. The Contract Drawings shall not be traced or reproduced by any method for use as or in lieu of detail shop drawings.

d. Show dimensions and note dimensions that are based on field measurement.

e. Identify materials and products in the work shown. Indicate compliance with standards and special coordination requirements.

f. Do not allow shop drawings to be used in connection with the Work without appropriate final "Action" markings by the Construction Manager.

g. Drawings shall be presented in a clear and thorough manner. Details shall be identified by reference to sheet and detail, specification section, schedule or room numbers shown on the Contract Drawings.

h. Minimum assembly drawings sheet size shall be 22 x 34 inches.

i. Minimum detail sheet size shall be 8 1/2 x 11 inches.

Section 4
Scope of Work and Technical Specifications
SECTION 01 33 23-2 SHOP DRAWINGS, PRODUCT DATA AND SAMPLES

- j. Minimum Scale:
 - 1) Assembly Drawings Sheet, Scale: 1 inch = 30 feet.
 - 2) Detail Sheet, Scale: 1/4 inch = 1 foot.

2. Product Data

- a. Product data includes standard printed information on materials, products and systems, not specially prepared for this Project, other than the designation of selections from among available choices printed therein.
- b. Collect required data into one submittal for each unit of work or system, and mark each copy to show which choices and options are applicable to the Project.
- c. Include manufacturer's standard printed recommendations for application and use, compliance with standards, application of labels and seals, notation of field measurements which have been checked and special coordination requirements.

3. Samples

- a. Samples include both fabricated and unfabricated physical examples of materials, products and units of work, both as complete units and as smaller portions of units of work, either for limited visual inspection or, where indicated, for more detailed testing and analysis.
- b. Provide units identical with final condition of proposed materials or products for the work.
 - 1) Include "range" samples, not less than three units, where unavoidable variations must be expected, and describe or identify variations between units of each set.
 - 2) Provide full set of optional samples where the Construction Manager's selection is required.
 - 3) Prepare samples to match the Construction Manager's sample where indicated.
 - 4) Information with each sample to show generic description, source or product name and manufacturer, limitations and compliance with standards.
 - 5) Samples are submitted for review and confirmation of color, pattern, texture and "kind" by the Construction Manager.

Section 4
Scope of Work and Technical Specifications
SECTION 01 33 23-3 SHOP DRAWINGS, PRODUCT DATA AND SAMPLES

6) Construction Manager will note "test" samples, except as otherwise indicated, for other requirements, which are the exclusive responsibility of the Contractor.

4. Miscellaneous submittals related directly to the Work (non-administrative) warranties, maintenance agreements, workmanship bonds, project photographs, survey data and reports, physical work records, statements of applicability, quality testing and certifying reports, copies of industry standards, record drawings, field measurement data, operating and maintenance materials, overrun stock, security/protection/safety keys and similar information, devices and materials applicable to the Work but not processed as shop drawings, product data or samples.

1.02 SPECIFIC CATEGORY REQUIREMENTS

A. General: Except as otherwise indicated in the individual work sections, comply with general requirements specified herein for each indicated category of submittal.

Submittals shall contain:

1. The date of submittal and the dates of any previous submittals.
2. The Project title.
3. Numerical submittal numbers, starting with 1.0, 2.0, etc. Revisions to be numbered 1.1, 1.2, etc.
4. The Names of:
 - a. Contractor
 - b. Supplier
 - c. Manufacturer
5. Identification of the product, with the Specification section number, permanent equipment tag numbers and applicable Drawing Number.
6. Field dimensions, clearly identified as such.
7. Relation to adjacent or critical features of the Work or materials.
8. Applicable standards, such as ASTM or Federal Specification numbers.
9. Notification to the Construction Manager in writing, at time of submissions, of any deviations on the submittals from requirements of the Contract Documents.
10. Identification of revisions on resubmittals.
11. An 8 x 3 inch blank space for Contractor and Construction Manager stamps.

Section 4
Scope of Work and Technical Specifications
SECTION 01 33 23-4 SHOP DRAWINGS, PRODUCT DATA AND SAMPLES

12. Contractor's stamp, initialed or signed, certifying to review of submittal, verification of products, field measurements and field construction criteria and coordination of the information within the submittal with requirements of the Work and of Contract Documents.

13. Submittal sheets or drawings showing more than the particular item under consideration shall have all but the pertinent description of the item for which review is requested crossed out.

1.03 ROUTING OF SUBMITTALS

A. Submittals and routine correspondence shall be routed as follows:

1. Supplier to Contractor (through representative if applicable)
2. Contractor to Construction Manager
3. Construction Manager to Contractor and Owner
4. Contractor to Supplier

PART 2 – PRODUCTS

2.01 SHOP DRAWINGS

A. Unless otherwise specifically directed by the Construction Manager, make all shop drawings accurately to a scale sufficiently large to show all pertinent features of the item and its method of connection to the Work.

B. Submit all shop drawings in the form of six hard copies and one pdf file.

C. One reproducible for all submittals larger than 11 x 17 inches and no more than three prints of other submittals will be returned to the Contractor.

2.02 MANUFACTURER'S LITERATURE

A. Where content of submitted literature from manufacturers includes data not pertinent to this submittal, clearly indicate which portion of the contents is being submitted for the Construction Manager's review.

B. Submit the number of copies which are required to be returned (not to exceed three) plus three copies which will be retained by the Construction Manager.

2.03 SAMPLES

A. Samples shall illustrate materials, equipment or workmanship and established standards by which completed work is judged.

B. Unless otherwise specifically directed by the Construction Manager, all samples shall be of the precise article proposed to be furnished.

C. Submit all samples in the quantity which is required to be returned plus one sample which will be retained by the Construction Manager.

2.04 COLORS

A. Unless the precise color and pattern is specifically described in the Contract Documents, wherever a choice of color or pattern is available in a specified product, submit accurate color charts and pattern charts to the Construction Manager for review and selection.

B. Unless all available colors and patterns have identical costs and identical wearing capabilities, and are identically suited to the installation, completely describe the relative costs and capabilities of each.

PART 3 – EXECUTION

3.01 CONTRACTOR'S COORDINATION OF SUBMITTALS

A. Prior to submittal for the Construction Manager's review, the Contractor shall use all means necessary to fully coordinate all materials, including the following procedures:

1. Determine and verify all field dimensions and conditions, catalog numbers and similar data.
2. Coordinate as required with all trades and all public agencies involved.
3. Submit a written statement of review and compliance with the requirements of all applicable technical Specifications as well as the requirements of this Section.
4. Clearly indicate in a letter or memorandum on the manufacturer's or fabricator's letterhead, all deviations from the Contract Documents.

B. Each and every copy of the shop drawings and data shall bear the Contractor's stamp showing that they have been so checked. Shop drawings submitted to the Construction Manager without the Contractor's stamp will be returned to the Contractor for conformance with this requirement.

C. The Owner may back charge the Contractor for costs associated with having to review a particular shop drawing, product data or sample more than two times to receive a "No Exceptions Taken" mark.

D. Grouping of Submittals

1. Unless otherwise specifically permitted by the Construction Manager, make all submittals in groups containing all associated items.
2. No review will be given to partial submittals of shop drawings for items which interconnect and/or are interdependent.

Section 4
Scope of Work and Technical Specifications
SECTION 01 33 23-6 SHOP DRAWINGS, PRODUCT DATA AND SAMPLES

- a. It is the Contractor's responsibility to assemble the shop drawings for all such interconnecting and/or interdependent items, check them and then make one submittal to the Construction Manager along with Contractor's comments as to compliance, non-compliance or features requiring special attention.

E. Schedule of Submittals

1. Within 30 days of Contract award and prior to any shop drawing submittal, the Contractor shall submit a schedule showing the estimated date of submittal and the desired approval date for each shop drawing anticipated.
2. A reasonable period shall be scheduled for review and comments.
3. Time lost due to unacceptable submittals shall be the Contractor's responsibility and some time allowance for resubmittal shall be provided. The schedule shall provide for submittal of items which relate to one another to be submitted concurrently.

3.02 TIMING OF SUBMITTALS

- A. Make all submittals far enough in advance of scheduled dates for installation to provide all required time for reviews, for securing necessary approvals, for possible revision and resubmittal, and for placing orders and securing delivery.
- B. In scheduling, allow sufficient time for the Construction Manager's review following the receipt of the submittal.

3.03 REVIEWED SHOP DRAWINGS

A. Construction Manager Review

1. Allow a minimum of 30 days for the Construction Manager's initial processing of each submittal requiring review and response, except allow longer periods where processing must be delayed for coordination with subsequent submittals.
 - a. The Construction Manager will advise the Contractor promptly when it is determined that a submittal being processed must be delayed for coordination.
 - b. Allow a minimum of two weeks for reprocessing each submittal.
 - c. Advise the Construction Manager on each submittal as to whether processing time is critical to progress of the Work, and therefore the Work would be expedited if processing time could be foreshortened.
2. Acceptable submittals will be marked "No Exceptions Taken". A minimum of three copies will be retained by the Construction Manager for Construction

Section 4
Scope of Work and Technical Specifications

SECTION 01 33 23-7 SHOP DRAWINGS, PRODUCT DATA AND SAMPLES

Manager's and the Owner's use and the remaining copies will be returned to the Contractor.

3. Submittals requiring minor corrections before the product is acceptable will be marked "Make Corrections Noted". The Contractor may order, fabricate and ship the items included in the submittals, provided the indicated corrections are made. Drawings must be resubmitted for review and marked "No Exceptions Taken" prior to installation or use of products.

4. Submittals marked "Amend and Resubmit" must be revised to reflect required changes and the initial review procedure repeated.

5. The "Rejected See Remarks" notation is used to indicate products which are not acceptable. Upon return of a submittal so marked, the Contractor shall repeat the initial review procedure utilizing acceptable products.

6. Only two copies of items marked "Amend and Resubmit" and "Rejected See Remarks" will be reviewed and marked. One copy will be retained by the Construction Manager and the other copy with all remaining unmarked copies will be returned to the Contractor for resubmittal.

B. No work or products shall be installed without a drawing or submittal bearing the "No Exceptions Taken" notation. The Contractor shall maintain at the job site a complete set of shop drawings bearing the Construction Manager's stamp.

C. Substitutions: In the event the Contractor obtains the Construction Manager's approval for the use of products other than those which are listed first in the Contract Documents, the Contractor shall, at the Contractor's own expense and using methods approved by the Construction Manager, make any changes to structures, piping and electrical work that may be necessary to accommodate these products.

D. Use of the "No Exceptions Taken" notation on shop drawings or other submittals is general and shall not relieve the Contractor of the responsibility of furnishing products of the proper dimension, size, quality, quantity, materials and all performance characteristics, to efficiently perform the requirements and intent of the Contract Documents.

1. The Construction Manager's review shall not relieve the Contractor of responsibility for errors of any kind on the shop drawings.

2. Review is intended only to assure conformance with the design concept of the Project and compliance with the information given in the Contract Documents. The Contractor is responsible for dimensions to be confirmed and correlated at the job site.

3. The Contractor is also responsible for information that pertains solely to the fabrication processes or to the technique of construction and for the coordination of the work of all trades.

Section 4
Scope of Work and Technical Specifications
SECTION 01 33 23-8 SHOP DRAWINGS, PRODUCT DATA AND SAMPLES

3.04 RESUBMISSION REQUIREMENTS

A. Shop Drawings

1. Revise initial drawings as required and resubmit as specified for initial submittal, with the resubmittal number shown.
2. Indicate on drawings all changes which have been made other than those requested by the Construction Manager.

B. Project Data and Samples:

1. Resubmit new data and samples as specified for initial submittal, with the resubmittal number shown.

END OF SECTION

SECTION 01 35 00

UNIQUE REQUIREMENTS

PART 1 – GENERAL

1.01 SCOPE

A. The scope of this Section is to convey to the Contractor unique and unusual stipulations and requirements which have been established for this Project.

1. Some of the stipulations and requirements are a result of negotiations with various entities and organizations which have an interest in this Project.

2. Some requirements are based on technical aspects of the Project which are not otherwise conveyed to the Contractor.

B. The provisions of this Section shall not supersede the Bidding Requirements, Contract Forms or Conditions of the Contract.

1.02 MILESTONE DATES

A. The Contractor shall be required to complete the following activities by the indicated date or days after the Notice to Proceed:

1. Consecutive Calendar Days after Notice to Proceed Milestone Liquidated Damages per Calendar Day

a.	30 Days	Completion of Administrative Period
b.	540 Days	Substantial Completion of All Work \$1,000
c.	600 Days	Final Completion of All Work \$250

1) Revise per specific contract term

B. Substantial Completion, for the purposes of assessing liquidated damages, shall be defined as the time at which the work (or a specified part thereof) has progressed to the point where, in the opinion of Construction Manager, the work (or a specified part thereof) is sufficiently complete, in accordance with the Contract Documents, so that the work (or a specified part thereof) can be utilized for the purposes for which it is intended.

C. The terms “substantially complete” and “substantially completed” as applied to all or part of the Work refer to Substantial Completion thereof. At minimum, Substantial Completion shall be defined as:

1. That degree of completion of the Project’s operating facilities or systems sufficient to provide the Owner full time, uninterrupted, continuous operation of the work; and

2. All required functional, performance, and operational or startup testing has been successfully demonstrated for all components, devices, equipment, systems, including instrumentation and controls to the satisfaction of the Construction Manager in accordance with the requirements of the Specifications; and
3. All inspections required have been completed. Specific items of work that must be completed prior to the Construction Manager's issuance of a certificate of Substantial Completion include, but are not limited to, the following:
 - a. Correcting deficient work items listed by any regulatory agencies.
 - b. All submittals must be received and approved by the Construction Manager, including, but not necessarily limited to, the following:
 - 1) Record documents.
 - 2) Factory test reports.
 - 3) Equipment and structure test reports.
 - 4) Manufacturer's Certificate of Proper Installation.
 - 5) Operating and Maintenance information, instructions, manuals, documents, drawings, diagrams, and records.
 - 6) Spare parts lists.
 - c. All additional warranty or insurance coverage requirements have been provided.

1.03 STANDARDS

- A. Existing pavement, sidewalks and curb and gutter, driveways or storm sewer, if affected by the construction, shall be replaced, in accordance with the relevant City and/or the Georgia Department of Transportation specifications and standards to match existing conditions at a minimum.

1.04 SUBMITTALS

- A. Sequence Submittal
 1. Submit a proposed sequence in accordance with Section 01 32 16 with appropriate times of starting and completion of tasks to Construction Manager for review.
 2. The Contractor may propose alternatives to the sequencing constraints to that shown in this Section in an attempt to reduce the disruption of the operation of the existing facility or streamline the tasks of this Contract.

3. The Owner and Construction Manager are not obligated to accept any of these alternatives.

B. All requested submittals must be approved by the Owner or Construction Manager, prior to any on site work.

1. This includes, but is not limited to the construction sequencing schedule, Erosion and Sedimentation Control Plan, Tree Protection Plan, Traffic Management Plan, product shop drawings, and health and safety and loss prevention programs.

1.05 EXISTING FACILITY OPERATIONS

A. All existing services and continuity of sewer service must be maintained during the time construction activities are in progress.

B. The Contractor shall coordinate all work with the Construction Manager, so that the construction will not restrain or hinder the operation of the existing services.

1. If, at any time, any portion of the existing service will be interrupted, the Contractor must obtain approval from the Construction Manager, one week in advance, as to the date, time and length of time that portion of the services will be interrupted, until the services are restored.

C. Connections to the existing facilities or alteration of existing facilities will be made at times when the facility involved is not in use or at times, established by the Owner, when the use of the facility can be conveniently interrupted for the period of time needed to make the connection or alteration.

D. After having coordinated the work with the Owner, the Contractor shall prepare a submittal in accordance with Section 01 33 23 to include the time, time limits and methods of each connection or alteration and have the approval of the Construction Manager before any work is undertaken on the connections or alterations.

E. The Contractor shall comply with the stipulations contained in permits obtained from the relevant or applicable government entity, pertaining to work hours, lane closures, noise pollution, traffic detours, and road closures.

F. Before driveways are interrupted, the Contractor is responsible to coordinate their work activities with the property residence, so that construction will not hinder excess to the property.

G. Before any roadway or facilities are blocked off, the local issuing authority and Owner's approval shall be obtained to coordinate operations for the Work.

H. The Contractor shall not open or close valves or take any other such actions concerning the operation of existing systems.

1.06 SEQUENCING

A. General

1. The Contractor is responsible for all construction activities sequencing, unless adjustment to any construction activity sequencing, is due to the Project's constraint, and/or requested by Construction Manager.
2. The completion of specific preliminary sequencing tasks will be required, prior to any construction activities.
3. The Contractor is responsible to verify the project's existing topography, prior to the procurement and delivery of pipe materials.
4. The Contractor is responsible to keep the road fully operational and functional, during the execution of the Project, unless approval is given by the relevant governing authority.

B. The Contractor shall notify the Construction Project Manager in writing at least 72 hours, prior to starting work that will require taking existing facilities out of service.

C. The Contractor may utilize multiple crews to construct the pipeline concurrently at various locations with the approval of the Construction Manager, in order to maintain the Project's completion schedule, or as required by the Construction Manager.

D. The Contractor is responsible to make their own assessment and determination of requirements that affect or may affect the work progress and sequencing.

E. Prior to the procurement of the proposed sewer line materials, the Contractor is responsible to field locate the starting and ending, tie-in points and connections locations of existing sewer pipe line. Field stake the horizontal center line of the proposed pipe line, in order to better procure the total amount of proposed sewer line linear footage.

F. The Contractor is responsible to provide, as an attachment to their Progress Payment Request Submittals, the applicable to date As-Built progress drawing of the installed sewer line that will support linear footage of the sewer line, to be approved for payment.

1.07 SEQUENCING CONSTRAINTS

A. The following construction sequencing constraints are to emphasize critical tasks of the work in this Contract. It is not a complete list of all work to be completed.

1. None

1.08 SITE PHYSICAL CONDITIONS

A. The Contractor shall field verify the locations of existing subsurface structures, utilities, services, and depth of underground facilities, prior to the start of excavation and construction.

B. The Contractor is responsible to identify, locate, and make the necessary exploratory excavations where existing underground utilities, services, and structures may potentially conflict with propose construction.

C. All exploratory excavations shall be conducted sufficiently ahead to avoid possible delays to the Contractor's proposed sewer line installation schedule, and project's Contract Time.

D. The Contractor is responsible to field locate accurately and document, prior to start of work, the existing site condition of all landscaping features, walls, sidewalk, and curb and gutter alignment, including any existing features that may be impacted

1.09 TRAFFIC CONTROL

A. The Contractor is responsible to furnish the necessary traffic flagmen and/or escorts to direct traffic in the roadway areas affected by their construction operations, whenever and wherever, in the opinion of the Construction Manager traffic is sufficiently congested or public safety is endangered.

B. Under the Contract Terms, the employment or presence of traffic flagmen or escort, shall not in any way relieve the Contractor of their responsible and/or liability.

1.10 CONSTRUCTION STAKING

A. The Project Construction Drawings show the alignment of the sewer line, and the location of manholes and other appurtenances.

B. The base line shall be defined as the centerline to which the location of the sewer line is referenced, or survey line. The Contractor shall be responsible for performing all survey work required for constructing the sewer line, including the establishment of its base line and/or centerline, and any details surveys needed for the sewer line installation and construction.

C. This work shall include the staking out of permanent and temporary easements, to ensure that the Contractor is not deviating from the designated easements.

D. The sewer line level of detail of survey shall be that the correct location, as described on the Construction Drawings or as laid out in the field can be established for construction and can be verified in the field by the Construction Project Manager.

1.11 REFERENCE POINTS

A. The Contractor shall take all precautions necessary, which includes, but not limited to, installing reference points, in order to protect and preserve the centerline or baseline established.

B. Reference points shall be placed at or no more than three (3) from the outside of the construction easement or right-of-way.

C. The location of the reference points shall be recorded in a log with a copy provided to the Construction Project Manager, prior to reference point locations verification.

D. The distances between reference points and the sewer centerline shall be accurately measured to 0.01 foot.

E. The Contractor shall give the Construction Project Manager reasonable notice to field verify the set reference points.

1.12 ADMINISTRATION PERIOD

A. During the Administration Period the Contractor shall be limited in site access to only the following:

1. Nondestructive field verification of existing conditions.
2. Construction of Contractor's temporary field offices.

B. During the Administration Period the Contractor shall complete, as a minimum, the following:

1. Issuance of contracts, subcontracts, and purchase orders for all major products and systems.
2. Complete all submittals, release for manufacture, and schedule delivery for the products or systems referenced above.
3. Prepare and submit approvable documents required by Section 01 32 16, including OPS.
4. Install Contractor's temporary field offices complete with all required utilities, internet, network, supplies, and furnishings required.
5. Complete and submit all preconstruction photos, videos, and initial aerial photographs.

C. The duration of the Administration Period is 30 consecutive calendar days, after which time the Construction Period shall automatically begin.

D. Construction Period may begin prior to the 30 days, provided all requirements of the Administration Period have been completed, submitted, and approved by the Construction Manager.

PART 2 – MATERIALS

(NOT USED)

Section 4
Scope of Work and Technical Specifications
SECTION 01 35 00-7 UNIQUE REQUIREMENTS

PART 3 – EXECUTION

(NOT USED)

END OF SECTION

SECTION 01 35 29

HEALTH, SAFETY AND EMERGENCY RESPONSE PROCEDURES

PART 1 – GENERAL

1.01. CONTRACTOR'S RESPONSIBILITY FOR SAFETY

- A. The Contractor shall determine the safety hazards involved in prosecuting the Work and the precautions necessary to conduct the Work safely.
 - 1. If the Contractor is unsure as to any special hazards which may be unique to the various processes and facilities involved in wastewater conveyance and treatment, it shall be Contractor's responsibility to determine such information prior to beginning the Work.
- B. The Contractor shall conduct its operations and perform all work safely and perform all work necessary to ensure the safety of its personnel and others and shall be solely and completely responsible for the conditions on the jobsite, including the safety of all persons and property, both public and private, during the Contract period.
- C. This protection shall be provided for all persons including but not limited to his employees, employees of other contractors or subcontractors, members of the general public, Owner's employees including the Owner, Engineer's employees, and regulatory agencies' personnel that may be on or about the work. Protection of public and private property including but not limited to utilities, pipes, equipment, motor vehicles, and structures.
- D. The Contractor's responsibility for protection is described in Article 25 of the General Conditions.
- E. These requirements shall apply continuously and not be limited to normal working hours.
- F. The Contractor shall bear all risks associated with performing the Work and shall fully indemnify and hold harmless the Owner, the Owner and Engineer.

PART 2 – SAFETY AND HEALTH REGULATIONS

2.01. GENERAL

- A. Safety provisions shall conform to the Federal and State Departments of Labor Occupational Safety and Health Act (OSHA), and all other applicable Federal, State, County, and local laws, ordinances, codes, the requirements set forth herein, and any regulations that may be specified elsewhere in these Contract Documents.
- B. Where any of these are in conflict, the more stringent requirement shall be followed. The Contractor's failure to thoroughly familiarize himself with the

Section 4
Scope of Work and Technical Specifications

SECTION 01 35 29-2 HEALTH, SAFETY AND EMERGENCY RESPONSE PROCEDURES

aforementioned safety provisions shall not relieve him from compliance with the obligations or relieve him of the penalties set forth therein.

C. All construction shall be conducted in accordance with the latest applicable requirements of the following:

1. Part 1926 - Safety and Health Regulations for Construction of the Occupational Safety and Health Act.
2. Section 107 of the Contract Work Hours and Safety Standards Act.
3. Any other local, state or federal safety codes, laws, regulations and standards that apply.

D. Copies of these regulations may be obtained from Labor Building, 14th and Constitution Avenue N.W., Washington, DC 20013.

PART 3 – EXECUTION

3.01. SAFE ACCESS TO THE WORK

A. The Contractor shall at all times provide proper facilities for safe access to the work by the Owner, the Owner, their authorized representatives and by all authorized government officials.

3.02. CONSTRUCTION SAFETY PROGRAM

A. Contractor shall develop a written job safety program specifically suited for this project and submit to Fulton County for review and approval.

B. The Contractor shall appoint for the duration of this Contract a qualified supervisory employee to develop and supervise the Contractor's job safety program that will effectively implement the required safety provisions.

C. Neither the Owner nor the Engineer shall not be responsible for safety precautions and programs in connection with the construction work.

D. The Contractor shall provide the Owner and the Engineer with two copies of the Contractor's safety program within 15 working days after the Notice to Proceed.

3.03. EXCAVATION PLANS

A. In accordance with the governing State and Federal requirements, the Contractor shall submit a detailed excavation plan to the Owner before excavation, showing the design of shoring, bracing, sloping or other provisions to be made for worker protection from the hazard of caving ground during the excavation of any trench or trenches five feet or more in depth.

B. The excavation plan shall be prepared, sealed and signed by a licensed engineer registered in the state of Georgia.

Section 4

Scope of Work and Technical Specifications
SECTION 01 35 29-3 HEALTH, SAFETY AND EMERGENCY RESPONSE PROCEDURES

C. This submittal is for record purposes only and will not be reviewed and approved by the Owner or Engineer.

D. The plan is the complete responsibility of the Contractor and submitting it to the Owner and Engineer shall not relieve the Contractor for overall responsibility and liability for the work.

E. It shall be understood that the above stipulated requirements are considered to be the minimum to be provided. It shall be the Contractor's responsibility to provide the additional strength required to support the side of the excavation against loads which may exceed those employed to derive the criteria set forth in the Industrial Safety Orders.

F. The Contractor shall be solely responsible for any and all liabilities which may arise from his failure to provide adequate shoring, bracing, or sheeting as necessary to support the excavation under any or all of the conditions of loading which may exist, or which may arise during the construction of the project.

3.04. SAFETY EQUIPMENT

A. The Contractor shall maintain at the jobsite safety equipment applicable to the Work as prescribed by the governing safety authorities and all articles necessary for giving first aid to the injured and shall establish the procedure for the immediate removal to a hospital or a doctor's care of persons who may be injured on the jobsite.

B. The performance of all work and all construction, particularly with respect to ladders, platforms, structure opening, scaffolding, shoring, lagging, gas monitors, and machinery guards, shall be in accordance with the requirements of applicable governing safety authorities.

3.05. ACCIDENT REPORTS

A. If death or serious injuries or serious damage are caused, the accident shall be reported immediately by telephone or messenger to the Owner. In addition, the Contractor must promptly report in writing to the Owner all accidents in connection with work, giving full details, names, and statements of witnesses.

B. If a claim is made by anyone against the Contractor or any subcontractor on account of any accident, the Contractor shall promptly report the facts in writing to the Owner, giving full details of the claim.

3.06. TRAFFIC SAFETY AND ACCESS TO PROPERTY

A. Comply with all rules and regulations of the City, State, and County authorities regarding closing or restricting the use of public street or highways.

B. No public or private road shall be closed, except by express permission of the Owner, or City having jurisdiction.

Section 4
Scope of Work and Technical Specifications

SECTION 01 35 29-4 HEALTH, SAFETY AND EMERGENCY RESPONSE PROCEDURES

C. Conduct the work so as to assure the least possible obstructions within traveled roadways by installing approved signs, barricades, and lights where necessary for the safety of the public in accordance to MUTCD requirements.

D. The convenience of the general public and residents adjacent to the project, and the protection of the persons and property are of prime importance and shall be provided for in an adequate and satisfactory manner.

3.07. FIRE PREVENTION AND PROTECTION

A. The Contractor shall execute all work in a fire-safe manner and shall supply and maintain on the site adequate fire-fighting equipment capable of extinguishing incipient fires.

B. The Contractor shall comply with applicable federal, local, and state fire prevention regulations.

C. Where these regulations do not apply, applicable parts of the National Fire Prevention Standards for Safeguarding Building Construction Operations, (NFPA No. 241) shall be followed.

D. Sufficient number of fire extinguishers of the type and capacity required to protect the Work and ancillary facilities, shall be provided and maintained by the Contractor in readily accessible locations.

E. Fire extinguishers shall be inspected monthly and must be operable, free of dents, leaks and other signs of damage. Pressure gauge arrows must be in the green "charged" zone.

3.08. SPECIAL REQUIREMENTS

A. The Contractor's attention is directed to the fact that construction activities involving existing wastewater facilities and sewer systems will occasionally involve work in potentially hazardous environments in which oxygen deficient, toxic or explosive conditions may exist.

B. Additional hazards arise from the presence of pathogens in the wastewater and sludge and from the slime and scum layer that coat walking, working and other surfaces.

C. In dealing with these hazards, the Contractor shall take special precautions to ensure worker safety. Such precautions shall include, but are not limited to, the following, as applicable:

1. Installing temporary forced air ventilation equipment and ducts for fresh air in enclosed areas.

2. Using pneumatic tools and equipment instead of electric driven equipment in hazardous areas.

Section 4
Scope of Work and Technical Specifications

SECTION 01 35 29-5 HEALTH, SAFETY AND EMERGENCY RESPONSE PROCEDURES

3. Avoiding the use of cutting torches, field welding and grinders in hazardous areas.
 4. Cleaning and disinfecting working surfaces with hot water, high pressure washers prior to commencing work.
 5. Installing sealed wooden baffles or bulkheads to isolate working areas from hazardous atmospheres.
 6. Providing portable oxygen meters, combustible gas detectors and hydrogen sulfide detectors to continuously monitor the atmosphere in enclosed working areas.
 7. Providing safety harnesses, safety lines and recovery crews for workers in hazardous areas.
 8. Providing self-contained breathing apparatus with spare air cylinders for workers in hazardous areas.
 9. Providing dry chemical fire extinguishers and connected fire hoses in areas where a danger of fire or explosion exists.
 10. Providing adequate, oxygen equipped, first aid facilities.
 11. Providing suitable wash up areas and facilities for workers.
 12. Installing temporary lighting using explosion proof fixtures in hazardous environments.
 13. Installing approved warning and hazard signs and posting safety procedures.
 14. Instructing all workers as to the hazards present, the procedures to be followed and the proper function and use of all safety and emergency equipment furnished.
 15. Ensure confined space entry requirements are enforced such as permit, training, emergency responses, equipment and ventilation.
- D. Prior to entering or commencing work in a hazardous area, the Contractor shall ensure that all safety and emergency equipment is in place and in satisfactory operating condition.
- E. Prior to commencing Work on existing facilities and equipment, the Contractor shall notify the system/facility superintendent and shall ensure that the source of electrical energy to all affected equipment is shut off and locked out at the appropriate motor control center. Local switches and pushbutton stations, where provided, shall be locked in the "off" position.

Section 4

Scope of Work and Technical Specifications

SECTION 01 35 29-6 HEALTH, SAFETY AND EMERGENCY RESPONSE PROCEDURES

3.09. EMERGENCY PHONE NUMBERS

A. Emergency phone numbers (fire, medical, police) shall be posted at all telephone locations at the Site of the Work and their locations made known to all.

END OF SECTION

SECTION 01 35 43

ENVIRONMENTAL PROCEDURES

PART 1 – GENERAL

1.01 SITE MAINTENANCE

- A. The Contractor shall keep the work site clean and free from rubbish and debris. Materials and equipment shall be removed from the site when they are no longer necessary.
- B. Upon completion of the Work and before final acceptance, the work site shall be cleared of equipment, unused materials, and rubbish to present a clean and neat appearance.

1.02 TEMPORARY DAMS

- A. Except in time of emergency, earth dams are not acceptable at catch basin openings, local depressions or elsewhere.
- B. Temporary dams of sand bags, asphaltic concrete, or other acceptable material will be permitted when necessary to protect the Work, provided their use does not create a hazard or nuisance to the public.
- C. Such dams shall be removed from the site as soon as they are no longer necessary.

1.03 AIR POLLUTION CONTROL

- A. The Contractor shall not discharge smoke, dust, and other contaminants, into the atmosphere that violate the regulations of any legally constituted authority.
- B. The Contractor shall also abate dust nuisance by cleaning, sweeping, and sprinkling with water or other means as necessary. The use of water, in amounts that result in mud on public streets, is not acceptable as a substitute for sweeping or other methods.
- C. The Contractor shall provide dust control at no additional cost to the Owner.

1.04 NOISE CONTROL

- A. Noise from Contractor's operations shall not exceed limits established by applicable laws or regulations and local noise ordinances.

1.05 SEDIMENTATION AND EROSION CONTROL

- A. Contractor shall employ best management practices in accordance with Local, State and Federal guidelines and regulations for erosion and sedimentation control.

Section 4
Scope of Work and Technical Specifications
SECTION 01 35 43-2 ENVIRONMENTAL PROCEDURES

Unless otherwise noted, Contractor shall obtain related permits or approvals and pay applicable fees.

1.06 STATE OR FEDERAL WATERS

A. State or Federal waters, wetlands or other environmental features shall not be disturbed without proper approvals, permits or notifications, which are the responsibility of the Contractor.

1.07 HAZARDOUS MATERIALS STORAGE

A. The Contractor shall submit Material Safety Data Sheets (MSDSs) for all hazardous chemicals contained onsite to the Owner.

B. The Contractor shall also maintain a copy of all applicable MSDSs onsite at all times.

C. The Contractor shall notify the Owner and the Owner upon receipt of any hazardous chemicals onsite.

D. All hazardous chemicals onsite must be placed in approved containment with an appropriate leak detection system. Flammable materials such as paints, thinners, solvents, etc. must be stored in approved fire storage cabinets.

PART 2 – PRODUCTS

(NOT USED)

PART 3 – EXECUTION

(NOT USED)

END OF SECTION

SECTION 01 40 00

QUALITY REQUIREMENTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section includes administrative and procedural requirements for quality assurance and quality control.

B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.

1. Specific quality-assurance and -control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.

2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and -control procedures that facilitate compliance with the Contract Document requirements.

3. Requirements for Contractor to provide quality-assurance and -control services required by Engineer, Owner or authorities having jurisdiction are not limited by provisions of this Section.

4. Specific test and inspection requirements are not specified in this Section.

1.03 DEFINITIONS

A. **Quality-Assurance Services:** Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.

B. **Quality-Control Services:** Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Services do not include contract enforcement activities performed by Engineer.

C. **Preconstruction Testing:** Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria.

- D. **Product Testing:** Tests and inspections that are performed by an NRTL, an NVLAP, or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.
- E. **Source Quality-Control Testing:** Tests and inspections that are performed at the source, e.g., plant, mill, factory, or shop.
- F. **Field Quality-Control Testing:** Tests and inspections that are performed on-site for installation of the Work and for completed Work.
- G. **Testing Agency:** An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.
- H. **Installer/Applicator/Erector:** Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.
 - 1. Use of trade-specific terminology in referring to a trade or entity does not require that certain construction activities be performed by accredited or unionized individuals, or that requirements specified apply exclusively to specific trade(s).
- I. **Experienced:** When used with an entity or individual, "experienced" means having successfully completed a minimum of five previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

1.04 CONFLICTING REQUIREMENTS

- A. **Referenced Standards:** If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer conflicting requirements that are different, but apparently equal, to Architect for a decision before proceeding.
- B. **Minimum Quantity or Quality Levels:** The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

1.05 INFORMATIONAL SUBMITTALS

- A. **Contractor's Quality-Control Plan:** For quality-assurance and quality-control activities and responsibilities.

- B. Qualification Data : For Contractor's quality-control personnel.
- C. Contractor's Statement of Responsibility: When required by authorities having jurisdiction, submit copy of written statement of responsibility sent to authorities having jurisdiction before starting work on the following systems:
 - 1. Seismic-force-resisting system, designated seismic system, or component listed in the designated seismic system quality-assurance plan prepared by Engineer.
 - 2. Main wind-force-resisting system or a wind-resisting component listed in the wind-force-resisting system quality-assurance plan prepared by Engineer.
- D. Testing Agency Qualifications: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.
- E. Schedule of Tests and Inspections: Prepare in tabular form and include the following:
 - 1. Specification Section number and title.
 - 2. Entity responsible for performing tests and inspections.
 - 3. Description of test and inspection.
 - 4. Identification of applicable standards.
 - 5. Identification of test and inspection methods.
 - 6. Number of tests and inspections required.
 - 7. Time schedule or time span for tests and inspections.
 - 8. Requirements for obtaining samples.
 - 9. Unique characteristics of each quality-control service.

1.06 CONTRACTOR'S QUALITY-CONTROL PLAN

- A. Quality-Control Plan, General: Submit quality-control plan within 10 days of Notice to Proceed, and not less than five days prior to preconstruction conference. Submit in format acceptable to Engineer. Identify personnel, procedures, controls, instructions, tests, records, and forms to be used to carry out Contractor's quality-assurance and quality-control responsibilities. Coordinate with Contractor's construction schedule.
- B. Quality-Control Personnel Qualifications: Engage qualified full-time personnel trained and experienced in managing and executing quality-assurance and quality-control procedures similar in nature and extent to those required for Project.

1. Project quality-control manager may also serve as Project superintendent.
- C. Submittal Procedure: Describe procedures for ensuring compliance with requirements through review and management of submittal process. Indicate qualifications of personnel responsible for submittal review.
- D. Testing and Inspection: In quality-control plan, include a comprehensive schedule of Work requiring testing or inspection, including the following:
1. Contractor-performed tests and inspections including subcontractor-performed tests and inspections. Include required tests and inspections and Contractor-elected tests and inspections.
 2. Special inspections required by authorities having jurisdiction and indicated on the "Statement of Special Inspections."
 3. Owner-performed tests and inspections indicated in the Contract Documents.
- E. Continuous Inspection of Workmanship: Describe process for continuous inspection during construction to identify and correct deficiencies in workmanship in addition to testing and inspection specified. Indicate types of corrective actions to be required to bring work into compliance with standards of workmanship established by Contract requirements and approved mockups.
- F. Monitoring and Documentation: Maintain testing and inspection reports including log of approved and rejected results. Include work Engineer has indicated as nonconforming or defective. Indicate corrective actions taken to bring nonconforming work into compliance with requirements. Comply with requirements of authorities having jurisdiction.

1.07 REPORTS AND DOCUMENTS

- A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:
1. Date of issue.
 2. Project title and number.
 3. Name, address, and telephone number of testing agency.
 4. Dates and locations of samples and tests or inspections.
 5. Names of individuals making tests and inspections.
 6. Description of the Work and test and inspection method.
 7. Identification of product and Specification Section.

Section 4
Scope of Work and Technical Specifications
SECTION 01 40 00-5 QUALITY REQUIREMENTS

8. Complete test or inspection data.
9. Test and inspection results and an interpretation of test results.
10. Record of temperature and weather conditions at time of sample taking and testing and inspecting.
11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
12. Name and signature of laboratory inspector.
13. Recommendations on retesting and reinspecting.

B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:

1. Name, address, and telephone number of technical representative making report.
2. Statement on condition of substrates and their acceptability for installation of product.
3. Statement that products at Project site comply with requirements.
4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
6. Statement whether conditions, products, and installation will affect warranty.
7. Other required items indicated in individual Specification Sections.

C. Factory-Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include the following:

1. Name, address, and telephone number of factory-authorized service representative making report.
2. Statement that equipment complies with requirements.
3. Results of operational and other tests and a statement of whether observed performance complies with requirements.
4. Statement whether conditions, products, and installation will affect warranty.

5. Other required items indicated in individual Specification Sections.

D. Permits, Licenses, and Certificates: For Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.

1.08 QUALITY ASSURANCE

A. General: Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.

B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

D. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.

E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar in material, design, and extent to those indicated for this Project.

F. Specialists: Certain Specification Sections require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.

1. Requirements of authorities having jurisdiction shall supersede requirements for specialists.

G. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 329; and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.

1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.

2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.

H. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

I. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

J. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:

1. Contractor responsibilities include the following:

a. Provide test specimens representative of proposed products and construction.

b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.

c. Provide sizes and configurations of test assemblies to adequately demonstrate capability of products to comply with performance requirements.

d. Build site-assembled test assemblies using installers who will perform same tasks for Project.

e. When testing is complete, remove test specimens, assemblies, do not reuse products on Project.

2. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Engineer with copy to Contractor. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.

1.10 QUALITY CONTROL

A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.

Section 4
Scope of Work and Technical Specifications
SECTION 01 40 00-8 QUALITY REQUIREMENTS

1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspecting they are engaged to perform.
2. Payment for these services will be made from testing and inspecting allowances, as authorized by Change Orders.
3. Costs for retesting and reinspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor.

B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities required to verify that the Work complies with requirements, whether specified or not.

1. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
2. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.
 - a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.
3. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspecting will be performed.
4. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
5. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
6. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.

C. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Section 01 33 00 "Submittal Procedures."

D. Manufacturer's Technical Services: Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in preinstallation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.

E. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.

F. Testing Agency Responsibilities: Cooperate with Engineer and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.

1. Notify Engineer and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
2. Determine the location from which test samples will be taken and in which in-situ tests are conducted.
3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
6. Do not perform any duties of Contractor.

G. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:

1. Access to the Work.
2. Incidental labor and facilities necessary to facilitate tests and inspections.
3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
4. Facilities for storage and field curing of test samples.
5. Delivery of samples to testing agencies.
6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
7. Security and protection for samples and for testing and inspecting equipment at Project site.

H. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.

1. Schedule times for tests, inspections, obtaining samples, and similar activities.

I. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents[as a component of Contractor's quality-control plan]. Coordinate and submit concurrently with Contractor's construction schedule. Update as the Work progresses.

1. Distribution: Distribute schedule to Owner, Engineer, testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

1.11 SPECIAL TESTS AND INSPECTIONS

A. Special Tests and Inspections: Engage a qualified testing agency to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner, and as follows:

B. Special Tests and Inspections: Conducted by a qualified testing agency as required by authorities having jurisdiction, as indicated in individual Specification Sections, and as follows:

1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures and reviews the completeness and adequacy of those procedures to perform the Work.
2. Notifying Engineer and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
3. Submitting a certified written report of each test, inspection, and similar quality-control service to Engineer with copy to Contractor and to authorities having jurisdiction.
4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
5. Interpreting tests and inspections and stating in each report whether tested and inspected work complies with or deviates from the Contract Documents.
6. Retesting and reinspecting corrected work.

PART 2 – PRODUCTS

(Not Used)

PART 3 - EXECUTION

3.01 TEST AND INSPECTION LOG

- A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:
1. Date test or inspection was conducted.
 2. Description of the Work tested or inspected.
 3. Date test or inspection results were transmitted to Architect.
 4. Identification of testing agency or special inspector conducting test or inspection.
- B. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for Engineer's reference during normal working hours.

3.02 REPAIR AND PROTECTION

- A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.
1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible.
- B. Protect construction exposed by or for quality-control service activities.
- C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION

SECTION 01 40 10

MATERIALS TESTING

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

A. The following information regarding Employment of and Payment for Testing Services under the work of Specifications shall take precedence over any conflicting statement otherwise, which may have remained in the Project Manual after editing:

1. Initial testing required by the Contract Documents for Divisions 2, 3, and 5 shall be provided by a testing agency pre-approved by the Owner & Contractor, and employed, and paid by the Contractor unless testing allowance is listed under contract.

- a. Other testing required shall be at the Contractor's expense.

2. Any retesting required (due to questionable materials or construction methods, for verification purposes, etc.) shall be at the Contractor's expense when the results of such retesting indicate any work or materials do not comply with requirements of the Contract Documents.

3. Any retesting under the above provisions shall be performed by the same Owner-accepted testing agency.

B. The Contractor shall be responsible for contacting and directing the accepted testing agency and for any follow-up communications required, for all testing required by the Contract Documents. The Contractor shall copy the Engineer on all materials testing correspondence and testing results.

C. No unsuitable or unsatisfactory existing soils or building materials (other than work in Contract) shall be removed without either the presence of or concurrence of and prior approval of the Engineer & Construction Manager and the accepted testing agency, so as to assure the quality of the Work is maintained.

D. All materials testing (geotechnical, concrete, etc.) shall be paid for by the Contractor and included in the base bid as incidental to the work.

E. The Contractor shall be required to have geotechnical analysis performed on any fill material to ensure it meets the earthwork/backfill specifications.

1.02 RELATED DOCUMENTS

A. Drawings and provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Related work specified elsewhere includes:

Section 4
Scope of Work and Technical Specifications
SECTION 01 40 10-2 MATERIALS TESTING

1. Section 31 23 00 – Trench Excavation and Backfill
2. Appendix A – Geotechnical Borings
3. Appendix B – Seismic Report

1.03 ALLOWANCES

- A. If no allowances are set, Contractor shall include all testing required for the completion of the project.

END OF SECTION

SECTION 01 42 00

CODES AND STANDARDS

PART 1 – GENERAL

1.01 DESCRIPTION

A. Whenever reference is made to conforming to the standards of any technical society, organization, body, code or standard, it shall be construed to mean the latest standard, code, specification or tentative specification adopted and published at the time of advertisement for Bids. This shall include the furnishing of materials, testing of materials, fabrication and installation practices. In those cases where the Contractor's quality standards establish more stringent quality requirements, the more stringent requirement shall prevail. Such standards are made a part hereof to the extent which is indicated or intended.

B. The inclusion of an organization under one category does not preclude that organization's standards from applying to another category.

C. In addition, all work shall comply with the applicable requirements of local codes, utilities and other authorities having jurisdiction.

D. All material and equipment, for which a UL Standard, an AGA or NSF approval or an ASME requirement is established, shall be so approved and labeled or stamped. The label or stamp shall be conspicuous and not covered, painted, or otherwise obscured from visual inspection.

E. The standards which apply to this Project are not necessarily restricted to those organizations which are listed in Article 1.02.

1.02 STANDARD ORGANIZATIONS

A. PIPING AND VALVES

ACPA American Concrete Pipe Association

ANSI American National Standards Institute

API American Petroleum Institute

ASME American Society of Mechanical Engineers

AWWA American Water Works Association

CISPI Cast Iron Soil Pipe Institute

DIPRA Ductile Iron Pipe Research Association

FCI Fluid Controls Institute

MSS Manufacturers Standardization Society

NCPI National Clay Pipe Institute

NSF National Sanitation Foundation

PPI Plastic Pipe Institute

Uni Bell PVC Pipe Association

B. MATERIALS

AASHTO American Association of State Highway and Transportation
 Officials

ANSI American National Standards Institute

ASTM American Society for Testing and Materials

C. PAINTING AND SURFACE PREPARATION

NACE National Association of Corrosion Engineers

SSPC Steel Structures Painting Council

D. ELECTRICAL AND INSTRUMENTATION

AEIC Association of Edison Illuminating Companies

AIEE American Institute of Electrical Engineers

EIA Electronic Industries Association

ICEA Insulated Cable Engineers Association

IEC International Electrotechnical Commission

IEEE Institute of Electrical and Electronic Engineers

IES Illuminating Engineering Society

IPC Institute of Printed Circuits

IPCEA Insulated Power Cable Engineers Association

ISA The Instrumentation, Systems, and Automation Society

NEC National Electric Code

NEMA National Electrical Manufacturers Association

NFPA National Fire Protection Association

REA Rural Electrification Administration

- TIA Telecommunications Industries Association
- UL Underwriter's Laboratories
- VRCI Variable Resistive Components Institute
- E. ALUMINUM
 - AA Aluminum Association
 - AAMA American Architectural Manufacturers Association
- F. STEEL AND CONCRETE
 - ACI American Concrete Institute
 - AISC American Institute of Steel Construction, Inc.
 - AISI American Iron and Steel Institute
 - CRSI Concrete Reinforcing Steel Institute
 - NRMA National Ready Mix Association
 - PCA Portland Cement Association
 - PCI Prestressed Concrete Institute
- G. WELDING
 - ASME American Society of Mechanical Engineers
 - AWS American Welding Society
- H. GOVERNMENT AND TECHNICAL ORGANIZATIONS
 - AIA American Institute of Architects
 - APHA American Public Health Association
 - APWA American Public Works Association
 - ASA American Standards Association
 - ASAE American Society of Agricultural Engineers
 - ASCE American Society of Civil Engineers
 - ASQC American Society of Quality Control
 - ASSE American Society of Sanitary Engineers
 - CFR Code of Federal Regulations
 - CSI Construction Specifications Institute

EDA Economic Development Administration
 EPA Environmental Protection Agency
 FCC Federal Communications Commission
 FmHA Farmers Home Administration
 FS Federal Specifications
 IAI International Association of Identification
 ISEA Industrial Safety Equipment Association
 ISO International Organization for Standardization
 ITE Institute of Traffic Engineers
 NBFU National Board of Fire Underwriters
 (NFPA)National Fluid Power Association
 NBS National Bureau of Standards
 NISO National Information Standards Organization
 OSHA Occupational Safety and Health Administration
 SI Salt Institute
 SPI The Society of the Plastics Industry, Inc.
 USDC United States Department of Commerce
 WEF Water Environment Federation

I. GENERAL BUILDING CONSTRUCTION

AHA American Hardboard Association
 AHAM Association of Home Appliance Manufacturers
 AITC American Institute of Timber Construction
 APA American Parquet Association, Inc.
 APA American Plywood Association
 BHMA Builders Hardware Manufacturers Association
 BIFMA Business and Institutional Furniture Manufacturers Association
 DHI Door and Hardware Institute
 FM Factory Mutual Fire Insurance Company

HPMA Hardwood Plywood Manufacturers Association

HTI Hand Tools Institute

IME Institute of Makers of Explosives

ISANTA International Staple, Nail and Tool Association

ISDSI Insulated Steel Door Systems Institute

IWS Insect Screening Weavers Association

MBMA Metal Building Manufacturers Association

NAAMM National Association of Architectural Metal Manufacturers

NAGDM National Association of Garage Door Manufacturers

NCCLS National Committee for Clinical Laboratory Standards

NFPA National Fire Protection Association

NFSA National Fertilizer Solutions Association

NKCA National Kitchen Cabinet Association

NWMA National Woodwork Manufacturers Association

NWWDA National Wood Window and Door Association

RMA Rubber Manufacturers Association

SBC SBCC Standard Building Code

SDI Steel Door Institute

SIA Scaffold Industry Association

SMA Screen Manufacturers Association

SPRI Single Ply Roofing Institute

TCA Tile Council of America

UBC Uniform Building Code

J. ROADWAYS

AREA American Railway Engineering Association

DOT Department of Transportation

SSRBC Standard Specifications for Construction of Transportation
 Systems, Georgia Department of Transportation

K. PLUMBING

AGA American Gas Association
 NSF National Sanitation Foundation
 PDI Plumbing Drainage Institute
 SPC SBCC Standard Plumbing Code

L. REFRIGERATION, HEATING, AND AIR CONDITIONING

AMCA Air Movement and Control Association
 ARI American Refrigeration Institute
 ASHRAE American Society of Heating, Refrigeration, and Air Conditioning Engineers
 ASME American Society of Mechanical Engineers
 CGA Compressed Gas Association
 CTI Cooling Tower Institute
 HEI Heat Exchange Institute
 IIAR International Institute of Ammonia Refrigeration
 NB National Board of Boilers and Pressure Vessel Inspectors
 PFMA Power Fan Manufacturers Association
 SAE Society of Automotive Engineers
 SMACNA Sheet Metal and Air Conditioning Contractors National Association
 SMC SBCC Standard Mechanical Code
 TEMA Tubular Exchangers Manufacturers Association

M. EQUIPMENT

AFBMA Anti Friction Bearing Manufacturers Association, Inc.
 AGMA American Gear Manufacturers Association
 ALI Automotive Lift Institute
 CEMA Conveyor Equipment Manufacturers Association
 CMAA Crane Manufacturers Association of America
 DEMA Diesel Engine Manufacturers Association

MMA Monorail Manufacturers Association

OPEI Outdoor Power Equipment Institute, Inc.

PTI Power Tool Institute, Inc.

RIA Robotic Industries Association

SAMA Scientific Apparatus Makers Association

1.03 SYMBOLS

- A. Symbols and material legends shall be as scheduled on the Drawings.

PART 2 – MATERIALS

(NOT USED)

PART 3 – EXECUTION

(NOT USED)

END OF SECTION

SECTION 01 45 29

TESTING AND LABORATORY SERVICES

PART 1 – GENERAL

1.01 SCOPE

- A. This Section includes testing which the Owner may require, beyond that testing required of the manufacturer, to determine if materials provided for the Project meet the requirements of these Specifications.
- B. This work also includes all testing required by the Owner to verify work performed by the Contractor is in accordance with the requirements of these Specifications (i.e., concrete strength and slump testing, existing soils conditions, soil compaction, etc.).
- C. This work does not include materials testing required in various sections of these Specifications to be performed by the manufacturer (e.g., testing of pipe).
- D. The testing laboratory or laboratories will be pre-approved by the Owner.

1.02 PAYMENT FOR TESTING SERVICES

- A. The cost of testing services required by the Contract shall be the responsibility of the Contractor.
- B. The cost of additional testing services not specifically required in the Specifications, but requested by the Owner or Engineer, shall be paid for by the Owner.
- C. The cost of material testing described in various sections of these Specifications or as required in referenced standards to be provided by a material manufacturer, shall be included in the price bid for that item and shall not be paid for by the Owner.
- D. The cost of retesting any item that fails to meet the requirements of these Specifications and/or false starts due to the Contractor's failure to properly schedule testing technicians shall be paid for by the Contractor. Retesting shall be performed by the testing laboratory approved by the Owner.

1.03 LABORATORY DUTIES

- A. Cooperate with the Owner, Engineer and Contractor.
- B. Provide qualified personnel promptly on notice.
- C. Perform specified inspections, sampling and testing of materials.
 - 1. Comply with specified standards, ASTM, other recognized authorities, and as specified.
 - 2. Ascertain compliance with requirements of the Contract Documents.

Section 4
Scope of Work and Technical Specifications
SECTION 01 45 29-2 TESTING AND LABORATORY SERVICES

D. Promptly notify the Engineer and Contractor of irregularity or deficiency of work which are observed during performance of services.

E. Promptly submit three copies (two copies to the Engineer and one copy to the Contractor) of report of inspections and tests in addition to those additional copies required by the Contractor with the following information included:

1. Date issued.
2. Project title and number.
3. Testing laboratory name and address.
4. Name and signature of inspector.
5. Date of inspection or sampling.
6. Record of temperature and weather.
7. Date of test.
8. Identification of product and Specification section.
9. Location of Project.
10. Type of inspection or test.
11. Results of test.
12. Observations regarding compliance with the Contract Documents.

F. Perform additional services as required.

G. The laboratory is not authorized to release, revoke, alter or enlarge on requirements of the Contract Documents, or approve or accept any portion of the Work.

1.04 CONTRACTOR RESPONSIBILITIES

A. Cooperate with laboratory personnel, provide access to Work and/or manufacturer's requirements.

B. Provide to the laboratory, representative samples, in required quantities, of materials to be tested.

C. Furnish copies of mill test reports.

D. Furnish required labor and facilities to:

1. Provide access to Work to be tested.
2. Obtain and handle samples at the site.
3. Facilitate inspections and tests.

Section 4
Scope of Work and Technical Specifications
SECTION 01 45 29-3 TESTING AND LABORATORY SERVICES

4. Build or furnish a holding box for concrete cylinders or other samples as required by the laboratory.

E. Notify the laboratory sufficiently in advance of operation to allow for the assignment of personnel and schedules of tests.

F. Laboratory Tests: Where such inspection and testing are to be conducted by an independent laboratory agency, the sample(s) shall be selected by such laboratory or agency, or the Engineer, and shipped to the laboratory by the Contractor at Contractor's expense.

G. Copies of all correspondence between the Contractor and testing agencies shall be provided to the Engineer.

1.05 QUALITY ASSURANCE

A. Testing shall be in accordance with all pertinent codes and regulations and with procedures and requirements of the American Society for Testing and Materials (ASTM).

1.06 PRODUCT HANDLING

A. Promptly process and distribute all required copies of test reports and related instructions to insure all necessary retesting or replacement of materials with the least possible delay in the progress of the Work.

1.07 FURNISHING MATERIALS

A. The Contractor shall be responsible for furnishing all materials necessary for testing.

1.08 CODE COMPLIANCE TESTING

A. Inspections and tests required by codes or ordinances or by a plan approval authority, and made by a legally constituted authority, shall be the responsibility of, and shall be paid for by the Contractor, unless otherwise provided in the Contract Documents.

1.09 CONTRACTOR'S CONVENIENCE TESTING

A. Inspection or testing performed exclusively for the Contractor's convenience shall be the, sole responsibility of the Contractor.

1.10 SCHEDULES FOR TESTING

A. Establishing Schedule

1. The Contractor shall, by advance discussion with the testing laboratory selected by the Owner, determine the time required for the laboratory to perform its tests and to issue each of its findings, and make all arrangements for the testing laboratory to be on site to provide the required testing.

Section 4
Scope of Work and Technical Specifications
SECTION 01 45 29-4 TESTING AND LABORATORY SERVICES

2. Provide all required time within the construction schedule.

B. When changes of construction schedule are necessary during construction, coordinate all such changes of schedule with the testing laboratory as required.

C. When the testing laboratory is ready to test according to the determined schedule, but is prevented from testing or taking specimens due to incompleteness of the Work, all extra costs for testing attributable to the delay will be back-charged to the Contractor and shall not be borne by the Owner.

1.11 TAKING SPECIMENS

A. Unless otherwise provided in the Contract Documents, all specimens and samples for tests will be taken by the testing laboratory or the Engineer.

1.12 TRANSPORTING SAMPLES

A. The Contractor shall be responsible for transporting all samples, except those taken by testing laboratory personnel, to the testing laboratory.

END OF SECTION

SECTION 01 50 10

TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities.

B. Related Requirements:

1. Section 01 10 00 "Summary" for work restrictions and limitations on utility interruptions.

1.03 USE CHARGES

A. General: Installation and removal of and use charges for temporary facilities shall be included in the Contract Sum unless otherwise indicated. Allow other entities to use temporary services and facilities without cost, including, but not limited to Engineer, testing agencies, and authorities having jurisdiction.

B. Sewer Service: Sewer service use charges shall be by the Contractor utilizing portable facilities.

C. Water Service: Water-service use charges for water used by all entities for construction operations shall be by the Contractor.

D. Electric Power Service: Electric-power-service use charges for electricity used by all entities for construction operations shall be by the Contractor.

1.04 INFORMATIONAL SUBMITTALS

A. Site Plan: Show temporary facilities, utility hookups, staging areas, and parking areas for construction personnel.

B. Erosion and Sedimentation Control Plan: Show compliance with requirements of Georgia Erosion and Sedimentation Control Act of 1975 and any additional federal or local ordinances. All erosion and sediment control measures shall be designed for a 25-year storm event and installed according to the Manual for Erosion and Sediment Control in Georgia (1975 and as amended in the latest edition) and The Georgia Department of Transportation, GDOT Standard Specifications Construction of Transportation Systems, latest edition. Also, Storm Water Discharge(s) will be in strict

compliance with State of Georgia Department of Natural Resources Environmental Protection Division General Permit No. GAR 100002 effective August 1, 2023.

C. Moisture-Protection Plan: Describe procedures and controls for protecting materials and construction from water absorption and damage.

1. Describe delivery, handling, and storage provisions for materials subject to water absorption or water damage.
2. Indicate procedures for discarding water-damaged materials, protocols for mitigating water intrusion into completed Work, and replacing water-damaged Work.
3. Indicate sequencing of work that requires water, such as sprayed fire-resistive materials, plastering, and terrazzo grinding, and describe plans for dealing with water from these operations. Show procedures for verifying that wet construction has dried sufficiently to permit installation of finish materials.

1.05 QUALITY ASSURANCE

- A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.
- B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

1.06 PROJECT CONDITIONS

- A. Temporary Use of Permanent Facilities: Engage Installer of each permanent service to assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.

PART 2 - PRODUCTS

2.01 TEMPORARY FACILITIES

A. Contractor's Field Office

1. The Contractor shall furnish, equip, and maintain a field office at the site of a size required for his operations. The contractor shall provide his own telephone service and shall be readily accessible at the field office, copies of the Contract Documents. Latest approved Shop Drawings, and all field Project related correspondence, Change Order, etc.

B. Project Sign and Sign Panel

1. The General Contractor shall erect a sign at the Project site identifying the Project. The sign shall be erected within twenty-one (21) calendar days after the Notice to Proceed and shall be in accordance with the Specifications and

Section 4
Scope of Work and Technical Specifications
SECTION 01 50 10-3 TEMPORARY FACILITIES AND CONTROLS

details included in this Section. The project sign and sign panel shall be furnished, erected, and maintained by the Contractor at the location designated by the Construction Manager. Wording and colors shall be shown on the detail at the end of this Section.

2. The project sign shall be fabricated, erected, and maintained by the Contractor in accordance with the following specifications:

a. Sign Panel: The sign panel shall be constructed of $\frac{3}{4}$ -inch minimum thickness marine plywood rabbeted into a 2-inch x 4-inch wood frame. All fasteners used in the construction of the sign shall be of a rustproof nature.

b. Painting: All supports, trim, and back of the sign panel shall be painted with at least two (2) coats of the same paint used for the sign face. All paint used shall be exterior grade paint, suitable for use on wood signs.

c. Sign Supports: The supports for the project sign shall be at least two 4-inch by 4-inch treated wood posts. The sign panel shall be securely fastened to the sign supports with at least six (6) $\frac{3}{8}$ -inch diameter galvanized bolts, nuts, and washers. The positioning and alignment of the sign shall be as determined by the Construction Manager.

d. Maintenance: The project sign shall be maintained by the Contractor, in good condition, at all times, for the duration of construction.

e. Removal of Sign from Project Site: The removal of the project sign from the construction site by the Contractor shall be at the completion of construction, when ordered by the Construction Manager.

f. Payment: The cost of the fabrication, erection, maintenance, and removal of the project sign, including all labor and materials, shall be included in the Contractor's Lump Sum Bid. No extra payment will be made for obliterating certain names and offices and replacement thereof of others because of administrative changes during the course of the Contract. Coordinate "Storage and Fabrication Sheds" Paragraph below with Owner for use of existing building for storage and protection of materials to be incorporated into Project.

C. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations.

1. Store combustible materials apart from building.

2.02 EQUIPMENT

A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.

B. HVAC Equipment: Provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.

1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.

C. Air-Filtration Units: Primary and secondary HEPA-filter-equipped portable units with four-stage filtration. Provide single switch for emergency shutoff. Configure to run continuously.

PART 3 - EXECUTION

3.01 INSTALLATION, GENERAL

A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.

B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.02 TEMPORARY UTILITY INSTALLATION

A. General: Install temporary service or connect to existing service.

1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.

B. Sewers and Drainage: Provide temporary utilities to remove effluent lawfully.

1. Connect temporary sewers to system as directed by authorities having jurisdiction.

C. Water Service: Install water service and distribution piping in sizes and pressures adequate for construction.

D. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.

E. Heating and Cooling: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.

Section 4
Scope of Work and Technical Specifications
SECTION 01 50 10-5 TEMPORARY FACILITIES AND CONTROLS

F. Isolation of Work Areas in Occupied Facilities: Prevent dust, fumes, and odors from entering occupied areas.

1. Prior to commencing work, isolate the HVAC system in the area where work is to be performed according to coordination drawings.
 - a. Disconnect supply and return ductwork in the work area from HVAC systems servicing occupied areas.
 - b. Maintain negative air pressure within the work area using HEPA-equipped air-filtration units, starting with the commencement of temporary partition construction, and continuing until the removal of temporary partitions is complete.
2. Maintain dust partitions during the work. Use vacuum collection attachments on dust-producing equipment. Isolate limited work within occupied areas using portable dust-containment devices.
3. Perform daily construction cleanup and final cleanup using approved, HEPA-filter-equipped vacuum equipment.

G. Ventilation and Humidity Control: Provide temporary ventilation required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce ambient conditions required and minimize energy consumption.

1. Provide dehumidification systems when required to reduce substrate moisture levels to the level required to allow installation or application of finishes.

H. Electric Power Service: Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.

1. Install electric power service overhead or underground or as indicated.

I. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.

1. Install and operate temporary lighting that fulfills security and protection requirements without operating the entire system.

J. Telephone Service: Provide temporary telephone service in common-use facilities for use by all construction personnel.

1. At each telephone, post a list of important telephone numbers:
 - a. Police and fire departments.
 - b. Ambulance service.

Section 4
Scope of Work and Technical Specifications
SECTION 01 50 10-6 TEMPORARY FACILITIES AND CONTROLS

- c. Contractor's home office.
- d. Contractor's emergency after-hours telephone number.
- e. Engineer's office.
- f. Owner's office.
- g. Emergency contacts.
- h. Principal subcontractors' field and home offices.

- 2. Provide superintendent with a cellular telephone for use when away from the field office.

3.03 SUPPORT FACILITIES INSTALLATION

- A. General: Comply with the following:

- 1. Maintain support facilities until the Engineer and/or Construction Manager schedules the Substantial Completion inspection. Remove before Final Completion.

- B. Temporary Roads and Paved Areas: Construct and maintain temporary roads and paved areas adequate for construction operations. Locate temporary roads and paved areas within construction limits indicated on Drawings.

- 1. Provide dust-control treatment that is nonpolluting and nontracking. Reapply treatment as required to minimize dust.

- C. Temporary Use of Permanent Roads and Paved Areas: Locate temporary roads and paved areas in the same location as permanent roads and paved areas. Construct and maintain temporary roads and paved areas adequate for construction operations. Extend temporary roads and paved areas within construction limits indicated, as necessary for construction operations.

- 1. Coordinate elevations of temporary roads and paved areas with permanent roads and paved areas.
- 2. Prepare subgrade and install subbase and base for temporary roads.
- 3. Recondition the base after temporary use, including removing contaminated material, regrading, proofrolling, compacting, and testing.
- 4. Delay installation of the final course of permanent hot-mix asphalt pavement until immediately before Substantial Completion. Repair hot-mix asphalt base-course pavement before installation of the final course according to Section 32 12 16 "Asphalt Paving."

- D. Traffic Controls: Comply with the requirements of authorities having jurisdiction.

Section 4
Scope of Work and Technical Specifications
SECTION 01 50 10-7 TEMPORARY FACILITIES AND CONTROLS

1. Protect existing site improvements to remain, including curbs, pavement, and utilities.
 2. Maintain access for fire-fighting equipment and access to fire hydrants.
- E. Parking: Provide temporary parking areas for construction personnel.
- F. Project Signs: Provide project signs as indicated. Unauthorized signs are not permitted. Subcontractors are not authorized to have signage.
1. Identification Signs: Provide project identification signs as indicated on Drawings.
 2. Temporary Signs: Provide other signs as indicated and as required to inform the public and individuals seeking entrance to the project.
 - a. Provide temporary construction signs as required by funding agencies.
 - b. Provide temporary, directional signs for construction personnel and visitors.
 3. Maintain and touch up signs so they are legible at all times.
- G. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction. Comply with progress cleaning requirements in Section 01 70 00 "Execution and Closeout Requirements."
- H. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.
- I. Temporary Stairs: Until permanent stairs are available, provide temporary stairs where ladders are not adequate.

3.04 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at the project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.
- B. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.
1. Comply with work restrictions specified in Section 01 10 00 "Summary."

Section 4
Scope of Work and Technical Specifications
SECTION 01 50 10-8 TEMPORARY FACILITIES AND CONTROLS

C. Temporary Erosion and Sedimentation Control: Comply with authorities having jurisdiction and requirements specified in Section 31 25 00 "Erosion and Sedimentation Controls."

D. Stormwater Control: Comply with requirements of authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.

E. Pest Control: Engage pest-control service to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests and to perform extermination and control procedures at regular intervals so the project will be free of pests and their residues at Substantial Completion. Perform control operations lawfully, using environmentally safe materials.

F. Site Enclosure Fence: Before construction operations begin, furnish and install site enclosure fence in a manner that will prevent people and animals from easily entering the site except by entrance gates.

1. Extent of Fence: As required to enclose the entire project site or portion determined sufficient to accommodate construction operations.

G. Security Enclosure and Lockup: Install a temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security. Lock entrances at the end of each workday.

H. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.

I. Temporary Egress: Maintain temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction.

J. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosures for the building exterior.

1. Where heating or cooling is needed and permanent enclosure is incomplete, insulate temporary enclosures.
2. Where fire-resistance-rated temporary partitions are indicated or are required by authorities having jurisdiction, construct partitions according to the rated assemblies.
3. Insulate partitions to control noise transmission to occupied areas.

4. Seal joints and perimeter. Equip partitions with gasketed dustproof doors and security locks where openings are required.
5. Protect air-handling equipment.
6. Provide walk-off mats at each entrance through the temporary partition.

K. Provide video surveillance of the Construction Site.

3.05 MOISTURE AND MOLD CONTROL

A. Contractor's Moisture-Protection Plan: Avoid trapping water in finished work. Document visible signs of mold that may appear during construction.

B. Exposed Construction Phase: Before installation of weather barriers, when materials are subject to wetting and exposure to airborne mold spores, protect as follows:

1. Protect porous materials from water damage.
2. Protect stored and installed material from flowing or standing water.
3. Keep porous and organic materials from coming into prolonged contact with concrete.
4. Remove standing water from decks.
5. Keep deck openings covered or dammed.

C. Partially Enclosed Construction Phase: After installation of weather barriers but before full enclosure and conditioning of the building, when installed materials are still subject to infiltration of moisture and ambient mold spores, protect as follows:

1. Do not load or install drywall or other porous materials or components, or items with high organic content, into a partially enclosed building.
2. Keep interior spaces reasonably clean and protected from water damage.
3. Periodically collect and remove waste containing cellulose or other organic matter.
4. Discard or replace water-damaged material.
5. Do not install material that is wet.
6. Discard, replace, or clean stored or installed material that begins to grow mold.
7. Perform work in a sequence that allows any wet materials adequate time to dry before enclosing the material in drywall or other interior finishes.

3.06 OPERATION, TERMINATION, AND REMOVAL

A. Maintenance: Maintain facilities in good operating condition until removal.

Section 4
Scope of Work and Technical Specifications
SECTION 01 50 10-10 TEMPORARY FACILITIES AND CONTROLS

1. Maintain the operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid the possibility of damage.
- B. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.
- C. Termination and Removal: Remove each temporary facility when the need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with the temporary facility. Repair damaged work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.
1. Materials and facilities that constitute temporary facilities are the property of the Contractor. The Owner reserves the right to take possession of Project identification signs.
 2. Remove temporary roads and paved areas not intended for or acceptable for integration into permanent construction. Where an area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil. Remove materials contaminated with road oil, asphalt, and other petrochemical compounds, and other substances that might impair the growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at temporary entrances, as required by authorities having jurisdiction.
 3. At Substantial Completion, repair, renovate, and clean permanent facilities used during the construction period. Comply with final cleaning requirements specified in Section 01 70 00 "Execution and Closeout Requirements."

END OF SECTION

SECTION 01 56 16

DUST CONTROL

PART 1 – GENERAL

1.01 SCOPE

A. The Contractor shall limit blowing dust caused by construction operations by applying water or employing other appropriate means or methods to maintain dust control, subject to the approval of the Owner.

B. As a minimum, this may require the use of a water wagon twice a day to suppress dusty conditions.

1.02 PROTECTION OF ADJACENT PROPERTY

A. The Contractor shall visit the site and note the buildings, landscaping, roads, parking areas and other facilities near the Work site that may be damaged by their operations.

B. The Contractor shall make adequate provision to fully protect the surrounding area and will be held fully responsible for all damages resulting from Contractor's operations.

C. The Contractor shall protect all existing facilities (indoors or out) from damage by dust, fumes, spray or spills (indoors or out).

D. Protect motors, bearings, electrical gear, instrumentation and building or other surfaces from dirt, dust, welding fumes, paint spray, spills or droppings causing wear, corrosion, malfunction, failure or defacement by enclosure, sprinkling or other dust palliatives, masking and covering, exhausting or containment.

PART 2 – MATERIALS

(NOT USED)

PART 3 – EXECUTION

(NOT USED)

END OF SECTION

SECTION 01 56 33

JOB SITE SECURITY

PART 1 – GENERAL

1.01 BARRICADES, LIGHTS AND SIGNALS

- A. The Contractor shall furnish and erect such barricades, fences, lights and danger signals and shall provide such other precautionary measures for the protection of persons or property and of the Work as necessary.
- B. Barricades shall be painted in a color that will be visible at night. From sunset to sunrise, the Contractor shall furnish and maintain at least one light at each barricade and sufficient numbers of barricades shall be erected to keep vehicles from being driven on or into any Work under construction.
- C. The contractor shall use safety cones and/or barrels as deemed necessary.
- D. The Contractor will be held responsible for all damage to the Work due to failure of barricades, signs and lights and whenever evidence is found of such damage, the Contractor shall immediately remove the damaged portion and replace it at Contractor's cost and expense.
- E. The Contractor's responsibility for the maintenance of barricades, signs and lights shall not cease until the Project has been accepted by the Owner.

PART 2 – MATERIALS

(NOT USED)

PART 3 – EXECUTION

(NOT USED)

END OF SECTION

SECTION 01 58 00

PROJECT IDENTIFICATION AND SIGNS

PART 1 – GENERAL

1.01 SCOPE

A. The work under this Section shall include the furnishing of a minimum of two painted signs for each Division of work of not less than 32 square feet in area, with painted graphic content that includes:

1. Project title.
2. Owner's name.
3. Names of governmental units participating in the Project.
4. Names and titles of other parties to be directed by the Construction Manager.
5. Logos.

1.02 DESIGN

A. The Contractor shall provide a scale drawing showing the graphic design, style of lettering and colors to the Construction Manager for approval.

PART 2 – PRODUCTS

2.01 MATERIALS

- A. Structure and framing: May be new or used, wood or metal in sound condition, structurally adequate to work and suitable for specified finish.
- B. Sign Surfaces: Exterior soft wood plywood with medium density overlay, standard large sizes to minimize joints.
- C. Thickness: As required by standards to span framing members, to provide even, smooth surface without waves or buckles.
- D. Rough Hardware: Galvanized.
- E. Paint: Exterior quality.

PART 3 – EXECUTION

3.01 ERECTION

A. Erect the sign on the site in a high visibility location, adjacent to the Project as approved by the Construction Manager.

Section 4
Scope of Work and Technical Specifications
SECTION 01 58 00-2 PROJECT IDENTIFICATION AND SIGNS

3.02 MAINTENANCE

- A. Contractor shall maintain the Project Sign in good condition during the Contract period.

END OF SECTION

SECTION 01 62 00

MATERIAL AND EQUIPMENT

PART 1 - GENERAL

1.01 REQUIREMENTS INCLUDED

- A. Material and equipment incorporated into the Work:
 - 1. Conform to applicable specifications and standards.
 - 2. Comply with size, make, type and quality specified, or as specifically approved in writing by the Engineer.
 - 3. Manufactured and Fabricated Products:
 - a. Design, fabricate and assemble in accord with the best engineering and shop practices.
 - b. Manufacturer like parts of duplicate units to standard size and gages, to be interchangeable.
 - c. Two or more items of the same kind shall be identical, by the same manufacturer.
 - d. Products shall be suitable for service conditions.
 - e. Equipment capacities, sizes and dimensions shown or specified shall be adhered to unless variations are specifically approved in writing.
 - 4. Do not use material or equipment for any purpose other than that for which it is designed or is specified.

1.02 RELATED WORK

- A. Conditions of the Contract.
- B. Section 01 11 00: Summary of Work.
- C. Section 01 33 00: Submittals.

1.03 MANUFACTURER'S INSTRUCTIONS

- A. When Contract Documents require that installation of work shall comply with manufacturer's printed instructions, obtain and distribute copies of such instructions to parties involved in the installation, including two copies to Engineer.
 - 1. Maintain one set of complete instructions at the job site during installation and until completion.

B. Handle, install, connect, clean, condition and adjust products in strict accord with such instructions and in conformance with specified requirements.

1. Should job conditions or specified requirements conflict with manufacturer's instructions, consult with Engineer for further instructions.
2. Do not proceed with work without clear instructions.

C. Perform work in accord with manufacturer's instructions. Do not omit any preparatory step or installation procedure unless specifically modified or exempted by Contract Documents.

1.04 TRANSPORTATION AND HANDLING

A. Arrange deliveries of Products in accord with construction schedules, coordinate to avoid conflict with work and conditions at the site.

1. Deliver Products in undamaged condition, in manufacturer's original containers or packaging, with identifying labels intact and legible.
2. Immediately on delivery, inspect shipments to assure compliance with requirements of Contract Documents and approved submittals and that Products are properly protected and undamaged.

B. Provide equipment and personnel to handle Products by methods to prevent soiling or damage to Products or packaging.

1.06 STORAGE AND PROTECTION

A. Store Products in accord with manufacturer's instructions, with seals and labels intact and legible.

1. Store Products subject to damage by the elements in weathertight enclosures.
2. Maintain temperature and humidity within the ranges required by manufacturer's instructions.

B. Exterior Storage:

1. Store fabricated products above the ground, on blocking or skid, prevent soiling or staining. Cover products which are subject to deterioration with impervious sheet coverings, provide adequate ventilation to avoid condensation.
2. Store loose granular materials in a well-drained area on solid surfaces to prevent mixing with foreign matter.

C. Arrange storage in a manner to provide easy access for inspection. Make periodic inspections of stored products to assure that Products are maintained under specified conditions, and free from damage or deterioration.

D. Protection After Installation:

1. Provide substantial coverings as necessary to protect installed Products from damage from traffic and subsequent construction operations. Remove when no longer needed.

1.07 PRODUCT OPTIONS

A. Products List:

1. Within 10 days after Contract Date, submit to Engineer a complete list of major products proposed to be used, with the name of the manufacturer and the installing subcontractor.

B. Contractor's Options:

1. For Products specified only by reference standard, select any product meeting that standard with Owner's approval.
2. For Products specified by naming several products or manufacturers, select any one of the products or manufacturers named, which complies with the specifications with Owner's approval.
3. For Products specified by naming one or more Products or manufacturers and "or equal", Contractor must submit a request for Approval for any Product or manufacturer not specifically named.
4. For Products that are specifically identified herein by a manufacturer's name, model, or catalog number and the words "or equal" or "or approved equal" do not follow the manufacturer's name, only such items may be used in the Base Bid, except as hereinafter provided:
 - a. Substitute products must be accompanied by full descriptive and technical data for products proposed, together with statement of amount of cost addition or deduction from the base bid if alternate is accepted.
 - b. The contractor must judge that such substitute product is of comparable character to the specified item. Unless otherwise specified within this division, the engineer will not approve or disapprove any substitute products before the bids are opened.
 - c. Any changes to other trades as a result of the use of substitute products will be the responsibility of the contractor submitting these products. The Progressive Design-Build Contractor shall include in his bid all additional construction costs (mechanical, electrical, architectural, structural, instrumentation, and engineering redesign costs) associated with that substitute product.

d. In the event that the engineer does not allow the product for use as a substitute, then the product item as specified shall be furnished for the amount indicated in the Base Bid.

e. In the event that the engineer allows the product for use as a substitute, the proposed substitute product shall be furnished and the Base Bid shall be adjusted.

1.08 PRODUCT SUBSTITUTIONS

A. General

1. Allowance of substitute products does not constitute a waiver of the specifications.

2. Substitute products may be deemed equal provided that the "equal" product is the same or better than the product specified in function, performance, reliability, quality, and general configuration.

3. Determination of "equal" in reference to the project design requirements will be made solely by the engineer.

4. No substitute equipment will be considered unless, in the opinion of the engineer, it conforms to the Contract Drawings and Specifications in all respects, except for make and manufacturer and minor details.

5. Should the Progressive Design-Build Contractor propose substitute products, he shall notify the engineer in writing, after the award of the contract, of all DIMENSIONAL, MECHANICAL, ELECTRICAL, INSTRUMENTATION, AND STRUCTURAL CHANGES AND/OR REQUIREMENTS FOR THE SUBSTITUTE EQUIPMENTS USE, INCLUDING INTERRELATIONSHIPS BETWEEN THE PRODUCTS AND/OR FACILITIES and shall REIMBURSE THE ENGINEER THROUGH THE OWNER FOR ANY ASSOCIATED REDESIGN AND/OR CONSTRUCTION DRAWINGS OR SPECIFICATIONS.

6. Reimbursement for the Engineer's re-design work and any other costs resulting from substitutions shall be at the contractor's expense.

B. Submittal Requirements:

1. For a period of 10 days after Contract Date, Engineer will consider written requests from Contractor for substitution of products specified as "or equal" in paragraph 1.07 B.3 above.

2. The engineer will consider substitution requests for products specifically identified by manufacturer, name, and/or catalog number in paragraph 1.07 B.4 above that are included with the bid.

Section 4
Scope of Work and Technical Specifications
SECTION 01 62 00-5 MATERIAL AND EQUIPMENT

3. Submit a separate substitution request for each Product, supported with complete data, with drawings and samples as appropriate, including (as applicable):
 - a. Complete description of the product, equipment, system, process, or function.
 - b. Complete list of system components and dimensional and weight information on separate components and assemblies.
 - c. Drawings, catalog information and cuts.
 - d. Manufacturer's specifications, including materials, description and paint system.
 - e. Performance data and pump curves.
 - f. Horsepower and efficiency of all motors supplied.
 - g. Outside utility requirements for each component.
 - h. List of parameters controlled, monitored, or alarmed.
 - i. Addresses and phone numbers of for the nearest parts warehouse capable of providing full parts replacements and/or repair services.
 - j. Addresses and phone numbers of nearest service centers and a listing of manufacturer's representative's services available at these locations.
 - k. List of the three most recent installations where similar products by the manufacturer or manufacturer's representative are currently in service; include contact name, telephone number, mailing address, and the names of the engineer, owner, and installing contractor. If three installations do not exist, the list should include all that do exist, if any.
 - l. Comparison of the qualities of the proposed substitution with that specified.
 - m. Detailed information on structural, electrical, mechanical, and all other changes or modifications necessary to adapt the product to the arrangement shown and/or functions described on the contract documents.
 - n. Any additional space requirements necessary to provide the minimum clear space around the product as shown.
 - o. Submittal requirements specified herein in the individual product specifications.

Section 4
Scope of Work and Technical Specifications
SECTION 01 62 00-6 MATERIAL AND EQUIPMENT

- p. Effect on the construction schedule.
- q. Any required license fees or royalties.
- r. Availability of maintenance service, and source of replacement materials.

C. Contractor's Representations:

1. A request for a substitution constitutes a representation that the Contractor:

- a. Has investigated the proposed Product and determined that is equal to or superior in all respects to that specified.
- b. Will provide the same warranties or bonds for the substitution as for the Product specified.
- c. Will coordinate the installation of an accepted substitution into the work, and make such other changes as may be required to make the work complete in all respects.
- d. Waives all claims for additional cost, under his responsibility, which may subsequently become apparent.

D. Engineer will review requests for substitutions with reasonable promptness, and notify Contractor, in writing, of the decision to accept or reject the requested substitution.

PART 2 - PRODUCTS

(Not Used)

PART 3 - EXECUTION

(Not Used)

END OF SECTION

SECTION 01 65 00

TRANSPORTATION AND HANDLING

PART 1 – GENERAL

1.01 SCOPE

- A. The Contractor shall provide transportation of all equipment, materials and products furnished under these Contract Documents to the work site.
- B. The Contractor shall provide preparation for shipment, loading, unloading, handling and preparation for installation and all other work and incidental items necessary or convenient to the Contractor for the satisfactory prosecution and completion of the work.
- C. All equipment, materials and products damaged during transportation or handling shall be repaired or replaced by the Contractor at no additional cost to the Owner prior to being incorporated into the work.
- D. The Contractor shall maintain and keep in good repair the Work covered by these Drawings and Specifications until acceptance by the Owner.

1.02 TRANSPORTATION

- A. All equipment shall be suitably boxed, crated or otherwise protected during transportation.
- B. Where equipment will be installed using existing cranes or hoisting equipment, the Contractor shall ensure that the weights of the assembled sections do not exceed the capacity of the cranes or hoisting equipment.
- C. Small items and appurtenances such as gauges, valves, switches, instruments and probes which could be damaged during shipment shall be removed from the equipment prior to shipment, packaged and shipped separately.
- D. All openings shall be plugged or sealed to prevent the entrance of water or dirt.

1.03 HANDLING

- A. All equipment, materials and products shall be carefully handled to prevent damage or excessive deflections during unloading or transportation.
- B. Lifting and handling drawings and instructions furnished by the manufacturer or supplier shall be strictly followed.
 - 1. Eyebolts or lifting lugs furnished on the equipment shall be used in handling the equipment.
 - 2. Shafts and operating mechanisms shall not be used as lifting points.

Section 4
Scope of Work and Technical Specifications
SECTION 01 65 00-2 TRANSPORTATION AND HANDLING

3. Spreader bars or lifting beams shall be used when the distance between lifting points exceeds that permitted by standard industry practice.
- C. Under no circumstances shall equipment or products such as pipe, structural steel, castings, reinforcement, lumber, piles, poles, etc., be thrown or rolled off of trucks onto the ground.
- D. Slings and chains shall be padded as required to prevent damage to protective coatings and finishes.

PART 2 – MATERIALS

(NOT USED)

PART 3 – EXECUTION

(NOT USED)

END OF SECTION

SECTION 01 66 00

STORAGE AND PROTECTION

PART 1 – GENERAL

1.01 SCOPE

A. The work under this Section includes, but is not necessarily limited to, the furnishing of all labor, tools and materials necessary to properly store and protect all materials, equipment, products and the like, as necessary for the proper and complete performance of the Work.

1.02 PIPE

A. Pipe and appurtenances shall be handled, stored, and installed as recommended by the manufacturer. Pipes with paint, tape coatings, linings or the like shall be stored to protect the coating or lining from physical damage or other deterioration. Pipes shipped with interior bracing shall have the bracing removed only when recommended by the pipe manufacturer.

1.03 STORAGE

A. During the interval between the delivery of equipment to the site and installation, all equipment, unless otherwise specified, shall be stored in an enclosed space affording protection from weather, dust and mechanical damage and providing favorable temperature, humidity and ventilation conditions to ensure against equipment deterioration. Manufacturer's recommendations shall be adhered to in addition to these requirements.

B. Equipment and materials to be located outdoors may be stored outdoors if protected against moisture condensation. Equipment shall be stored at least 6 inches above ground. Temporary power shall be provided to energize space heaters or other heat sources for control of moisture condensation. Space heaters or other heat sources shall be energized without disturbing the sealed enclosure.

C. Should the Contractor choose to store material or equipment or use for assembly property which is not owned by the Fulton County or the Contractor, a letter of permission signed by the legal owner of the property shall be obtained by the Contractor and submitted to the Construction Manager a minimum of 24 hours prior to delivery. All material and equipment stored at any facility other than the site shall be tagged with the Owner's name and the project number. Payment shall not be made for "Stored Materials" for any material stored at locations or in any manner not suitable to the Owner.

D. Equipment and products stored outdoors shall be supported above the ground on suitable wooden blocks or braces arranged to prevent excessive deflection or bending

between supports. Items such as pipe, structural steel and sheet construction products shall be stored with one end elevated to facilitate drainage.

E. Unless otherwise permitted in writing by the Construction Manager, building products and materials such as cement, grout, plaster, gypsum board, particleboard, resilient flooring, acoustical tile, paneling, finish lumber, insulation, wiring, etc., shall be stored indoors in a dry location.

F. Building products such as rough lumber, plywood, concrete block and structural tile may be stored outdoors under a properly secured waterproof covering.

G. Tarps and other coverings shall be supported above the stored equipment or materials on wooden strips to provide ventilation under the cover and minimize condensation. Tarps and covers shall be arranged to prevent ponding of water.

H. All materials shall meet the requirements of these Specifications at the time that they are used in the Work.

I. Store products in accordance with manufacturer's instructions.

1.04 PROTECTION

A. Use all means necessary to protect the materials, equipment and products of every section before, during and after installation and to protect the installed work and materials of all other trades.

B. All materials shall be delivered, stored and handled to prevent the inclusion of foreign materials and damage by water, breakage, vandalism or other causes.

C. Substantially constructed weathertight storage sheds, with raised floors, shall be provided and maintained as may be required to adequately protect those materials and products stored on the site which may require protection from damage by the elements.

1.05 DAMAGE

A. Equipment, products and materials shall be shipped, handled, stored, and installed in ways which will prevent damage to the items. Damaged items will not be permitted as part of the work except in cases of minor damage that have been satisfactorily repaired.

B. In the event of damage, immediately make all repairs and replacements necessary for the approval of the Construction Manager and at no additional cost to the Owner.

C. Damage shall be corrected to conform to the requirements of the Contract before the assembly is incorporated into the Work.

D. All property damaged by reason of storing of material shall be properly replaced at no additional cost to the Owner.

1.06 EXTENDED STORAGE

A. In the event that certain items of major equipment, such as large diameter valves, have to be stored for an extended period of time, the Contractor shall provide satisfactory long-term storage facilities which are acceptable to the Construction Manager.

B. The Contractor shall provide all special packaging, protective coverings, protective coatings, power, nitrogen purge, desiccants, lubricants and exercising necessary or recommended by the manufacturer to properly maintain and protect the equipment during the period of extended storage.

C. All equipment, materials and products shall be carefully handled to prevent damage or excessive deflections during unloading or transportation.

1.07 PACKAGE AND MARKING

A. All equipment shall be protected against damage from moisture, dust, handling, or other cause during transport from manufacturer's premises to site. Each item or package shall be marked with the number unique to the specification reference covering the item.

B. Stiffeners shall be used where necessary to maintain shapes and to give rigidity. Parts of equipment shall be delivered in assembled or sub-assembled units where possible

1.08 IDENTIFICATION

A. Each item of equipment and valve shall have permanently affixed to it a label or tag with its equipment or valve number designated in this contract. Marker shall be of stainless steel. Location of label will be easily visible.

PART 2 – MATERIALS

(NOT USED)

PART 3 – EXECUTION

(NOT USED)

END OF SECTION

SECTION 01 70 00

EXECUTION AND CLOSEOUT REQUIREMENTS

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Field engineering.
2. Closeout procedures.
3. Starting of systems.
4. Demonstration and instructions.
5. Testing, adjusting, and balancing.
6. Project record documents.
7. Operation and maintenance data.
8. Manual for materials and finishes.
9. Manual for equipment and systems.
10. Spare parts and maintenance products.
11. Product warranties and product bonds.
12. Examination.
13. Preparation.
14. Execution.
15. Cutting and patching.
16. Protecting installed construction.
17. Final cleaning.

B. Related Requirements:

1. Section 01 33 00 "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.
2. Section 01 78 23 "Operation and Maintenance Data" for submitting operation and maintenance manuals.

1.02 FIELD ENGINEERING

Section 4
Scope of Work and Technical Specifications
SECTION 01 70 00-2 EXECUTION AND CLOSEOUT REQUIREMENTS

- A. Employ land surveyor registered in the state of Georgia acceptable to Owner.
- B. Locate, protect, and survey control and reference points. Promptly notify Engineer of discrepancies discovered.
- C. Control datum for survey as indicated on Drawings.
- D. Verify setbacks and easements; confirm Drawing dimensions and elevations.
- E. Provide field engineering services. Establish elevations, lines, and levels using recognized engineering survey practices.
- F. Submit copy of certificate signed by land surveyor certifying elevations and locations of the Work are in conformance with Contract Documents.
- G. On completion of foundation walls and major Site improvements, prepare certified survey illustrating dimensions, locations, angles, and elevations of construction and site work.
- H. Protect survey control points prior to starting Site Work; preserve permanent reference points during construction.
- I. Replace dislocated survey control points based on original survey control. Make no changes without prior written notice to Engineer.

1.03 CLOSEOUT PROCEDURES

- A. Prerequisites to Substantial Completion: Complete the following items before requesting Certification of Substantial Completion, either for the entire Work or for portions of Work:
 - 1. Submit operation and maintenance manuals, Project record documents, and other similar final record data in compliance with this Section.
 - 2. Complete facility startup, testing, adjusting, balancing of systems and equipment, demonstrations, and instructions to Owner's operating and maintenance personnel as specified in compliance with this Section.
 - 3. Conduct inspection to establish basis for request that Work is substantially complete. Create comprehensive list (initial punch list) indicating items to be completed or corrected, value of incomplete or nonconforming Work, reason for being incomplete, and date of anticipated completion for each item. Include copy of list with request for Certificate of Substantial Completion.
 - 4. Obtain and submit releases enabling Owner's full, unrestricted use of Project and access to services and utilities. Include certificate of occupancy, operating certificates, and similar releases from authorities having jurisdiction and utility companies.

Section 4
Scope of Work and Technical Specifications
SECTION 01 70 00-3 EXECUTION AND CLOSEOUT REQUIREMENTS

5. Deliver tools, spare parts, extra stocks of material, O & M Manuals (electronic and 3 hard copies), and similar physical items to Owner.
6. Make final change-over of locks and transmit keys directly to Owner. Advise Owner's personnel of change-over in security provisions.
7. Discontinue or change over and remove temporary facilities and services from Project Site, along with construction tools, mockups, and similar elements.
8. Perform final cleaning according to this Section.

B. Substantial Completion Inspection:

1. When Contractor considers Work to be substantially complete, submit to Engineer:
 - a. Written certificate that Work, or designated portion, is substantially complete.
 - b. List of items to be completed or corrected (initial punch list).
2. Within seven days after receipt of request for Substantial Completion, Engineer & Owner will make inspection to determine whether Work or designated portion is substantially complete.
3. Should Engineer determine that Work is not substantially complete:
 - a. Owner will promptly notify Contractor in writing, stating reasons for its opinion.
 - b. Contractor shall remedy deficiencies in Work and send second written request for Substantial Completion to Engineer.
 - c. Engineer will re-inspect Work.
 - d. Redo and Inspection of Deficient Work: Repeated until Work passes Engineer and Owner's inspection.
4. When Engineer finds that Work is substantially complete, Engineer will:
 - a. Prepare Certificate of Substantial Completion on EJCDC C-625 - Certificate of Substantial Completion accompanied by Contractor's list of items to be completed or corrected as verified and amended by Engineer and Owner (final punch list).
 - b. Submit Certificate to Owner and Contractor for their written acceptance of responsibilities assigned to them in Certificate.
5. After Work is substantially complete, Contractor shall:

Section 4
Scope of Work and Technical Specifications
SECTION 01 70 00-4 EXECUTION AND CLOSEOUT REQUIREMENTS

- a. Allow Owner occupancy of Project under provisions stated in Certificate of Substantial Completion.
 - b. Complete Work listed for completion or correction within time period stipulated.
- C. Prerequisites for Final Completion: Complete the following items before requesting final acceptance and final payment.
 - 1. When Contractor considers Work to be complete, submit written certification that:
 - a. Contract Documents have been reviewed.
 - b. Work has been examined for compliance with Contract Documents.
 - c. Work has been completed according to Contract Documents.
 - d. Work is completed and ready for final inspection.
 - 2. Submittals: Submit the following:
 - a. Final punch list indicating all items have been completed or corrected.
 - b. Final payment request with final releases and supporting documentation not previously submitted and accepted. Include certificates of insurance for products and completed operations where required.
 - c. Specified warranties, workmanship/maintenance bonds, maintenance agreements, and other similar documents.
 - d. Accounting statement for final changes to Contract Sum.
 - e. Contractor's affidavit of payment of debts.
 - f. Contractor affidavit of release of liens.
 - g. Consent of surety to final payment.
 - 3. Perform final cleaning for Contractor-soiled areas according to this Section.
- D. Final Completion Inspection:
 - 1. Within seven days after receipt of request for final inspection, Owner and Engineer will make an inspection to determine whether Work or designated portion is complete.
 - 2. Should Engineer consider Work to be incomplete or defective:

Section 4
Scope of Work and Technical Specifications
SECTION 01 70 00-5 EXECUTION AND CLOSEOUT REQUIREMENTS

- a. Engineer will promptly notify Contractor in writing, listing incomplete or defective Work.
- b. Contractor shall remedy stated deficiencies and send a second written request to confirm Work is complete.
- c. Engineer will re-inspect Work.
- d. Redo and Inspection of Deficient Work: Repeated until Work passes inspection.

1.04 STARTING OF SYSTEMS

- A. Coordinate schedule for startup of various equipment and systems. Start-up schedule submitted and approved.
- B. Notify Engineer and Owner seven days prior to the startup of each item.
- C. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, and conditions which may cause damage.
- D. Verify that tests, meter readings, and electrical characteristics agree with those required by equipment or system manufacturer.
- E. Verify that wiring and support components for equipment are complete and tested.
- F. Execute startup under the supervision of the manufacturer's representative or Contractors' personnel according to manufacturer's instructions.
- G. When specified in individual Specification Sections, require the manufacturer to provide an authorized representative who will be present at Site to inspect, check, and approve equipment or system installation prior to startup and will supervise placing equipment or system in operation.
- H. Submit a written report that equipment or system has been properly installed and is functioning correctly, as well as a certificate/field report from the manufacturer from his inspection of the installation.

1.05 DEMONSTRATION AND INSTRUCTIONS

- A. Demonstrate operation and maintenance of products to Owner's personnel as equipment becomes available for use and not later than 14 days prior to the date of Substantial Completion.
- B. Demonstrate Project equipment and instruct in a classroom environment located at the facility. Class shall be instructed by a qualified manufacturer's representative who is knowledgeable about the Project. Provide video of all training.

Section 4
Scope of Work and Technical Specifications
SECTION 01 70 00-6 EXECUTION AND CLOSEOUT REQUIREMENTS

C. Use operation and maintenance manuals as a basis for instruction. Review contents of the manual with Owner's personnel in detail to explain all aspects of operation and maintenance.

D. Demonstrate startup, operation, control, adjustment, troubleshooting, servicing, maintenance, and shutdown of each item of equipment at a scheduled time, at a designated location.

E. Prepare and insert additional data in operations and maintenance manuals when the need for additional data becomes apparent during instruction.

1.06 TESTING, ADJUSTING, AND BALANCING

A. Contractor, with Engineer approval, will appoint and employ the services of an independent firm to perform testing, adjusting, and balancing. Contractor shall pay for services.

B. Reports will be submitted by an independent firm to Engineer indicating observations and results of tests and indicating compliance or noncompliance with the requirements of Contract Documents.

1.07 PROJECT RECORD DOCUMENTS

A. Maintain on Site one set of the following record documents; record actual revisions to the Work:

1. Drawings.
2. Specifications.
3. Addenda.
4. Change Orders and other modifications to the Contract.
5. Reviewed Shop Drawings, product data, and Samples.
6. Manufacturer's instruction for assembly, installation, and adjusting.

B. Ensure entries are complete and accurate, enabling future reference by Owner.

C. Store record documents separate from documents used for construction.

D. Record information concurrent with construction progress, not less than weekly.

E. Specifications: Legibly mark and record, at each product Section, description of actual products installed, including the following:

1. Manufacturer's name and product model and number.
2. Product substitutions or alternates used.
3. Changes made by Addenda and modifications.

Section 4
Scope of Work and Technical Specifications
SECTION 01 70 00-7 EXECUTION AND CLOSEOUT REQUIREMENTS

F. Record Drawings: Legibly mark each item to record actual construction as follows:

1. Include Contract modifications such as Addenda, supplementary instructions, change directives, field orders, minor changes in the Work, design clarification, RFI, and change orders.
2. Include locations of concealed elements of the Work.
3. Identify depth of buried utility lines and provide dimensions showing distances from permanent facility components that are parallel to utilities.
4. Dimension ends, corners, and junctions of buried utilities to permanent facility components using triangulation.
5. Identify and locate existing buried or concealed items encountered during Project.
6. Measure depths of foundations in relation to finish floor datum.
7. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
8. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
9. Field changes of dimension and detail.
10. Details not on original Drawings.

G. Submit marked-up paper copy documents to Engineer with claim for final Application for Payment.

1.08 OPERATION AND MAINTENANCE DATA

A. See Section 01 78 23 "Operation and Maintenance Data" for operation and maintenance manuals.

PART 2 – PRODUCTS

Not Used

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify that existing Site conditions and substrate surfaces are acceptable for subsequent Work. Beginning new Work means acceptance of existing conditions.
- B. Verify that existing substrate is capable of structural support or attachment of new Work being applied or attached.

Section 4
Scope of Work and Technical Specifications
SECTION 01 70 00-8 EXECUTION AND CLOSEOUT REQUIREMENTS

- C. Examine and verify specific conditions described in individual Specification Sections.
- D. Verify that utility services are available with correct characteristics and in correct locations.

3.02 PREPARATION

- A. Clean substrate surfaces prior to applying next material or substance according to manufacturer's instructions.
- B. Seal cracks or openings of substrate prior to applying next material or substance.
- C. Apply manufacturer-required or -recommended substrate primer, sealer, or conditioner prior to applying new material or substance in contact or bond.

3.03 EXECUTION

- A. Comply with manufacturer's installation instructions, performing each step in sequence. Maintain one set of manufacturer's installation instructions at Project Site during installation and until completion of construction.
- B. When manufacturer's installation instructions conflict with Contract Documents, request clarification from Engineer before proceeding.
- C. Verify that field measurements are as indicated on approved Shop Drawings or as instructed by manufacturer.
- D. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, or disfigurement.
 - 1. Secure Work true to line and level and within specified tolerances, or if not specified, industry-recognized tolerances.
 - 2. Physically separate products in place, provide electrical insulation, or provide protective coatings to prevent galvanic action or corrosion between dissimilar metals.
 - 3. Exposed Joints: Provide uniform joint width and arrange to obtain best visual effect. Refer questionable visual-effect choices to Engineer for final decision.
- E. Allow for expansion of materials and building movement.
- F. Climatic Conditions and Project Status: Install each unit of Work under conditions to ensure best possible results in coordination with the entire Project.
 - 1. Isolate each unit of Work from incompatible Work as necessary to prevent deterioration.

Section 4
Scope of Work and Technical Specifications
SECTION 01 70 00-9 EXECUTION AND CLOSEOUT REQUIREMENTS

2. Coordinate enclosure of Work with required inspections and tests to minimize necessity of uncovering Work for those purposes.
- G. Mounting Heights: Where not indicated, mount individual units of Work at industry-recognized standard mounting heights for the particular application indicated.
1. Refer questionable mounting height choices to Engineer for final decision.
 2. Elements Identified as Accessible to Handicapped: Comply with applicable codes and regulations.
- H. Adjust operating products and equipment to ensure smooth and unhindered operation.
- I. Clean and perform maintenance on installed Work as frequently as necessary through the remainder of the construction period. Lubricate operable components as recommended by the manufacturer.

3.04 CUTTING AND PATCHING

- A. Employ skilled and experienced installers to perform cutting and patching.
- B. Submit written request in advance of cutting or altering elements affecting:
1. Structural integrity of element.
 2. Integrity of weather-exposed or moisture-resistant elements.
 3. Efficiency, maintenance, or safety of element.
 4. Visual qualities of sight-exposed elements.
 5. Work of Owner or separate contractor.
- C. Execute cutting, fitting, and patching including excavation and fill to complete Work and to:
1. Fit the several parts together, to integrate with other Work.
 2. Uncover Work to install or correct ill-timed Work.
 3. Remove and replace defective and nonconforming Work.
 4. Remove samples of installed Work for testing.
 5. Provide openings in elements of Work for penetrations of mechanical and electrical Work.
- D. Execute Work by methods to avoid damage to other Work and to provide proper surfaces to receive patching and finishing.
- E. Cut masonry and concrete materials using masonry saw or core drill.

Section 4
Scope of Work and Technical Specifications
SECTION 01 70 00-10 EXECUTION AND CLOSEOUT REQUIREMENTS

- F. Restore Work with new products according to requirements of Contract Documents.
- G. Fit Work tight to pipes, sleeves, ducts, conduits, and other penetrations through surfaces.
- H. Maintain integrity of wall, ceiling, or floor construction; completely seal voids.
- I. At penetrations of fire-rated walls, partitions, ceiling, or floor construction, completely seal voids with fire-rated material to full thickness of penetrated element.
- J. Refinish surfaces to match adjacent finishes. For continuous surfaces, refinish to nearest intersection; for assembly, refinish entire unit.
- K. Identify hazardous substances or conditions exposed during the Work to Engineer for decision or remedy.

3.05 PROTECTING INSTALLED CONSTRUCTION

- A. Protect installed Work and provide special protection where specified in individual Specification Sections.
- B. Provide temporary and removable protection for installed products. Control activity in immediate Work area to prevent damage.
- C. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.
- D. Use durable sheet materials to protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects.
- E. Prohibit traffic or storage upon waterproofed or roofed surfaces. When traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.
- F. Prohibit traffic from landscaped areas.

3.06 FINAL CLEANING

- A. Execute final cleaning prior to final Project assessment.
 - 1. Employ experienced personnel or professional cleaning firm.
- B. Clean interior and exterior surfaces exposed to view; remove temporary labels, stains, and foreign substances; polish transparent and glossy surfaces, and vacuum carpeted and soft surfaces.
- C. Clean equipment and fixtures to sanitary condition with appropriate cleaning materials.
- D. Clean filters of operating equipment.

Section 4
Scope of Work and Technical Specifications
SECTION 01 70 00-11 EXECUTION AND CLOSEOUT REQUIREMENTS

- E. Clean debris from roofs, gutters, downspouts, and drainage systems.
- F. Clean Site; sweep paved areas, rake clean landscaped surfaces.
- G. Remove waste and surplus materials, rubbish, and construction facilities from Site. Materials not in dumpster will be immediately removed from site.

END OF SECTION

SECTION 01 71 33

PROTECTION AND MAINTENANCE OF PROPERTY AND WORK

PART 1 – GENERAL

1.01. SUMMARY

A. This Section specifies protection and maintenance of underground and above ground utilities, structures, fences, parking strips, sidewalks, driveways, streets, and other improvements which may be affected by the Work.

1.02. SUBMITTALS

A. Procedures: Section 01 33 00.

B. Action submittal items:

1. Listing and schedule of all potholing.
2. Listing of all utilities/facilities to be physically protected and relocated.

C. Informational submittal items for this section:

1. Shoring for all affected structures and utilities.
2. Submit detail drawings of proposed methods to support, protect, and buttress utilities and structures where the depth of the excavation is greater than the horizontal distance from the structure or utility.

1.03. LOCATION OF EXISTING UNDERGROUND FACILITIES

A. The Drawings indicate the existence of underground facilities known to the Owner.

1. Utilities are shown schematically on the plans and are not necessarily accurate in location as to plan or elevation.
2. Determine the location of all utilities that may be impacted during construction.
3. The Contractor shall familiarize himself with and comply with the provisions of O.C.G.A. Section 25-9-1 et. seq.

B. The Contractor shall call, by law, the Utilities Protection Center, d/b/a Georgia 811 at "811" or 1-800-282-7411 and shall request that all owners of utilities, including, but not limited to, gas companies, electric companies, telephone companies, cable companies and governmental units, prior to starting any excavation of the Project, locate and mark their respective facilities.

Section 4
Scope of Work and Technical Specifications

SECTION 01 71 33-2 PROTECTION AND MAINTENANCE OF PROPERTY AND WORK

- C. Locate existing underground utilities. Review with the Owner the locations of existing utilities in relation to the new construction and evaluate areas of conflict.
- D. Excavate and expose all major and minor existing utilities prior to new construction to determine utility elevations in relation to the new facilities.
- E. Examine and repair all pipelines prior to pipelines being buried.

1.04. EXISTING UTILITIES AND FACILITIES

- A. Protect, modify, and/or relocate all existing utilities required to complete the Work.
- B. The locations of existing major utilities, whether above ground or underground, are indicated on the Drawings.
 - 1. This information has been obtained from utility maps and field surveys.
 - 2. The Owner does not guarantee the accuracy or completeness of this information, and it is to be understood that other above ground or underground facilities not shown on the Drawings may be encountered during the course of the Work.
- C. Contractor shall be responsible for damages resulting from any failure to contact utility owners for location, routing and marking of a specific utility and its subsequent effects.
- D. The Drawings may show underground utilities which are to be relocated. Contractor shall be responsible for all these relocations prior to commencing work in the area.
- E. Protect, modify or relocate existing utilities and facilities required to accommodate Contractor's means and methods.
 - 1. Specific means and methods to be utilized by the Contractor are not known to the Owner. Therefore, the Owner will not be liable for utility protection, modification and relocation not shown on the Drawings that are required by the Contractor due to its means and methods.
 - 2. It is the Contractor's responsibility to determine the work required by the Construction Documents and make provision for protection, modification and relocation required.
 - 3. Coordinate all protection, modification and relocation work through the affected utility.
 - 4. Complete work to the utility owner's requirements and standards.
- F. Underground Utilities:

Section 4
Scope of Work and Technical Specifications

SECTION 01 71 33-3 PROTECTION AND MAINTENANCE OF PROPERTY AND WORK

1. For the purpose of this Section an underground utility will be defined as a transmission, collection or distribution line where it would be customary to expect that drawings would exist for the line and the utility owner would be aware of the line.
 2. An existing underground utility is considered to be in conflict if it crosses or projects into the specified excavation at an elevation between the top and bottom of the new facility or when parallel to the new facility, and projects into the specified excavation.
 3. Contractor shall be responsible for all protection, affects and damage on utilities not in conflict with the new construction, whether or not the utilities are shown on the Drawings.
 4. When not shown on the Drawings and in conflict with the new construction, meet and agree with the Owner on how to proceed.
 5. When not shown on the Drawings and no conflict with the new facility exists, no additional payment will be considered.
 6. When in a substantially different location and not in conflict with the new construction, no additional payment will be considered.
 7. When in a substantially different location and in conflict with the new construction, reimbursement for additional work per the General Conditions.
- G. Abandoned pipelines shown on the Drawings shall be removed and plugged per the local agency requirements when encountered.
- H. Locate existing underground utilities with the field staking. Review with the Owner the locations of existing utilities in relation to the new construction and evaluate areas of conflict
- I. Storm and Sanitary Sewers:
1. Existing live sewers shall remain in service. Adequate provision shall be made for disposal of existing sewage flow.
 - a. Immediately repair construction damage to the existing sewer system and manholes to a condition equal to or better than that existing prior to the damage.
 - b. Repair all damage which results from the disturbance of the existing sewer.
 2. Remove water accumulating during construction from the new sewers and prevent it from entering existing lines.

Section 4
Scope of Work and Technical Specifications

SECTION 01 71 33-4 PROTECTION AND MAINTENANCE OF PROPERTY AND WORK

3. Flush existing pipes which were affected by the construction to the point of the next upstream connection and repair any pipelines or manholes damaged by gravel, rocks, or other debris that has entered the existing system during construction.

4. The physical connection to an existing manhole or sewer line shall not be made until so authorized by the Owner.

J. Aboveground Electrical, Cable, and Communication Facilities:

1. Attention is called to all overhead items including, but not limited to, power, communication and telephone lines, temporary traffic signals, traffic signal mast arms, overhead sign bridges, sign support span wires, signs, and street lights.

2. Observe the location of these overhead facilities and plan and conduct work operations, accordingly.

3. Take precautions to protect and avoid damage to all overhead facilities.

4. Relocate facilities as required to meet the means and methods to be utilized.

5. Observe and investigate the presence of facilities that may be affected by the Work.

a. Consult with and rely on the information given by utility owners and operators to determine the extent of any hazards and measures required.

b. Determine the extent of any hazard created by facilities in all areas and follow approved safety procedures during the work.

6. Support poles at risk of being undermined by the Work.

7. Follow the requirements of the local power company for all energized primary conductors.

a. For 50 kV lines and less, at no time shall personnel or equipment approach closer than 10 feet to any energized primary conductors.

b. For greater than 50 kV, meet the requirements of the local power company.

K. Underground Electrical, Cable, and Communication Facilities:

1. Determine the protection necessary to proceed safely to protect these underground facilities.

L. Gas:

Section 4
Scope of Work and Technical Specifications

SECTION 01 71 33-5 PROTECTION AND MAINTENANCE OF PROPERTY AND WORK

1. As required by the appropriate utility owner, protect, maintain, support in place, or relocate all gas mains crossing the pipeline trenches.
2. Provide a minimum of 12 inches of clearance, measured from edge to edge, between gas mains or gas service lines and new facilities
 - a. If relocating either utility is not practical, a protective wrap shall be provided for the entire distance where less than 12 inches of vertical clearance and less than 6 inches of horizontal clearance are provided.
 - b. Wrapping material shall consist of either a split polyvinyl chloride (PVC) pipe or PVC wrapping of at least 0.04 inch in thickness, and shall be applied to either one of the pipes.
3. All abandoned gas mains encountered in the trench area shall be removed.
4. All temporary gas service slack lines shall be protected and maintained during pipeline installation.
5. Notify the Owner and the utility at least two business days (minimum of 48 hours) in advance of any excavation in the vicinity of any gas piping.
6. The utility may require one of its inspectors to be onsite anytime work is conducted near gas lines.

M. Water:

1. As required by the appropriate utility, protect, maintain, support in place, or relocate all water pipelines affected by the Work.
2. Maintain water service along the alignment of work at all times.
3. Thrust blocks may not be shown on the Drawings and shall be assumed to be present at all water line deflections of 11-1/4 degrees or greater.
4. Notify the Owner in writing immediately of any damage. Begin repairs immediately, and work continuously until water service is restored.

N. Roadways:

1. Take adequate precautions to protect existing sidewalks, curbs, pavements, utilities, adjoining property, and structures, and avoid damage.
2. Traffic signage, paint striping, and channelization shall be protected and replaced if damaged.
3. Maintain the existing illumination pattern for signs and roads at all times.
4. Install temporary roadway lighting as necessary.

Section 4
Scope of Work and Technical Specifications
SECTION 01 71 33-6 PROTECTION AND MAINTENANCE OF PROPERTY AND WORK

5. Access for emergency equipment shall be maintained at all times.

1.05. SHORING AND BRACING

A. Shore up, brace, under-pin, and protect as necessary, the foundations and other parts of existing structures adjoining the site of the Work that may be affected by the Work.

B. Contractor is responsible for any damages because of settlements or the loss of lateral or subjacent support of adjoining property and from all loss and damages to adjoining and adjacent structures and their premises.

C. Fully comply with the requirements of the authority having jurisdiction (AHJ) and the State of Georgia, as applicable.

1.06. EMERGENCIES

A. Whenever work endangers the safety of life or property, including adjoining property or property in the immediate proximity of the Work, take all reasonable and prudent actions to prevent threatened loss or injury.

PART 2 – MATERIALS

(NOT USED)

PART 3 – EXECUTION

3.01. GENERAL

A. Contact the Owner and the affected utilities prior to an excavation per the General Conditions.

B. Pothole to locate and expose all utility locations to be affected by the Work prior to new construction in the area of the utility.

C. Adjust work when location of utility is different than shown on the Drawings and materially impacts construction.

D. If the utility requires relocation not shown on the Drawings and the Contractor incurs additional cost, the Owner will consider additional costs.

E. Relocation of minor utilities such as irrigation lines less than 4 inches, water service lines, building drainage pipes will be considered incidental and will not be considered for additional costs.

F. If damage to a utility occurs, repair damage to the requirements of the utility owner prior to backfilling said utility.

END OF SECTION

SECTION 01 74 00

CLEANING AND WASTE MANAGEMENT

PART 1 – GENERAL

1.01 SCOPE

A. This Section covers the general cleaning which the Contractor shall be required to perform both during construction and before final acceptance of the Project unless otherwise shown on the Drawings or specified elsewhere in these Specifications.

1.02 QUALITY ASSURANCE

A. Daily, and more often if necessary, conduct inspections verifying that requirements of cleanliness are being met.

B. In addition to the standards described in this Section, comply with all pertinent requirements of governmental agencies having jurisdiction.

1.03 HAZARDOUS MATERIAL AND WASTE

A. The Contractor shall handle hazardous waste and materials in accordance with applicable local, State, and Federal regulations. Waste shall also be disposed of in approved landfills as applicable.

B. The Contractor shall prevent accumulation of wastes which create hazardous conditions.

C. Burning or burying rubbish and waste materials on the site will not be allowed.

D. Disposal of hazardous wastes or materials into sanitary or storm sewers will not be allowed.

PART 2 – PRODUCTS

2.01 CLEANING MATERIALS AND EQUIPMENT

A. Provide all required personnel, equipment and materials needed to maintain the specified standard of cleanliness.

2.02 COMPATIBILITY

A. Use only the cleaning materials, methods and equipment which are compatible with the surface being cleaned, as recommended by the manufacturer of the material or as approved by the Owner.

PART 3 – EXECUTION

3.01 PROGRESS CLEANING

Section 4
Scope of Work and Technical Specifications
SECTION 01 74 00-2 CLEANING AND WASTE MANAGEMENT

A. General

1. Do not allow the accumulation of scrap, debris, waste material and other items not required for construction of this Work.
2. At least each week and more often if necessary, completely removes all scrap, debris and waste material from the job site.
3. Provide adequate storage for all items awaiting removal from the job site, observing all requirements for fire protection and protection of the environment.

B. Site

1. Daily, and more often if necessary, inspect the site and pick up all scrap, debris and waste material. Remove all such items to the place designated for their storage.
2. Restack materials stored on site weekly.
3. At all times maintain the site in a neat and orderly condition which meets the approval of the Owner.

C. Structures

1. Weekly, and more often if necessary, inspect the structures and pick up all scrap, debris and waste material. Remove all such items to the place designated for their storage.
2. Weekly, and more often if necessary, sweep all interior spaces clean. "Clean", for the purpose of this subparagraph, shall be interpreted as meaning free from dust and other material capable of being removed by using a hand-held broom.
3. As required preparatory to installation of successive materials, clean the structures or pertinent portions as recommended by the manufacturer of the successive material.
4. Following the installation of finish floor materials, clean the finish floor daily. "Clean", for the purpose of this Paragraph, shall be interpreted as meaning free from all foreign material which, in the opinion of the Owner, may be injurious to the finish floor material.
5. Schedule cleaning operation so that dust and other contaminants resulting from cleaning operations will not fall on wet, recently painted surfaces.

3.02 FINAL CLEANING

- A. Definitions:** Unless otherwise specifically specified, "clean" for the purpose of this Article shall be interpreted as the level of cleanliness generally provided by

Section 4
Scope of Work and Technical Specifications
SECTION 01 74 00-3 CLEANING AND WASTE MANAGEMENT

commercial building maintenance subcontractors using commercial quality building maintenance equipment and materials.

B. General: Prior to completion of the Work, remove from the job site all tools, surplus materials, equipment, scrap, debris and waste. Conduct final progress cleaning as described in 3.01 above.

C. Site: Unless otherwise specifically directed by the Owner, hose down all paved areas on the site and all public sidewalks directly adjacent to the site; rake clean other surfaces of the grounds. Completely remove all resultant debris.

D. Structures

1. Remove all traces of soil, waste material, splashed material, and other foreign matter to provide a uniform degree of exterior cleanliness.

a. Visually inspect all exterior surfaces and remove all traces of soil, waste material, and other foreign matter.

b. Remove all traces of splashed materials from adjacent surfaces.

c. If necessary to achieve a uniform degree of exterior cleanliness, hose down the exterior of the structure.

d. In the event of stubborn stains not removable with water, the Owner may require light sandblasting or other cleaning at no additional cost to the Owner.

2. Visually inspect all interior surfaces and remove all traces of soil, waste material, smudges and other foreign matter. Remove all paint droppings, spots, stains and dirt from finished surfaces.

3. Clean all glass inside and outside.

4. Polish all surfaces requiring the routine application of buffed polish. Provide and apply polish as recommended by the manufacturer of the material being polished.

E. Post Construction Cleanup: All evidence of temporary construction facilities, haul roads, work areas, structures, foundations of temporary structures, stockpiles of excess or waste materials, or any other evidence of construction, as directed by the Owner.

F. Restoration of Landscape Damage: Any landscape feature damaged by the Contractor shall be restored as nearly as possible to its original condition at the Contractor's expense. The Owner will decide what method of restoration shall be used.

G. Timing: Schedule final cleaning as approved by the Owner to enable the Owner to accept the Project.

3.03 CLEANING DURING OWNER'S OCCUPANCY

A. Should the Owner occupy the Work or any portion thereof prior to its completion by the Contractor and acceptance by the Owner, responsibilities for interim and final cleaning of the occupied spaces shall be as determined by the Owner in accordance with the Supplementary Conditions of the Contract Documents.

3.04 DISPOSAL OF WASTE

A. The definitions contained in Georgia Environmental Protection Division Rules 391-3-4-.01 shall be applicable to this Project. The term waste shall include excess and surplus materials, and shall include liquid and solid wastes.

B. Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.

C. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.

D. Remove and transport waste in a manner that will prevent spillage on adjacent surfaces and areas.

E. Burning: Do not burn waste materials on site.

F. Waste removed from the Project site shall be disposed of in sites permitted by the Georgia Environmental Protection Division for the acceptance of type of waste as follows:

1. Inert Waste Landfills
2. Municipal Solid Waste Landfills
3. Municipal Solid Waste Landfills permitted to receive only construction and demolition wastes.

G. Exceptions to Paragraph F are as follows:

1. Hazardous waste shall be disposed of in accordance with Georgia Environmental Protection Division Rules 391-3-11.
2. Asbestos-containing waste shall also be handled and disposed of in accordance with Georgia Environmental Protection Division Rules 391-3-14.

H. No waste shall be placed at a transfer station facility.

I. The Contractor shall maintain records related to all waste removed from the Project site so as to allow the Owner or the Owner to readily determine the following:

1. Date waste removed from Project site.

Section 4
Scope of Work and Technical Specifications
SECTION 01 74 00-5 CLEANING AND WASTE MANAGEMENT

2. Name of hauler (company and driver) transporting such waste.
3. General description of waste transported.
4. "Truck tickets" indicating the waste disposal site and amount of waste disposed therein.

END OF SECTION

SECTION 01 75 16

FACILITY STARTUP

PART 1 - GENERAL

1.01 RELATED SECTIONS

- A. There are multiple section specifications related to this specification.

1.02 DEFINITIONS

- A. Pre-Operational Checkout (Step 1): Preparation of documented physical checks shall verify that piping systems and items of equipment or equipment systems are ready for functional testing. Example components of pre-operational checkout /testing include, but are not limited to, the following:

1. Pressure and/or leakage tests, water-tightness of concrete structures and pipe testing
2. Electrical testing, resistance testing in accordance with NETA - Section 16T Electrical Acceptance Tests and Phase/motor rotation checks
3. Instrument calibration and loop tests as well as pre-operational check-out of instrumentation system controls
4. Pre-operational checkout of mechanical and HVAC equipment to include alignment, lubrication, and other checks, as recommended by the manufacturer

- B. Functional Test (Step 2): A test or tests, in the presence of the County, to demonstrate that the installed equipment or system meets manufacturer's installation and adjustment requirements and other requirements.

The testing of the individual items of equipment within a system shall be performed under simulated operating conditions to determine contract compliance. This test shall utilize plant effluent, potable water, or another acceptable substitute test media. The equipment shall be operated long enough to gather information (data) on noise, temperature, vibration, performance characteristics, and to make initial adjustments of any applicable controls. Initial baseline data shall be gathered on equipment with motors greater than 1 horsepower, including amperage, bearing temperatures, and vibration.

The instrumentation and control field testing (loop checks from the field devices to PLC or distributed control systems, as well as field calibrations), shall be accomplished during the pre-operational checkout and functional testing stages as defined above.

- C. Operational Test (Step 3): A test, performed in the presence of the County, of components within a system collectively to verify that the system and its integral components function as intended. Water and/or other temporary media supplied by the Contractor shall be circulated through the completed facility/system for 5 days with

systems operating under various loading conditions, as proposed by the Contractor and approved by the County.

The instrumentation and control system automatic function for the overall system shall be verified and documented during the operational testing stage described above.

D. Punch List: Items that could affect, or be affected by, the full-time operation of the system (as deemed critical by the County) shall be complete prior to the operational test phase.

E. Acceptance Test (Step 4): The startup and operation of the systems installed, under actual operating conditions, as part of the actual plant process. The acceptance test period is 30 days. County O&M staff will be responsible for running the system with the Contractor's support team available for assistance 24/7. Upon completion of this commissioning period, the Contractor may apply for a Substantial Completion certificate meeting the contract and General Requirements.

F. Performance Test: All special tests, performed in the presence of the County, called for by the specific equipment or system specifications that are to be performed in addition to the installation and acceptance tests noted in this start-up specification (pre-operational checkout, functional testing, operational testing, and acceptance testing).

G. System: The overall process, or a portion thereof, that performs a specific function. A system may consist of two or more subsystems as well as two or more types of equipment. Examples of systems on this Project are as follows:

1. Pumps, motors, and controls
2. Instrumentation and control system(s)

H. Substantial Completion: The date certified by the County when the entire, or a part of, the Work as identified in the County's certification:

1. Has been properly installed per the contract documents and manufacturer recommendations,
2. Has been deemed operational through the completion of the pre-operational checkouts, functional tests, operational tests,
3. Has had every test document with Operation and Maintenance manuals delivered,
4. Is sufficiently completed in accordance with the requirements of the Contract Documents, and
5. Has been demonstrated through the 30-day Acceptance Test, proving that the identified portion of the Work can reliably be utilized for the purposes for which it is intended.

1.03 SUBMITTALS

A. Administrative Submittals:

1. Functional and performance test schedules and plan for equipment, units, and systems at least 14 days prior to start of related testing. Include test plan, procedures, and log format.
2. Schedule and plan of facility startup activities at least 60 days prior to commencement.

B. Quality Control Submittals:

1. Manufacturer's authorized representative's signature shall be on the Certificate of Proper Installation, as required.
2. Functional and performance test reports, in a format acceptable to the County and certification of functional and performance test for each piece of equipment or system specified.
3. Certifications of calibration of testing equipment.

1.04 CONTRACTOR FACILITY STARTUP RESPONSIBILITIES

A. General:

1. The Contractor shall provide, at no expense to the County: power, fuel, compressed air supplies, water, and chemicals; as well as labor, temporary piping, heating, ventilating, and air conditioning or bypass pumping, for any areas where the Improved Facilities are not complete and operable at the time of Acceptance Testing and its prerequisites. Contractor shall provide other items and Work required to complete Acceptance Testing and its prerequisites. Temporary facilities shall be maintained until permanent systems are in service.
2. The Contractor shall provide necessary qualified operations personnel and manufacturers' field service personnel of the major equipment suppliers on an 8-hour-per-day basis at the facilities and on a 24-hour-per-day basis locally during the operational and acceptance test periods.
3. At no time during startup shall the Contractor allow the facility to be operated in a manner that subjects equipment to conditions that are more severe than the maximum allowable operating conditions for which the equipment was designed.

B. Tie-Ins or Modifications to Existing Systems – Work Plan:

1. Each time the Contractor ties into or modifies an existing system, a detailed Work plan shall be required. Submittal of this Work plan shall be a minimum of 30 days in advance of commencement of the subject Work. This

Work plan shall include a detailed description of the Work, a step-by-step plan of the modification or tie-in, a detailed timeline schedule, a detailed list of materials and equipment required, demonstrated communications capacity, and a listing of gates or valves that shall be operated. Working drawings shall be submitted as required for any permanent or temporary structural modifications. A temporary safety plan covering the period of the Work, and a listing of contingency plans and supplies, including, but not limited to, spill prevention planning and spill containment kits, shall be required. The Contractor, the County, and the Designer shall hold coordination meetings with the County's water/sewer systems operations staff, as required, at least 30 days prior to the commencement of the modification or tie-in. A final coordination meeting shall be held to provide final detailed Work assignments to the involved parties, the day before the commencement of the modification or tie-in.

2. The County has the right to require, at no additional cost to the County, stand-by equipment on item(s) deemed critical enough to delay the Work. The Contractor shall have available stand-by personnel to supplement the committed forces, should problems arise. The Contractor shall be responsible for meeting OSHA standards, including entrance and exit safety, confined space entry, fall protection, scaffolding, rigging, etc.

C. Contractor's Startup Manager: The Contractor shall appoint a qualified Startup Manager to manage, coordinate, and supervise the varied aspects of the Contractor's startup and testing program, including, but not limited to, those components of the program as listed with this Section. The Startup Manager shall have at least 5 years of total experience, or experience on at least five separate projects, in managing the startup and commissioning of mechanical, electrical, instrumentation, HVAC, and piping systems. Contractor shall submit the Startup Manager's resume for review and approval a minimum of 6 months prior to any testing, or prior to 50% completion of the first constructed system.

D. Contractor's Testing Team – Quality Assurance Manager:

1. The Contractor's Testing Team shall include at a minimum the Quality Assurance Manager, Contractor's Operations Specialist, qualified Mechanical/Equipment Foreman, qualified Electrical Journeyman, qualified Instrument Technician, and qualified/Certified Plant Operations personnel. The Operations specialist shall be a graduate from a minimum four-year course in mechanical, civil, or a related program of study. The operations specialist shall have equivalent documented experience in plant operations and maintenance.

2. The Contractor shall have the appropriate personnel, procedures, and test forms at the test site when performing a scheduled checkout/testing activity that shall be witnessed by the County.

E. Test Equipment:

1. All test equipment (gauges, meters, thermometers, analysis instruments, and other equipment) used for calibrating or verifying the performance of equipment installed under this contract shall be calibrated to within plus or minus 2 percent of actual value at full scale. Test equipment employed for individual test runs shall be selected so that expected values as indicated by the detailed performance specifications fall between 60 and 85 percent of full scale. Pressure gauges shall be calibrated in accordance with ANSI/ASME B40.1. Thermometers shall be calibrated in accordance with ASTM E77 and shall be furnished with a certified calibration curve. Contractor to use permanently installed calibrated equipment when available.

2. Test instruments shall be calibrated to references traceable to the National Bureau of Standards and shall have a current sticker showing date of calibration, deviation from standard, name of calibration laboratory and technician, and date recalibration is required.

3. Calibration equipment/test instruments utilized for startup and testing shall be documented to include identification (by make, manufacturer, model, and serial number) of the test equipment, date of original calibration, subsequent calibrations, calibration method, and test laboratory as well as documentation of current calibration.

4. All analysis instruments, sensors, gauges, and meters used for performance testing shall be subject to recalibration to confirm accuracy after completion, but prior to acceptance of each performance test. All analysis instruments, sensors, gauges, and meters installed under this Contract shall be subject to recalibration prior to Acceptance.

5. Test equipment used to simulate inputs and read outputs shall have a rated accuracy at the point of measurement at least three times greater than the component under test. Buffer solutions and reference fluids shall be provided as necessary for tests of analytical equipment.

1.05 COUNTY'S FACILITY STARTUP RESPONSIBILITIES

A. General:

1. Review Contractor's Testing and Startup Plans and schedule.
2. Witness each functional, operational (portions of), and performance test.
3. Coordinate other plant operations, if necessary, to facilitate Contractor's tests.

B. Startup Test Period:

1. Operate process units and devices, with support of Contractor.

2. Provide sampling, labor, and materials as required and provide laboratory analyses.
3. Make available spare parts, special tools, operation, and maintenance information for County-furnished equipment.

PART 2 – PRODUCTS

(NOT USED)

PART 3 – EXECUTION

3.01 STARTUP PROGRAM IMPLEMENTATION

A. Startup Meetings:

1. The Contractor shall schedule and conduct regular periodic startup meetings (separate from regular progress meetings). The startup meetings shall be held at least every 10 days (once startup planning commences) and may be scheduled at a more frequent interval by the County if necessary. Startup meetings shall be held at a location designated by the Contractor and approved by the County.
2. Startup meetings shall be attended by the County, Contractor, subcontractors as appropriate to the agenda, suppliers as appropriate to the agenda, and others as required.
3. The meeting agenda shall generally include:
 - a. Review and approval of minutes of previous meeting
 - b. Review of Startup Schedule and progress since the previous meeting
 - c. Problems which impede delivery schedules and Startup Schedule
 - d. Field observations, problems, and conflicts
 - e. Corrective measures and procedures to regain the Startup Schedule
 - f. Revisions to Startup Schedule, progress and schedule of the preceding Work period
 - g. Coordination of schedules, review of start-up submittal schedules and status, status of start-up related requests for information
 - h. All other business deemed appropriate and timely

B. Startup and Testing Schedule:

1. The Contractor shall produce an overall testing schedule setting forth the sequence contemplated for performing the test Work. The schedule shall be in bar chart form plotted against calendar time, shall detail the equipment and systems to be tested, and shall be coordinated with the Construction Schedule. The testing schedule shall show the contemplated start date, duration of the test, and completion of each test.

2. The preliminary test schedule shall be submitted with an overall Start-up Acceptance Test Plan. The County shall not witness any testing Work until the Contractor has submitted a schedule. The County takes no exception. The test schedule shall be updated weekly, and presented at each start-up meeting, showing actual dates of test Work, indicating systems and equipment testing completed satisfactorily and meeting the requirements of the Contract Standards. The test schedule shall re-forecast the upcoming testing and reflect any schedule adjustments accompanied by written reason for the change. The Contractor's baseline start-up and testing schedule shall be submitted with the overall test plan.

C. Documentation:

1. The Contractor shall develop a recordkeeping system to document activities associated with Acceptance Testing and its prerequisites.

2. Equipment and system documentation shall include date of test, equipment number or system name, nature of test, test objectives, test results, test instruments employed for the test, and signature spaces for witness by the County, the Contractor's Start-Up/Quality Assurance Manager, and the Equipment Manufacturer. A separate file shall be established for each system, organized by startup phase (i.e., pre-operational, functional, operational, acceptance test phase), and shall include sections for each item of equipment. These files shall include the following information and documentation at a minimum. Test plan and documentation organization shall be as described below.

D. Test Plan Organization:

1. Index

2. Schedule

3. Steps 1 and 2: Each type of equipment shall have its own section within the system and include the following:

a. The detailed Pre-Operational test procedures

b. The detailed Functional Test procedures

- c. Customized mechanical equipment, customized electrical, and customized instrumentation pre-operational and functional test forms, as applicable
 - d. Other pre-operational test documentation as required for piping and mechanical equipment
- 4. Step 3: A separate section shall be created for the system operational testing and include the following:
 - a. The detailed 5-day operational test procedure
 - b. A detailed operational system check/sign-off sheet (based on system tests, control checks, and interlock checks to be performed)
 - c. System operational test completion sign-off form
 - d. Punch list form
- 5. Step 4: Another section shall be designated for the Acceptance Testing, including the following:
 - a. Detailed Work plans, communications plan, safety plan, and contingencies, as well as other requirements
 - b. List of specific testing to be performed and the passing criteria.
 - c. Thirty-day test overview and proposed spreadsheet forms to be utilized by the Contractor's staff to record appropriate operational and performance data on a regular interval for the 30 days
 - d. System acceptance test completion/sign-off form
- 6. The forms attached to this Section are samples showing the required format and level of detail for documentation. The Contractor is advised that these are samples only and are not specific to this project or to any item of equipment or system to be installed under this contract. The Contractor shall develop test documentation forms specific to each item of facilities, equipment, and systems installed under this contract. Acceptable example documentation forms for systems and items of equipment shall be produced and submitted for review and approval by the County. Submittal of Startup and Testing Plans are a condition precedent to the Contractor's receipt of progress payments in excess of 60% of the contract amount. Once the County has reviewed and taken no exception to the plans and forms proposed by the Contractor, the Contractor shall produce customized forms for each item of equipment and system and include these individual forms in the overall test plan that shall be submitted for approval.

7. The complete Test Plan and its sections shall be submitted 60 days prior to any testing and approved by the County prior to implementation (Code 1 or Code 1C).

3.02 TEST PLAN IMPLEMENTATION

- A. This program shall be implemented in four distinct steps.

3.03 STEP 1 - PRE-OPERATIONAL CHECKOUT AND TESTING

- A. Pre-operational Checkout: This includes multi-discipline Work completion and physical checkout. The Pre-operational Completion Verification and Pre-operational test reports include the following required testing. Examples of these documented tests include, but are not limited to:

1. Field pressure/leakage test reports for pipes, valves, and appurtenances
2. Wire insulation megohm reports for 120V and greater wire
3. Phasing, ratio, polarity, ground resistance, current injection, insulation resistance, over potential test, and circuit breaker contact resistance reports for medium voltage switchgear
4. Insulation power factor and resistance test reports for surge arresters
5. Megger reports for Unit Substations, Three Winding Transformers, and 4160V motor control centers
6. Megger reports and ground connection tests
7. Loop Status Report and Component Calibration forms
8. Equipment installation checkout forms

- B. Pipe Testing:

1. Prior to application of insulation on exposed piping, test the piping systems at the appropriate pressure according to the requirements of related piping specifications. All buried piping shall be tested prior to any backfill being placed, unless prior approval by the County is given in writing. Test duration shall be 120 minutes and witnessed by a County representative. Isolate equipment that may be damaged by the specified test conditions. Testing shall be performed using calibrated test gauges and calibrated volumetric measuring equipment to determine leakage rates. Each test gauge shall be selected so that the specified test pressure falls within the upper half of the gauge's range. Testing shall include existing piping systems that connect with new piping systems. Existing pipe shall be tested to the nearest existing valve. All piping that fails the test shall be repaired.

2. For gas, air, and vapor systems, the allowable leakage rate for systems tested with air shall be based on a maximum pressure drop of 5 percent of the specified test pressure for the duration of the period. Prior to starting a test interval using air, the air shall be at ambient temperature and specified test pressure. The allowable leakage rate for hazardous gas systems, insulated systems, and systems tested with water shall be zero at the specified test pressure throughout the specified test period. Hazardous gas systems shall include sulfur dioxide, chlorine, propane, sludge gas, and natural gas systems. Testing medium shall be as follows for gas, air, and vapor systems:

Pipeline size	Specified test pressure	Testing medium
2 inch and smaller	75 psi or less	Air or water
2 inch and smaller	Greater than 75 psi	Water
Greater than 2 inch	3 psi or less	Air or water
Greater than 2 inch	Greater than 3 psi	Water

3. For liquid systems, leakage shall be zero at the specified test pressure throughout the specified duration for exposed piping, buried insulated piping, and buried or exposed piping carrying liquid chemicals. Leakage from other buried liquid piping systems shall be less than 0.02 gallon per hour per inch diameter per 100 feet of buried piping. Drain systems, other than pumped drain systems, shall be tested in accordance with Georgia State Minimum Standards.

4. For hydraulic and lube oil systems, upon completion of cleaning, field connections shall be completed and the system tested at the specified pressure. Pressure loss shall be zero for the specified test period. For fluid power systems, the manufacturer shall supervise the installation and testing of system components including field piping.

C. Pipe System Cleaning and Flushing:

1. Piping systems shall be cleaned following completion of testing and prior to connection to operating, control, regulating, or instrumentation equipment. The Contractor shall clean and test sections of buried or exposed piping systems. Unless specified otherwise, piping 24 inches in diameter and smaller shall first be cleaned by pulling a tightly fitting cleaning ball or swab through the system. Piping larger than 24 inches in diameter shall be cleaned manually or with a cleaning ball or swab.

2. Upon completion of the cleaning, the Contractor shall connect the piping systems to related process equipment. Temporary screens, provided with locator tabs that remain visible from the outside when the screens are in place, shall be inserted in pipelines at the suction of pumps and compressors in accordance with the following table:

Section 4
Scope of Work and Technical Specifications
SECTION 01 75 16-11 FACILITY STARTUP

Equipment suction or piping size, inches	Maximum screen opening, inches
0 to 1	1/16
1-1/4 to 3	1/4
3-1/2 to 6	1/2
Over 6	1

3. The Contractor shall maintain the screens during testing prior to the start of Acceptance testing. In special cases, screens may be removed as required for performance tests. Prior to the start of Acceptance Testing, the Contractor shall remove the temporary screens and make the final piping connections after the screens have remained clean for at least 24 consecutive hours of operation. Systems handling solids are exempted.

4. Gas and air system piping 6 inches in diameter and smaller shall be blown out, using air or the testing medium specified. Piping larger than 6 inches shall be cleaned by having a swab or "pig" drawn through the separate reaches of pipe. After connection to the equipment, it shall then be blown out using the equipment. Upon completion of cleaning, the piping shall be drained and dried with an air stream. Sludge gas, natural gas, and propane systems shall be purged with nitrogen and a nitrogen pad maintained at 10 psig until the piping is placed in service.

5. After completion of cleaning, liquid systems, unless otherwise specified, shall be flushed with clean water. With temporary screens in place, the liquid shall be circulated through the piping system using connected equipment for a minimum period of 15 minutes and until no debris is collected on the screens. Potable water piping systems shall be flushed and disinfected in accordance with AWWA C651-05.

6. Upon completion of field piping, but before connection to any control components, hydraulic and fluid power oil systems shall be flushed and cleaned by circulating special flushing oil through the system. Flushing oil and procedures shall comply with ASTM D4174. System shall be cleaned such that internal contamination of system, when tested using procedures specified in SAE J1227, Section 2.3, shall not exceed the ACL. Unless otherwise specified, the ACL value shall be established by the manufacturer of the major hydraulic system components in accordance with SAE J1227, Section 9.1. System supplier shall provide certificate of compliance that the ACL has been met.

7. Cleaning/flushing fluids shall be disposed of in a lawful manner meeting Federal, State, and Local regulations.

8. The Contractor shall verify anchor bolt torque specifications on pipe harness and hangers.

D. Equipment Pre-Operational Checkout: Equipment pre-operational checks and tests shall include, but are not limited to, the following:

1. Check for proper installation, alignment, support, and anchorage per the applicable manufacturer's operation and maintenance manual and in accordance with the Contract Documents.
2. Check the equipment for proper adjustment, packing of seals, lubrication, drive connection, motor connection, and belt/chain tension per the applicable manufacturer's operation and maintenance manual and in accordance with the Contract Documents.
3. Check the associated process, seal water, drain, and vent pipe connections for proper routing and connection. Check to make sure the pipe testing was performed and signed as completed for the associated piping.
4. Verify that the equipment is clean and free of any construction debris that could potentially cause a malfunction.
5. Warrant that safety guards, signage, and other safety measures such as hearing protection, etc., are in place.
6. Have the manufacturer's representative perform pre-operational tests per the manufacturer's recommendations and review the equipment installation and sign the manufacturer's installation portion of the certification form. If the manufacturer's representative brings his or her own checklist, obtain a copy of the completed form and attach it to the Contractor's completed forms. Note that the manufacturer shall also fill out the contract approved check-out form and that the manufacturer's own forms shall not serve as a substitute.
7. All gates and valves associated with the equipment system shall be checked for proper installation, adjustment, and lubrication, per the manufacturer's recommendations.

E. Concrete Tanks Pre-Operational Checkout:

1. Water-retaining concrete structures shall be tested for water tightness in accordance with ACI 350.1R. The maximum allowable leakage rate shall be 0.075 percent over a 24-hour period.

F. Electrical Pre-Operational Checks/Tests: Prior to energizing electrical circuits, use a 1,000-volt megohmmeter to measure insulation resistance on conductors and insulated parts of electrical equipment. Measurements shall meet or exceed the appropriate ICEA, NEMA, or ANSI standard. Any insulation resistance less than 10 megohms is unacceptable. Record results, as well as ambient temperature. See attached form for example.

1. Measure phase-to-ground insulation resistance for circuits 120 volts and above, with the exception of lighting circuits. Measurements may be made with motors and other equipment connected, except that solid state equipment shall be disconnected unless the equipment is normally tested by the manufacturer at voltages in excess of 1,000 volts DC.
2. Complete Test Form for each installed motor. Measure the insulation resistance of motors before connection. Measure the insulation resistance for motors at the time of delivery as well as when connected. Insulation resistance values less than 10 megohms are not acceptable.
3. Adjust protective devices and make operative. Perform a functional check of the control circuit prior to energizing the equipment.
4. Review associated electrical terminations, switches, and breakers for satisfactory installation.

G. Individual Component/Instrument Calibration Pre-Operational Check/Test:

1. Each instrument and final element shall be field calibrated in accordance with the manufacturer's recommended procedure. Instruments shall then be tested in compliance with ISA S51.1 and the data entered on the applicable test report form. Alarm trips, control trips, and switches shall be set to initial values specified in the design at this time. Final elements shall be checked for range, dead band, and speed of response.
2. Calibration of analysis instruments, sensors, gauges, and meters installed under this contract shall proceed on a system-by-system basis. No equipment or system operational, performance, or acceptance tests shall be performed until instruments, gauges, and meters to be installed in that particular system have been calibrated and the calibration Work has been witnessed by the County.
3. Testing of instrument process piping/tubing, wiring, and individual components shall be completed and documented on the approved test forms provided to the County as part of the pre-operational testing phase and prior to commencement of individual loop testing conducted during the pre-operational functional test phase.
4. All components that fail to meet the required tolerances shall be repaired or replaced by the manufacturer and the above tests repeated until the component is within tolerance.
5. System instrumentation equipment supplied and installed shall be reviewed for proper installation and termination as part of the pre-operational checkout.

H. Pre-Operational Checkout Summary:

1. The pre-operational checkout and testing for each item shall be carried out in accordance with the Contractor's submitted and approved procedures and documented on the Contractor's approved pre-operational test forms.
2. The Contractor shall complete the pre-operational testing requirements listed above, at a minimum, for each item of mechanical, electrical, instrumentation, and HVAC equipment prior to beginning any functional testing with regard to the equipment or the systems in which the equipment functions.

3.04 STEP 2 - FUNCTIONAL TEST

A. General:

1. The second step in the program is the Functional Test. This is the functional testing of the equipment. These tests begin for each item of equipment only after the Pre-operational Checks have been completed for components for the particular equipment.
2. The functional testing for each item of equipment shall be carried out in accordance with the Contractor's submitted and approved procedures and documented on the Contractor's approved functional test forms.
3. Once affected equipment has been subjected to the required pre-operational testing procedures and the County has witnessed and has not found deficiencies in that portion of the Work, individual items of equipment and systems shall be started and operated under simulated operating conditions to determine as nearly as possible whether the equipment and systems meet the Contract Standards. If available, plant process media may be employed for the testing of liquid systems except gaseous, oil, or chemical systems. If not available, potable water shall be employed as the test medium. Test media for these systems shall be either the intended fluid or a compatible substitute. The equipment shall be operated for a sufficient period of time to determine machine operating characteristics, including noise, temperatures, and vibration; to observe performance characteristics; and to permit initial adjustment of operating controls. When testing requires the availability of auxiliary systems such as looped piping, electrical power, compressed air, control air, or instrumentation that have not yet been placed in service, the Contractor shall provide acceptable substitute sources, capable of meeting the requirements of the machine, device, or system at no additional cost to the County. Disposal methods for test media shall be subject to review by the County. During the functional test period, the Contractor shall obtain baseline operating data on equipment with motors greater than 1 horsepower to include amperage, bearing temperatures, and vibration. The baseline data shall be collected for use as needed.
4. Test results shall be within the tolerances set forth in the detailed specification sections of the Contract Documents and as indicated in the

Contractor's functional test plan and the manufacturer's criteria. If no tolerances have been specified, test results shall conform to tolerances established by recognized industry practice. Where, in the case of an otherwise satisfactory functional test, any doubt, dispute, or difference should arise between the County and the Contractor regarding the test results or the methods or equipment used in the performance of such test, then the County shall have the right to order the test to be repeated at the Contractor's expense. Where the results of any functional test fail to comply with the Contract Standards for such test, then such repeat tests as may be necessary to achieve the Contract Standards shall be made by the Contractor at no additional expense to the County.

B. The Functional Test reports include the required testing. Examples of these types of reports include, but are not limited to:

1. The Functional Field Test of valves
2. The cycling/functions checks of the sluice gates, slide gates, weir gates, stop logs, and stop plates
3. The leakage testing of sluice gates, slide gates, weir gates, stop logs, and stop plates in accordance with AWWA specifications
4. Vibration, noise, and capacity testing of pumps and motors
5. Air distribution and leakage test of any diffused air systems
6. Loop functional test for Instrumentation and Control

C. Process/Mechanical/Equipment - (Functional Testing):

1. During the Functional Verification Check and Testing process, the Contractor and the various Manufacturers' Technical representatives shall examine and record the initial start-up performance of the components provided by their respective firms in accordance with the Contractor's approved functional test procedure.
2. The initial operation, testing, and adjustment shall be as required to prove that the equipment has been installed properly and operates under the conditions specified.
3. Upon completion of this Work, the manufacturer's field service technician shall complete the Contractor's approved functional test form as well as their own signed report to record the results of the inspection, operation, adjustments, and tests. The report shall include detailed descriptions of the points inspected, tests, and adjustments made; quantitative results if such are specified; and suggestions for precautions to be taken to maintain proper maintenance.

D. Electrical - (Functional Testing):

1. The Contractor's electrician shall be present during testing to confirm the electrical, provide troubleshooting assistance, repair as needed, and assist in gathering baseline data such as motor amperages.
2. Energize each control circuit and operate each control, alarm, or malfunction device; and each interlock in turn to verify that the specified action occurs. The Contractor shall submit a description of the proposed functional electrical test procedures as part of the testing plan.
3. Verify that motors are connected to rotate in the correct direction. Verification may be accomplished by momentarily energizing the motor, provided the Contractor confirms that neither the motor nor the driven equipment shall be damaged by reverse operation.

E. Instrumentation and Control - (Functional Testing):

1. The Contractor's instrumentation representative shall be onsite full time during the functional test phase to perform loop checks and to support the Contractor's start-up team as needed. Any packaged equipment or manufacturer-supplied control panels shall be field tested to verify control interlocks and control functions during this phase of testing by the equipment supplier. Note that the Contractor's functional test procedure for each piece of equipment shall define each interlock to be tested.
2. Each instrument loop shall be tested. This testing shall check operation from transmitter to readout components. Signals shall be generated utilizing the primary measuring elements where possible. Signals shall be injected only if the primary element is unavailable.
3. If any output device fails to indicate properly, corrections to the loop shall be made as necessary and the test repeated until instruments operate properly.

F. Functional Testing Summary: The functional testing for each item of equipment, electrical, and instrumentation shall be carried out in accordance with the Contractor's submitted and approved procedures and documented on the Contractor's approved functional test forms.

3.05 STEP 3 – OPERATIONAL TESTING

- A.** The third step in the program is the Operational Testing. This step begins after Pre-operational checks and Functional tests have been satisfactorily completed. The Contractor shall plan activities to allow for County's witnessing of tests and shall provide 24 hours' advance notice of testing activities.
- B.** The Contractor's operational test plan shall be a detailed procedure to confirm System Automatic Mode functions, verify system interlocks, and reconfirm equipment functions and controls. Design and performance criteria shall be demonstrated and documented during this five-day period. The Contractor's manufacturer, electrical, and

instrumentation representatives shall be onsite on an 8-hour-a-day basis and locally on a 24-hour-a-day basis during this period.

C. In the event of failure to demonstrate satisfactory performance of the system on the first or any subsequent attempt, necessary alterations, adjustments, repairs, and replacements shall be made. When the system is again ready for operation, it shall be brought online and a new test shall be started. This procedure shall be repeated as often as necessary until the system has operated continuously to the satisfaction of the County, for the specified duration.

3.06 STEP 4 – ACCEPTANCE TESTING

A. The fourth step in the program is Acceptance Testing. The acceptance test period shall not begin until new systems and equipment have successfully completed the operational test period.

B. The Operations and Maintenance staff shall receive spare parts, safety equipment, tools and maintenance equipment, lubricants, approved operation and maintenance data, and the specified operation and maintenance instruction prior to the startup with plant process media. Valve tagging shall also be complete prior to this startup.

C. As part of the acceptance test plan, the Contractor shall submit detailed Work plans, communications plan, safety plan, contingencies, and other requirements.

D. In addition, a 30-day test overview and proposed spreadsheet forms shall be utilized by the Contractor's operations staff to record appropriate operational and performance data on a regular interval for these 30 days.

E. Prerequisites: Prior to the County's issuance of a Certificate of Substantial Completion for Design/Build Improvements, the Contractor shall perform Acceptance Testing. Acceptance Testing and the Acceptance Test Plan shall comprehensively cover potential modes of operation, including failure scenarios, as well as the operation of ancillary systems, to demonstrate full functionality of the Improved Facilities. Any failures of process, equipment, or systems shall result in restarting the acceptance testing period. The testing period shall be a minimum of 30 days of continuous operation, during which the facility shall meet the following criteria:

1. Continuous satisfactory operation at the rated capacity
2. Operation without violating the Contract Standards
3. Operation without creating a materially unsafe condition, nuisance condition or unacceptable risk to personnel, facilities or the public
4. Operation without producing biosolids products, air or water emissions, traffic, noise, odors, or other environmental impacts that the County, in its sole discretion, determines to be unacceptable to public safety, health or welfare

5. All portions of the acceptance test phase shall be carried out by qualified/certified operations personnel (supplied by the Contractor) that have a thorough knowledge of the process and can fully implement and document the facility performance as well as the Contractor's acceptance test plan.

6. Instrumentation Acceptance Test:

a. The instrument loop acceptance test shall fully demonstrate stable operation of the loop under normal operating conditions. This test shall be witnessed by the County, performed, and documented by the Instrumentation System Supplier.

b. Tuning parameters (proportional gain, integral time constant, and derivative time constant) for each control loop shall be adjusted to provide 1/4 amplitude damping unless otherwise specified and witnessed during system supplier factory testing.

F. Flow Meters: Liquid flow meters, including open channel flow meters and meters installed in pipelines with diameters greater than 2 inches shall be calibrated in situ using either the total count or dye dilution methods. Gas flow meters installed in piping systems with diameters greater than 6 inches shall be calibrated in situ using the Pitot tube velocity averaging method. Flow meter calibration Work shall be performed by individuals skilled in the techniques to be employed. Calibration tests for flow metering systems shall be performed over a range of not less than 10 percent to at least 75 percent of system full scale. At least five confirmed valid data points shall be obtained within this range and witnessed by the County. Confirmed data points shall be validated by not less than three test runs with results that agree within plus or minus 2 percent.

1. Testing for force main mag meter will require a factory NIST traceable calibration and manufacturer approval for the installation.

G. In the event of failure to demonstrate satisfactory performance of the system on the first or any subsequent attempt, necessary alterations, adjustments, repairs and replacements shall be made. When the system is again ready for operation, it shall be brought online and a new test shall be started. This procedure shall be repeated as often as necessary until the system has operated continuously to the satisfaction of the County, for the specified duration.

H. Completed operational test forms shall be placed into the master record test plan binder and provided to the County prior to acceptance.

END OF SECTION

SECTION 01 77 00
CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.01 REQUIREMENTS INCLUDED

- A. Comply with requirements stated in Conditions of the Contract and in Specifications for administrative procedures in closing out the work.

1.02 REQUIREMENTS

- A. Conditions of the Contract. Fiscal provisions, legal submittals and additional administrative requirements.
- B. Section 01 78 39: Record Documents.
- C. The respective sections of Specifications: Closeout Submittals Required of Trades.

1.03 SUBSTANTIAL COMPLETION

- A. When Contractor considers the work is substantially complete, he/she shall submit to the Engineer.
 - 1. A written notice that the work, or designated portion thereof, is substantially complete.
 - 2. A list of items to be completed or corrected.
- B. Within a reasonable time after receipt of such notice, the Engineer will make an inspection to determine the statue of completion.
- C. Should the Engineer determine that the work is not substantially complete:
 - 1. Engineer will promptly notify the Contractor in writing, giving the reasons therefore.
 - 2. Contractor shall remedy the deficiencies in the work, and send second written notice of substantial completion to the Engineer.
 - 3. Engineer will reinspect the work.
- D. When the Engineer finds that the work is substantially complete, he will:
 - 1. Prepare and deliver to the Owner a tentative Certificate of Substantial Completion, with a tentative list of items to be completed or corrected before final payment.
 - 2. After consideration of any objections made by the Owner as provided in Conditions of the Contract, and when the Engineer considers the work

substantially complete, he will execute and deliver to the Owner and the Contractor a definite Certificate of Substantial Completion with a revised tentative list of items to be completed or corrected.

1.04 INSPECTION

A. When Contractor considers the work is complete, he shall submit written certification that:

1. Documents have been reviewed.
2. Work has been inspected for compliance with Contract Documents.
3. Work has been completed in accordance with Contract Documents.
4. Equipment and systems have been tested in the presence of the Owner's representative and are operational.
5. Work is completed and ready for final inspection.

B. Engineer will make an inspection to verify the status of completion with reasonable promptness after receipt of such certification.

C. Should the Engineer consider that the work is incomplete or defective:

1. Engineer will promptly notify the Contractor in writing, listing the incomplete or defective work.
2. Contractor shall take immediate steps to remedy the stated deficiencies and send a second written certification to the engineer that the work is complete.
3. Engineer will reinspect the work.

D. When the Engineer finds that the work is acceptable under the Contract Documents, he shall request the Contractor to make closeout submittals.

1.05 REINSPECTION FEES

A. When the Engineer performs reinspections due to failure of the work to comply with the claims of status of completion made by the Contractor:

1. Owner will compensate Engineer for such additional services.
2. Owner will deduct the amount of such compensation from the final payment to the Contractor.

1.06 CLOSEOUT SUBMITTALS TO ENGINEER

- A. Evidence of compliance with requirements of governing authorities.
- B. Record Documents: To requirements of Section 01 78 39.

C. Evidence of payments and Release of Liens: To requirements of General and Supplementary Conditions.

D. Certificate of Insurance for Products and Completed Operations.

1.07 FINAL ADJUSTMENT OF ACCOUNTS

A. Submit a final statement of accounting to Engineer.

B. Statement shall reflect all adjustments to the Contract Sum:

1. The original Contract Sum.
2. Additions and deductions resulting from:
 - a. Previous Change Orders.
 - b. Allowances.
 - c. Unit Prices.
 - d. Deductions for uncorrected work.
 - e. Penalties and Bonuses.
 - f. Deductions for liquidated damages.
 - g. Deductions for reinspection payments.
 - h. Other adjustables.
3. Total Contract Sum as adjusted.
4. Previous payments.
5. Sum remaining due.

C. Engineer will prepare a final Charge Order reflecting approved adjustments to the Contract Sum which were not previously made by Change Orders.

1.08 APPLICATION FOR PAYMENT

A. Contractor shall submit the final Application for Payment in accordance with procedures and requirements stated in the Conditions of the Contract.

PART 2 - PRODUCTS

(Not Used)

PART 3 - EXECUTION

(Not Used)

END OF SECTION

SECTION 01 78 23

OPERATION AND MAINTENANCE DATA

PART 1 – GENERAL

1.01 SCOPE

- A. Operation and maintenance (O&M) instructions shall be provided in accordance with this section and as required in the technical sections of this project manual. O&M information shall be provided for each maintainable piece of equipment, equipment assembly or subassembly, and material provided or modified under this contract.
- B. O&M instructions must be submitted and accepted before on-site training may start.

1.02 TYPES OF INFORMATION REQUIRED

- A. General:
 - 1. O&M information shall contain the names, addresses, and telephone numbers of the manufacturer, the nearest representative of the manufacturer, and the nearest supplier of the manufacturer's equipment and parts. In addition, one or more of the following items of information shall be provided as applicable.
- B. Operating Instructions:
 - 1. Specific instructions, procedures, and illustrations shall be provided for the following phases of operations:
 - a. Safety Precautions: List personnel hazards for equipment and list safety precautions for all operating conditions.
 - b. Operator Prestart: Provide requirements to set up and prepare each system for use.
 - c. Start-Up, Shutdown, and Post-shutdown Procedures: Provide a control sequence for each of these operations.
 - d. Normal Operations: Provide control diagrams with data to explain operation and control of systems and specific equipment.
 - e. Emergency Operations: Provide emergency procedures for equipment malfunctions to permit a short period of continued operation or to shut down the equipment to prevent further damage to systems and equipment. Include emergency shutdown instructions for fire, explosion, spills, or other foreseeable contingencies. Provide guidance on emergency operations of all utility systems including valve locations and portions of systems controlled.

Section 4
Scope of Work and Technical Specifications
SECTION 01 78 23-2 OPERATION AND MAINTENANCE DATA

- f. Operator Service Requirements: Provide instructions for services to be performed by the operator such as lubrication, adjustments, and inspection.
- g. Environmental Conditions: Provide a list of environmental conditions (temperature, humidity, and other relevant data) which are best suited for each product or piece of equipment and describe conditions under which equipment should not be allowed to run.

C. Preventive Maintenance:

- 1. The following information shall be provided for preventive and scheduled maintenance to minimize corrective maintenance and repair:
 - a. Lubrication Data: Provide lubrication data, other than instructions for lubrication in accordance with paragraph 1.02 Operator Service Requirements.
 - 1) A table showing recommended lubricants for specific temperature ranges and applications;
 - 2) Charts with a schematic diagram of the equipment showing lubrication points, recommended types and grades of lubricants, and capacities; and
 - 3) A lubrication schedule showing service interval frequency.
 - b. Preventive Maintenance Plan and Schedule: Provide manufacturer's schedule for routine preventive maintenance, inspections, tests, and adjustments required to ensure proper and economical operation and to minimize corrective maintenance and repair. Provide manufacturer's projection of preventive maintenance man-hours on a daily, weekly, monthly, and annual basis including craft requirements by type of craft.

D. Corrective Maintenance:

- 1. Manufacturer's recommendations shall be provided on procedures and instructions for correcting problems and making repairs.
 - a. Troubleshooting Guides and Diagnostic Techniques: Provide step-by-step procedures to promptly isolate the cause of typical malfunctions. Describe clearly why the checkout is performed and what conditions are to be sought. Identify tests or inspections and test equipment required to determine whether parts and equipment may be reused or require replacement.
 - b. Wiring Diagrams And Control Diagrams: Wiring diagrams and control diagrams shall be point-to-point drawings of wiring and control

Section 4
Scope of Work and Technical Specifications
SECTION 01 78 23-3 OPERATION AND MAINTENANCE DATA

circuits including factory-field interfaces. Provide a complete and accurate depiction of the actual job-specific wiring and control work. On diagrams, number electrical and electronic wiring and pneumatic control tubing and the terminals for each type identically to actual installation numbering.

c. Maintenance and Repair Procedures: Provide instructions and list tools required to restore product or equipment to proper condition or operating standards.

d. Removal and Replacement Instructions: Provide step-by-step procedures and list required tools and supplies for removal, replacement, disassembly, and assembly of components, assemblies, subassemblies, accessories, and attachments. Provide tolerances, dimensions, settings, and adjustments required. Instructions shall include a combination of test and illustrations.

e. Spare Parts and Supply Lists: Provide lists of spare parts and supplies required for maintenance and repair to ensure continued service or operation without unreasonably delays. Special consideration is required for facilities at remote locations. List spare parts and supplies that have a long lead time to obtain.

f. Corrective Maintenance Man-hours: Provide manufacturer's projection of corrective maintenance man-hours including craft requirements by type of craft. Corrective maintenance that requires participation of the equipment manufacturer shall be identified and tabulated separately.

E. Appendices:

1. The following information shall be provided; include information not specified in the preceding paragraphs but pertinent to the maintenance or operation of the product or equipment.

a. Parts Identification: Provide identification and coverage for all parts of each component, assembly, subassembly, and accessory of the end items subject to replacement. Include special hardware requirements, such as requirement to use high-strength bolts and nuts. Identify parts by make, model, serial number, and source of supply to allow reordering without further identification. Provide clear and legible illustrations, drawings, and exploded views to enable easy identification of the items. When illustrations omit the part numbers and description, both the illustrations and separate listing shall show the index, reference, or key number which will cross-reference the illustrated part to the listed part. Parts shown in the listings shall be grouped by components, assemblies, and subassemblies.

Section 4
Scope of Work and Technical Specifications
SECTION 01 78 23-4 OPERATION AND MAINTENANCE DATA

- b. Warranty Information: List and explain the various warranties and include the servicing and technical precautions prescribed by the manufacturers or contract documents to keep warranties in force.
- c. Personnel Training Requirements: Provide information available from the manufacturers to use in training designated personnel to operate and maintain the equipment and systems properly.
- d. Testing Equipment and Special Tool Information: Provide information on test equipment required to perform specified tests and on special tools needed for the operation, maintenance, and repair of components.

F. Asset Management Data

1. As part of the Computerized Maintenance Management System (CMMS) implementation, the Design-Build (D/B) Company shall provide to the County, Asset Management Data on all major components that were installed during the D/B work. This data shall be in electronic form, excel format and also two printed copies of database tables. The database shall contain as a minimum the following data fields:

- a. Acquisition date
- b. Acquisition cost
- c. Serial numbers
- d. Name plate data
- e. Expected life
- f. Location
- g. Maintenance cost
- h. Warranty start and duration
- i. maintenance tasks and intervals
- j. performance/capacity data not included on "nameplate"
- k. additional items to be determined depending on equipment

1.03 TRANSMITTAL PROCEDURE

A. Unless otherwise specified, O&M manuals, information, and data shall be transmitted in accordance with Section 01 33 00 accompanied by Transmittal Form 01 78 23-A and Equipment Record Forms 01 78 23-B and/or 01 78 23-C, as appropriate, all as specified in Section 01 99 90. The transmittal form shall be used as a checklist to

ensure the manual is complete. Only complete sets of O&M instructions will be reviewed for acceptance.

B. One (1) electronic and two (2) hard copies of the specified O&M information in final format, with all prior comments addressed to the satisfaction of the Owner, shall be provided following preliminary review and pre-final review of the O&M information.

1. Electronic copies of O&M manuals also shall be provided per Section 01 33 00. For electronic copies, files shall be provided on flash drive in an indexed PDF file format.
2. For ease of identification, each manufacturer's brochure and manual shall be appropriately labeled with the equipment name and equipment number as it appears in the project manual.
3. The information shall be organized in the binders in numerical order by the equipment numbers assigned in the project manual.
4. The binders shall be provided with a table of contents and tab sheets to permit easy location of desired information.
5. Binders shall be heavy-duty, D-ring.
6. Include video of equipment training on jump drive in the binders.

C. If manufacturers' standard brochures and manuals are used to describe O&M procedures, such brochures and manuals shall be modified to reflect only the model or series of equipment used on this project. Extraneous material shall be crossed out neatly or otherwise annotated or eliminated.

1.04 PAYMENT

A. Acceptable O&M information for the project must be delivered to the Owner prior to the project being 65 percent complete. Progress payments for work in excess of 65 percent completion will not be made until the specified acceptable O&M information has been delivered to the Owner.

1.05 FIELD CHANGES

A. Following the acceptable installation and operation of an equipment item, the item's instructions and procedures shall be modified and supplemented by the Contractor to reflect any field changes or information requiring field data.

PART 2 – MATERIALS

(NOT USED)

Section 4
Scope of Work and Technical Specifications
SECTION 01 78 23-6 OPERATION AND MAINTENANCE DATA

PART 3 – EXECUTION

(NOT USED)

END OF SECTION

SECTION 01 78 36

WARRANTIES

PART 1 – GENERAL

1.01 PROJECT MAINTENANCE AND WARRANTY

- A. Maintain and keep in good repair the Work covered by these Drawings and Specifications until acceptance by Owner.
- B. The Contractor shall warrant for a minimum period of one year from the date of Owner's written acceptance of certain segments of the Work and/or Owner's written final acceptance of the Project, as defined in the Contract Documents, that the completed Work is free from all defects due to faulty products or workmanship. The Contractor shall promptly make such corrections as may be necessary by reason of such defects. The Owner will give notice of observed defects with reasonable promptness. In the event that the Contractor should fail to make such defects, the Owner may do so and charge the Contractor the cost thereby incurred. The Performance Bond shall remain in full force and effect throughout the warranty period.
- C. The Contractor shall not be obligated to make replacements which become necessary because of ordinary wear and tear, or as a result of improper operation or maintenance, or as a result of improper work or damage by another Contractor or the Owner, or to perform any work which is normally performed by a maintenance crew during operation.
- D. In the event of multiple failures of major consequences prior to the expiration of the one year warranty described above, the affected unit shall be disassembled, inspected and modified or replaced as necessary to prevent further occurrences. All related components which may have been damaged or rendered non-serviceable as a consequence of the failure shall be replaced. A new 12 month warranty against defective or deficient design, workmanship, and materials shall commence on the day that the item is reassembled and placed back into operation.
- E. As used herein, multiple failure shall be interpreted to mean two or more successive failures of the same kind in the same item or failures of the same kind in two or more items. Major failures may include, but are not limited to, cracked or broken housings, piping, or vessels, excessive deflections, bent or broken shafts, broken or chipped gear teeth, premature bearing failure, and excessive wear or excessive leakage around seals. Failures which are directly and clearly traceable to operator abuse shall be exempted from the scope of the one year warranty. Operator abuse may include, but not be limited to, operations in conflict with published operating procedures or improper maintenance, such as substitution of unauthorized replacement parts, use of incorrect lubricants or chemicals, flagrant over or under-lubrication and using maintenance procedures not conforming with published maintenance instructions. Should multiple

failures occur in a given item, all products of the same size and type shall be disassembled, inspected, modified or replaced as necessary and rewarranted for one year.

F. The Contractor shall, at Contractor's expense, furnish all labor, materials, tools and equipment required, as well as make such repairs and removals as necessary to perform work or reconstruction of any structural or functional defect or failure resulting from neglect, faulty workmanship or faulty materials, in any part of the Work performed by the Contractor. Such repair shall also include refilling of trenches, excavations or embankments that show settlement or erosion after backfilling or placement.

G. Except as noted on the Drawings or as specified, all structures such as embankments and fences shall be returned to their original condition prior to the completion of the Contract. Any and all damage to any facility not designated for removal, resulting from the Contractor's operations, shall be promptly repaired by the Contractor at no cost to the Owner.

H. The Contractor shall be responsible for all road and entrance reconstruction and repairs and maintenance of the same for a period of one year from the date of final acceptance. In the event of the repairs and maintenance are not made immediately and it becomes necessary for the owner of the road to make such repairs, the Contractor shall reimburse the owner of the road for the cost of such repairs.

I. In the event the Contractor fails to proceed to remedy the defects upon notification within 15 days of the date of such notice, the Owner reserves the right to cause the required materials to be procured and the work to be done, as described in the Drawings and Specifications, and to hold the Contractor and the sureties on Contractor's bond liable for the cost and expense thereof.

J. Notice to Contractor for repairs and reconstruction will be made in the form of a registered letter addressed to the Contractor at Contractor's home office.

K. Neither the foregoing paragraphs nor any provision in the Contract Documents, nor any special guarantee time limit implies any limitation of the Contractor's liability within the law of the place of construction.

END OF SECTION

SECTION 01 78 39

RECORD DOCUMENTS

PART 1 – GENERAL

1.01 SCOPE

A. The work under this Section includes, but is not necessarily limited to, the compiling, maintaining, recording and submitting of project record documents as herein specified.

B. Record documents refer to those documents maintained and annotated by the Contractor during construction and are defined as:

1. A neatly and legibly marked set of contract drawings showing the final location of piping, equipment, structures, electrical conduits, outlet boxes and cables.
2. Specifications annotated with addenda and change order items, by section.
3. Change orders and other modifications to the Contract.
4. Owner field orders or written instructions, including Requests for Information (RFI) and Clarification Memorandums.
5. Reviewed shop drawings, product data and samples.
6. Daily work reports.
7. Field test data.
8. Additional documents such as schedules, lists, drawings, and electrical and instrumentation diagrams included in the Specifications.

C. The Contractor shall maintain on the Project site throughout the Contract Time an up to date set of Record Drawings.

1.02 GENERAL REQUIREMENTS

A. Unless otherwise specified, record drawings shall be full size and maintained in a clean, dry and legible condition.

B. Record documents shall not be used for construction purposes and shall be available for review by the Owner and Owner during normal working hours.

C. At the completion of the Work, prior to final payment, all record drawings and any CAD files shall be submitted to the Owner.

D. The record documents shall be maintained continuously.

- E. Prior to each request for partial progress payment, Owner will review record drawings with Contractor.
- F. Progress payment requests will not be processed unless record drawings are current.

1.03 MAINTENANCE OF DOCUMENTS AND SAMPLES

- A. Storage
 - 1. The Contractor shall store documents and samples in the Contractor's field office, apart from documents used for construction.
 - 2. The Contractor shall provide files and racks for storage of documents.
 - 3. The Contractor shall provide locked cabinet or secure storage space for storage of samples.
- B. The Contractor shall file documents and samples in accordance with format of these Specifications.
- C. Maintenance
 - 1. The Contractor shall maintain documents in a clean, dry, legible condition and in good order.
 - 2. Do not use record documents for construction purposes.
 - 3. The Contractor shall maintain at the site for the Owner one copy of all record documents.
- D. Failure to maintain the Record Documents in a satisfactory manner may be cause for withholding of a certificate for payment.

1.04 QUALITY ASSURANCE

- A. Furnish qualified and experienced person, whose duty and responsibility shall be to maintain Record Documents.
- B. Accuracy of Records:
 - 1. Unless noted otherwise, Record Drawings shall provide dimensions, distances and coordinates to the nearest 0.1 foot.
 - 2. Unless noted otherwise, Record Drawings shall provide elevations to the nearest 0.01 foot for all pertinent items constructed by the Contractor.
 - 3. Coordinate changes within Record Documents, making legible and accurate entries on each sheet of Drawings and other documents where such entry is required to show change.

4. Purpose of Project Record Documents is to document factual information regarding aspects of Work, both concealed and visible, to enable future modification of Work to proceed without lengthy and expensive site measurement

C. Make entries within 24 hours after receipt of information that a change in Work has occurred.

D. Prior to submitting each request for progress payment, request Owner's review and approval of current status of Record Documents. Failure to properly maintain, update, and submit Record Documents may result in a deferral by Owner to recommend the whole or any part of the Contractor's Application for Payment, either partial or final.

1.05 CONTRACTOR MARK-UPS AND DATA ENTRY REQUIREMENTS

A. The Contractor shall provide one set of the Contract drawings, with all changes recorded in that one set.

B. Marking of the drawings shall be kept current and shall be done at the time the material and equipment are installed.

C. Annotations to the record drawings shall be made with an erasable colored pencil conforming to the following color code:

1. Additions – Red
2. Deletions – Green
3. Comments – Blue
4. Dimensions – Graphite

D. Legibly mark drawings to record actual construction, including:

1. Changes of dimension and detail.
2. Changes made by Requests for Information (RFI), field order, work change directives, clarification memorandums or by change order.
3. Details not on original Drawings.

E. Legibly mark to record actual depths, horizontal and vertical location of underground facilities, piping, taps, fitting, valves, underground structures, equipment, raceways, cables, and appurtenances referenced to permanent surface improvements. The horizontal locations shall be referenced to at least two easily identifiable, permanent landmarks (e.g., power poles, valve markers, etc.) or benchmarks.

F. Horizontal and vertical locations of all exposed and underground utilities and appurtenances, both new facilities constructed and those utilities encountered, referenced to permanent surface improvements.

- G. Location of and dimensions of roadways and parking areas, providing dimensions to back of curb when present.
- H. Provide elevation of piping through vaults / structures, invert elevation of all pipes entering manholes, junction boxes, valves, clean outs, etc. Provide center of manholes, and corners of facilities or structures with northing, easting and bottom / top elevations.
- I. The Contractor shall obtain a set of signed/sealed as-built drawings from the Georgia registered surveyor and submit to the Owner. Survey shall accurately reflect installed location, depth, pipe size and other pertinent details.
- J. Record Drawings shall be prepared using a survey that ties the site and improvements horizontally and vertically to the following state plane coordinate system or as amended by the Owner.
 - 1. Horizontal Control: North American Datum 83 (NAD83) (HARN) 1994
 - 2. Vertical Control: North American Vertical Datum of 1988 (NAVD88).
 - 3. Grid Zone: Georgia West 1002 (US Survey feet)
- K. As-built drawings shall include the following:
 - 1. GPS coordinates for manholes and other above grade appurtenances.
 - 2. Top and invert elevations of the manholes
 - 3. Size and invert of all sewers entering/exiting the manholes
- L. Label each document "Project Record" in neat, large printed letters.
- M. Specifications
 - 1. Legibly mark each section to record:
 - a. Manufacturer, trade name, catalog number, and supplier of each product and item of equipment actually installed.
 - b. Changes made by Requests for Information (RFI), field order, clarification memorandums, or by change order.

1.06 SUBMITTAL

- A. At contract closeout, deliver Record Documents to the Owner for the Owner.
- B. Accompany submittal with transmittal letter containing:
 - 1. Date
 - 2. Project title and number
 - 3. Contractor's name and address

Section 4
Scope of Work and Technical Specifications
SECTION 01 78 39-5 RECORD DOCUMENTS

4. Title and number of each record document
5. Signature of Contractor or Contractor's authorized representative

C. Cad Files

1. All as-built plans submitted to the Fulton County Department of Public Works must be provided in electronic computer aided design (CAD) format. CAD files to be submitted in accordance with Appendix A – “Fulton County As-Built CAD Standards”.

PART 2 – MATERIALS

(NOT USED)

PART 3 – EXECUTION

(NOT USED)

END OF SECTION

APPENDIX A

Fulton County As-Built CAD Standards

Effective Date: JANUARY 01, 2010

Version 0.2

Revised: 20 Feb 2009

As of 01 JANUARY 2010, all water and wastewater as-built plans submitted to the Fulton County Department of Public Works must be provided in electronic computer aided design (CAD) format. The following standards must be followed for all plans. Construction will not be approved until these standards are met.

Template (or seed) drawing file available at <http://www.fultoncountyga.gov/county/dpw> under Developer Information on the left side-bar.

Table of contents

- 1) General Requirements
- 2) Layers
- 3) Drawing
- 4) Table Specifications
- 5) Symbolization
- 6) Annotation
- 7) File Names and Revisions
- 8) Deliverable Formats

1) General Requirements

a) All as-built drawings must be georeferenced to the US State Plane coordinate system, NAD 83, GA West Zone, US Survey Feet. All drawings must contain two reference pins (i.e. property corners), which are labeled and tied to the Fulton County (FULCO) GPS monument network (please identify referenced GPS monuments with the monument number and coordinates). Reference pins must be able to be field verified using GPS and must be easily accessible (i.e., must not be in a creek). The survey method (GPS or conventional) used to place the reference pins should be identified in the HORIZONTAL_AND_VERTICAL_TEXT layer. Information on the FULCO GPS survey monuments can be found using the FULCO Monument Locator map application web site at: <http://wms.co.fulton.ga.us/ms/gps/> or may be obtained in person at the Fulton County Government Center, Department of Public Works.

- b) All features depicted in the as-built drawings must be surveyed after construction. FULCO will spot check all coordinates to ensure accuracy. Table 1 specifies the features that must be surveyed. Water system features must be surveyed at a horizontal accuracy of ≤ 0.3 ft and vertical accuracy of ≤ 0.5 ft. Sewer system features must be surveyed at a horizontal accuracy of ≤ 0.5 ft and a vertical accuracy of ≤ 0.1 ft.
- c) The following feature geometry types must be shot directly using the survey instrument and tied to the FULCO GPS monument network:
 - 1) All point features (hydrants, valves, sewer manholes, etc.),
 - 2) All line features at all endpoints, bends, and turns (pipes, etc.),
 - 3) All polygon features at all corners and bends (project boundaries, lots, right-of- ways, etc.)
- d) The following feature types are acceptable: Lines, Polylines, Text, Insert/Blocks. The Leaders as feature types must not be used. Where there is a need for Leaders they shall be drawn using Line features and must be put on a text layer. For example, the leader for the diameter of a water pipe should be on the WATER_LINE_TEXT layer, not the WATER_LINE layer.
- e) A template (or seed) drawing file, file containing the required FULCO blocks and AutoCAD tool pilot will be provided through the Department of Public Works website <http://www.fultoncountygga.gov/county/dpw>.
- f) The project boundary must be labeled on the PROJECT_BOUNDARY_TEXT layer, and the label must be within the extent of the project boundary.

2) Layers:

- a) Layer names for required layers must appear exactly as in Table 1.
- b) All required layers listed in FULCO CAD layers must contain only the features that are described for that layer. For example, the BOUNDARY_LINE layer must only contain the boundary line and not such features as north arrows or parcels.
- c) All required layers must be present in the drawing except for features that do not pertain to a particular project. For example, some commercial projects or apartment complexes may not contain sewer taps as part of the construction and should not be included in the drawing.
- d) All layers must be clearly differentiated from each other.
 - 1) Two layers having the names "WATER_LINE" and "WATER_LINES" should not exist in the same drawing.
- e) SEWER_LINE_TEXT and SEWER_TEXT should not exist in the same drawing. All text must appear on separate layers from the layers they annotate. For example, text

describing a sewer line must be on the SEWERLINE_TEXT layer, not the SEWER_LINE layer.

3) Drawing

a) All layers must conform to the proper geometry type (insert/block, line, polygon, text) as indicated in Table 1 below.

Table 1: Layer Names and Geometry Types			
<i>Layer Name</i>	<i>Type</i>	<i>Layer Contents</i>	<i>Surveyed</i>
ADDRESS_TEXT	Text	Street postal address number	No
BLOCK_LETTER_TEXT	Text	Indicates the block letter of a subdivision	No
CITY_BOUNDARY	Line	City boundary line	No
CITY_BOUNDARY_TEXT	Text	City names associated with the CITY_BOUNDARY	No
COUNTY_BOUNDARY	Line	County boundary lines	No
COUNTY_BOUNDARY_TEXT	Text	County Names for the COUNTY_BOUNDARY layer	No
CONTOUR	Line	Topological delineation information	
CONTOUR_TEXT	Text	Description info for contour layer	
CORNER_POINTS	Point	Establishing Reference points	
FIRE_HYDRANT	Insert	Fire Hydrants	Yes
FIRE_HYDRANT_TEXT	Text	Text Associated with FIRE_HYDRANT layer	No
FLOODPLAIN_100YR	Line	Existing floodplain delineation	
FLOODPLAIN_100YR_FUTURE	Line	Proposed floodplain delineation	
FLOODPLAIN_100YR_FUTURE_TEXT	Text	Text for proposed floodplain delineation	
FLOODPLAIN_100YR_TEXT	Text	Text for existing floodplain delineation	
FLOW_ARROW	Insert	Sewer line flow arrows	No
GABION_WALL	block	Any retaining type wall construction	
GREASE_TRAPS	block	Grease traps	
HORIZONTAL_AND_VERTICAL_CONTROL_POINT	Point	Survey control points (rebar or monuments) with x,y,z	Yes
HORIZONTAL_AND_VERTICAL_TEXT	Text	Corresponding text (coordinate values, monument number, Survey method etc.).	No
LAND_LOT_LINE	Line	Layer Contents	
LAND_LOT_LINE_TEXT	Text	Land lot numbers and other text.	No
LOT_NUMBER_TEXT	Text	Individual lot numbers	No
PROJECT_BOUNDARY	Poly	The boundary line of the subdivision or property.	Yes

Section 4
Scope of Work and Technical Specifications
APPENDIX A-4 Fulton County As-Built CAD Standards

Table 1: Layer Names and Geometry Types			
PROJECT_BOUNDARY_TEXT	Text	Project (Development) Name	No
PROPERTY_ID_TEXT	Text	Property Information	
PROPERTY_LINE	Poly	Property Lines (parcel lines)	Yes
PUMP_STATION	Point	Represents the centermost point of a pump station	Yes
PUMP_STATION_TEXT	Text	Text associated with PUMP_STATION	No
RAILROAD_LINE	Line	Railroad Lines	Yes
RAILROAD_TEXT	Text	Text Associated with RAILROAD	No
ROAD_EDGE_OF_PAVEMENT	Poly	Street Edge of Pavement (not back of curb); this layer should not include parking lots or curbing	Yes
ROAD_TEXT	Text	Road Names	No
ROAD_RIGHT-OF-WAY	Poly	Road Right-of-Way	Yes
ROAD_RIGHT-OF-WAY_TEXT	Text	Text relating to the road right of way layer	No
SEWER_END-OF-LINE	Insert	End of sewer line.	Yes
SEWER_END-OF-LINE_TEXT	Text	Text associated with SEWER_END-OF-LINE	No
SEWER_EXISTING	Line	Sewer lines present before the subdivision/project	Yes
SEWER_EXISTING_TEXT	Text	Text associated with the SEWER_EXISTING layer	No
SEWER_MANHOLE_EXISTING	Block	Existing Sewer Manholes	Yes
SEWER_MANHOLE_EXISTING_TEXT	Text	Text for the SEWER_MANHOLE EXISTING layer	No
SEWER_FORCE_MAIN	Line	Sewer force mains	Yes
SEWER_FORCE_MAIN_TEXT	Text	Text associated with SEWER_FORCE_MAIN	No
SEWER_LINE	Line	Sewer lines built as part of the subdivision/project.	Yes
SEWER_LINE_TEXT	Text	Text associated with the SEWER_LINE layer.	No
SEWER_MANHOLE	Block	Sewer Manholes	Yes
SEWER_MANHOLE_TEXT	Text	Text associated with the SEWER_MANHOLE layer	No
SEWER_SEPTIC_TANK	Line	Septic tank	
SEWER_TAP	Line	Sewer taps	Yes
SEWER_TAP_TEXT	Text	Distance between taps in feet	Yes
SEWER_TUNNEL	Line	Subsurface Sewer tunnel construction	
STORM_BMP	Poly	Engineered structures designed to improve management of Stormwater system (see section e-I)	
STORM_BMP_TEXT	Text	Label showing the BMP_ID (see section e-II)	No

Section 4
Scope of Work and Technical Specifications
APPENDIX A-5 Fulton County As-Built CAD Standards

Table 1: Layer Names and Geometry Types			
STORM_BMP_EXISTING	Poly	Engineered structures designed to improve management of Stormwater system (see section e-I)	No
STORM_BMP_EXISTING_TEXT	Text	Text associated with the STORM_BMP_EXISTING	No
STORM_CULVERT	Poly	A polygon representing the extent of pipe culvert or box Culvert structure (see section e-III)	Yes
STORM_CULVERT_TEXT	Text	Label for the features ID (see section e-III)	No
STORM_CULVERT_EXISTING	Poly	A polygon representing the extent of a culvert structure (see section e-III), prior to construction	Yes
STORM_CULVERT_EXISTING_TEXT	Text	Label for the features (see section e-III)	No
STORM_CULVERT_CHART	n/a	Describes the required parameters (e-III)	n/a
STORM_DROPINLET	Block	Stormwater drop inlet. (see section e-IV)	Yes
STORM_DROPINLET_TEXT	Text	Text describing layer (i.e. Invert Elevation)	No
STORM_DROPINLET_EXISTING	Block	Stormwater drop inlet (see section e-IV) that existed prior to construction	Yes
STORM_DROPINLET_EXISTING_TEXT	Text	Text describing layer	No
STORM_FLUME	Line	The centerline drawn in flow direction (see section V)	Yes
STORM_FLUME_TEXT	Text	Text for: material (lining), slope (see section e-VI)	No
STORM_FLUME_EXISTING	Line	The centerline that existed prior to construction Must be drawn in flow direction (see section V).	Yes
STORM_FLUME_EXISTING_TEXT	Text	Text associated with layer (see section e-VI)	No
STORM_HEADWALL	Block	Proposed new placement point of construction	
STORM_HEADWALL_TEXT	Text	Text associated with new headwall	
STORM_HEADWALL_EXISTING	Block	Headwall which existed prior to construction	
STORM_HEADWALL_EXISTING_TEXT	Text	Text associated which existed prior to construction	
STORM_JUNCTION_BOX	Insert	Block in the location of a Stormwater Junction Box	Yes
STORM_JUNCTION_BOX_TEXT	Text	Text for layer that must at least show: Rim Elevation, Invert Elevation, and Junction Box material.	No
STORM_JUNCTION_BOX_EXISTING	Insert	Pre-existing block for the Storm Junction Box	Yes
STORM_JUNCTION_BOX_EXISTING_TEXT	Text	Text for layer that must at least show: Rim Elevation, material, Invert Elevation, and Junction Box	No
STORM_LINE	Line	Pipe (i.e. Pipe line or driveway pipe) (see section e-VII)	Yes

Section 4
Scope of Work and Technical Specifications
APPENDIX A-6 Fulton County As-Built CAD Standards

Table 1: Layer Names and Geometry Types			
STORM_LINE_TEXT	Text	Text for layer (i.e. slope, diameter, material)	No
STORM_LINE_EXISTING	Line	Pre-existing stormwater line (pipe line or driveway pipe) drawn in the direction of flow (see section e-VII)	Yes
STORM_LINE_EXISTING_TEXT	Text	Text associated with layer (i.e. slope, diameter, material)	No
STORM_OPEN_CHANNEL	Line	Centerline drawn in the direction of flow (see section e-V)	Yes
STORM_OPEN_CHANNEL_TEXT	Text	Text layer: material (lining), slope (see section e-VI)	No
STORM_OPEN_CHANNEL_EXISTING	Line	Centerline of structure. Must be drawn in the direction of flow (see section e-V)	Yes
STORM_OPEN_CHANNEL_EXISTING_TEXT	Text	Text associated with layer (see section e-VI)	No
STORM_LINE_END	Insert	The structure at the Line End or a node representing the bare end of pipe (see section e-VIII)	Yes
STORM_LINE_END_TEXT	Text	Text layer (i.e. slope, diameter, material)	No
STORM_LINE_END_EXISTING	Insert	The structure at the Line End or a node representing the bare end of pipe (see section e-VIII)	Yes
STORM_LINE_END_EXISTING_TEXT	Text	Text associated with layer	No
STRUCTURE	Line	Above ground construction (Buildings, apartments, etc.)	
STRUCTURE_TEXT	Text	Name, or other information associated with the structure	
TANK_PROPOSED	Line	Any proposed tank construction	
TRASH_RACKS	Block	Trash Racks	
UTILITY_EASEMENT	Poly	Utility line easements	Yes
UTILITY_EASEMENT_TEXT	Text	Text Associated with Utility Easements	No
WATER_CAP	Insert	Cap at the end of water line.	Yes
WATER_CAP_TEXT	Text	Text associated with WATER_CAP_TEXT	No
WATER_EXISTING	Line	Water lines before the subdivision/project was built	Yes
WATER_EXISTING_TEXT	Text	Text associated with WATER_EXISTING	No
WATER_LINE	Line	Water lines built as part of the subdivision/project.	Yes
WATER_LINE_TEXT	Text	Text associated with WATER_LINE	No
WATER_METER	Insert	Customer water meters	Yes
WATER_METER_TEXT	Text	Text associated with WATER_METER	No
WATER_REDUCER	Insert	Water line reducer	Yes

Section 4
Scope of Work and Technical Specifications
APPENDIX A-7 Fulton County As-Built CAD Standards

Table 1: Layer Names and Geometry Types			
WATER_REDUCER_TEXT	Text	Text associated with WATER_REDUCER	No
WATER_SERVICE	Line	Water service lines	Yes
WATER_SERVICE_TEXT	Text	Text associated with WATER_SERVICE	No
WATER_STORAGE_SYSTEM	Block	Water Storage System construction	
WATER_STORAGE_SYSTEM_TEXT	Text	Text for Water Storage System construction	
WATER_VALVE_EXISTING	Insert	Existing water valves	Yes
WATER_VALVE_EXISTING_TEXT	Text	Text associated with WATER_VALVE_EXISTING	No
WATER_VALVE	Insert	Water valves	Yes
WATER_VALVE_TEXT	Text	Text associated with WATER_VALVE	No
WATER_VAULT	Insert	Large meter or fire connection vault	Yes
WATER_VAULT_TEXT	Text	Text associated with WATER_VAULT	No
WETLAND	Line	Wetland area	
WETLAND_TEXT	Text	Text associated with the Wetland	

- b) All Polygon type features must be completely closed. Lines may need to be duplicated on more than one layer.
- 1) Subdivision/project parcels must to be closed figures on their layer (not closed with the subdivision/project boundary).
 - 2) Road edge-of-pavement and road right-of-way must be drawn as closed polygons.
 - 3) Where a polygon feature extends beyond the edge of the plan, the property boundary (repeated on the polygon feature's layer) will be used to close the polygon.
 - 4) All edges on polygon features must be snapped together at the vertices. Gaps in polygon boundaries will not be accepted.
- c) Sewer Features
- 1) Sewer Lines and Sewer Taps need to be digitized with proper directionality: lines must be drawn from the uphill node to the downhill node or flipped after the lines have been digitized.
 - 2) All tangents between sewer manholes need to be drawn with a single line. Lines must not continue for more than one tangent.

- 3) All tangents must be snapped at endpoints intersecting at the exact center of the manhole. No gaps should exist between tangents.
- 4) Manholes need to be symbolized consistently with an insert centered and snapped on the tangent endpoints.
- 5) Sewer tap locations must be snapped to the sewer tangent and accurately placed. Placement shall be based on the televising reports. FULCO will verify tap placement against the televising report. The as-built engineer is responsible for obtaining the televising report.

d) Water Features

- 1) Water lines must be digitized with all straight-line pipes consisting of only two end points. Straight-line pipes will begin and end at the following features (nodes): hydrants, valves, meters, pumps, tees, crosses, and valves. Polyline should be used wherever a water line contains elbows or bends (i.e., when the line does make a straight run from node to node).
- 2) Curves may be digitized with enough vertices to capture the curve geometry, but they must be single, continuous lines. Curves or arcs may also be used to designate curved pipe.
- 3) Hydrants must be shown in their true, surveyed location, and must be connected to the water main via a valved fire hydrant line.
- 4) All water lines must be continuous, with pipe endpoints snapped to each other at endpoints (nodes).
- 5) End-of-line caps must be drawn to differentiate end-of-lines from lines that extend beyond the extent of the drawing. Caps should be drawn for lines that are to be permanently capped when the project is complete, not for lines that are temporarily capped pending inspection.

e) Stormwater Features

- 1) The entire BMP must be represented on the Storm_BMP layer using a polygon. The following are the examples of BMPs: Enhanced Swale, Stormwater Pond, Stormwater Wetland, Sand Filter, Bioretention Cell, Infiltration Trench, Filter Strip, Gravity Oil-Grit Separator, Proprietary Structural Control, Underground Detention, Porous Concrete, Modular Porous Paver System. Please consult with the FULCO water resources engineer for a list of currently accepted BMPs.
- 2) A BMP_ID is going to be assigned to each STORM_BMP feature by the FULCO engineer during the plan review process. The contractor must clearly mark every BMP feature with the assigned BMP_ID in the STORM_BMP_TEXT layer of the asbuilt.

3) In the STORM_CULVERT and STORM_CULVERT_EXISTING layers, the structures must be drawn as polygons to show their length, width, location, and orientation. All the corners of the culvert extents must be surveyed. All culverts must be labeled in the corresponding STORM_CULVERT_TEXT or STORM_CULVERT_EXISTING_TEXT layer with the number matching the culvert chart shown on the asbuilt. The storm culvert chart shall be put in the STORM_CULVERT_CHART layer. For Culvert Chart contents see the Stormwater Development Guidelines.

4) In the STORM_DROPINLET and STORM_DROPINLET_EXISTING layers, the structures shall be drawn with different inserts (blocks) according to the type of the Drop Inlet: Single Wing Catch Basin, Double Wing Catch Basin, Square Catch Basin, Rectangular Catch Basin, Grate Cover Inlet, Catch Basin with Grate, Curb Inlet, Circular Weir Inlet, Rectangular Weir Inlet. The contractor must only use the blocks provided by FULCO for these features.

5) In the STORM_OPEN_CHANNEL, STORM_OPEN_CHANNEL-EXISTING, STORM_FLUME and STORM_FLUME_EXISTING layers, the feature shall be represented by a line reflecting the centerline of the structure and must be drawn in the direction of flow. The lines shall be broken at any point where the slope percent changes. All endpoints (including the points of slope changes) shall be surveyed.

6) STORM_OPEN_CHANNEL_TEXT, STORM_OPEN_CHANNEL_EXISTING_TEXT, STORM_FLUME_TEXT and STORM_FLUME_EXISTING TEXT layers shall contain a label indicating the percent slope and a type of material (lining) of the corresponding open channel or flume.

7) In the STORM_LINE or STORM_LINE_EXISTING layers, the features must be drawn in the direction of flow. This feature must be digitized with all straight-line pipes consisting of only two end points. Straight-line pipes will begin and/or end at the following features: STORM_LINE_END, STORM_JUNCTION_BOX, STORM_DROP_INLET.

8) In the STORM_LINE_END and STORM_LINE_END_EXISTING layers, the structures must be drawn with different inserts (blocks) according to the type: Straight Headwall, U-type Headwall, Tapered Headwall, L-Type Headwall, Flared-End Section, Straight Wingwall, Angled Wingwall, Bare End and BMP Outlet. STORM_LINE_END and STORM_LINE_END_EXISTING features must be snapped to the ends of the STORM_LINE or STORM_LINE_EXISTING or the centers of STORM_CULVERT or STORM_CULVERT_EXISTING openings. The contractor must only use the blocks provided by FULCO for these features (see section 4) Symbolization)

4) Table Specifications

- a) A table with the following attribute data for each sewer line
- 1) Unique identifier matching the identifier in the as-built drawing
 - 2) Unique identifier matching upstream manhole identifier in the as-built drawing
 - 3) Upstream Measure Down - Distance from the upstream manhole lid top to invert of pipe as measured in feet
 - 4) Upstream Invert – Elevation (z) of the invert of the upstream end of the pipe
 - 5) Unique identifier matching downstream manhole identifier in the as-built drawing
 - 6) Downstream Measure Down - Distance from downstream manhole lid top to invert of pipe as measured in feet
 - 7) Downstream Invert – Elevation (z) of the invert of the downstream end of the pipe
 - 8) Pipe diameter measured in inches
 - 9) Pipe Material (CI, DI, PVC, VC, RCP, UNK, IRON, TRAN, PE, TR)
 - 10) Pipe Length measured in feet

Example Table: Sewer Line

Pipe ID	Upstr MH ID	Upstr Measure Down	Upstr Invert	Downstr MH ID	Downstr Measure Down	Downstr Invert	Pipe Diameter	Pipe Material	Pipe Length
Pipe#1	SSMH#1	6.1	908.78	Pump Station	10.2	905.08	8	PVC	291
Pipe#2	SSMH#2	7.1	908.33	SSMH#1	6.05	908.83	8	PVC	238
Pipe#3	SSMH#3	8	908.76	SSMH#2	7.1	908.03	8	PVC	64

- b) A table with the following attribute data for each water line
- 1) Unique identifier matching the identifier in the as-built drawing
 - 2) Pipe diameter measured in inches
 - 3) Pipe Material (CI, PVC, DI, GV, PB, CO, UNK, TRAN,CP, SC.)
 - 4) Pipe Length measured in feet
 - 5) End1 ID (Valve, Meter, Reducer, etc.)
 - 6) End2 ID (Valve, Meter, Reducer, etc.)

Example Table: Water Line

Section 4
Scope of Work and Technical Specifications
APPENDIX A-11 Fulton County As-Built CAD Standards

Pipe ID	Pipe Diameter	Pipe Material	Pipe Length	End1 ID	End2 ID
WL #1	8	PVC	291	WV #2	FH #23
WL #2	8	PVC	238	WM #43	WV #2
WL #3	8	PVC	64	WV #2	WV #54

- c) A table with the following attribute data for each storm line
- 1) Unique identifier matching the identifier in the as-built drawing
 - 2) Unique identifier matching upstream structure identifier in the as-built drawing
 - 3) Upstream Measure Down - Distance from the upstream structure elevation to invert of pipe measured in feet
 - 4) Upstream Invert – Elevation (z) of the invert of the upstream end of the pipe
 - 5) Unique identifier matching downstream structure identifier in the as-built drawing
 - 6) Downstream Measure Down - Distance from downstream structure elevation to invert of pipe measured in feet
 - 7) Downstream Invert – Elevation (z) of the invert of the downstream end of the pipe
 - 8) Pipe Shape (Box, Elliptical, Circular, etc.)
 - 9) Pipe height measured in inches
 - 10) Pipe width measured in inches
 - 11) Pipe Material (BCCMP, RCP, HDPE, CMP.)
 - 12) Pipe Length measured in feet

Example Table: Storm Line

Pipe ID	Upstr-ID	Upstr Measure Down	Upstr Invert	Downstr-ID	Downstr Measure Down	Downstr Invert	Pipe Shape	Pipe Height	Pipe Width	Pipe Material	Pipe Length
Pipe #1	DI #1	6.1	906.78	JB #3	10.2	905.06	Circular	24	24	BCCMP	291
Pipe #2	CB #2	7.1	908.33	FES #1	6.05	908.83	Ellipse	36	24	BCCMP	238
Pipe #3	HW #1	0	908.76	HW #2	0	908.33	Box	60	84	RCP	64

5) Symbolization

- a) Symbols must be standardized according to examples provided in the FULCO template file. The following “point” features must be symbolized using standard FULCO CAD symbols and drawn as inserts:

Section 4
Scope of Work and Technical Specifications
APPENDIX A-12 Fulton County As-Built CAD Standards

- 1) Vault
- 2) Valve
- 3) Hydrant
- 4) Manhole
- 5) Meter
- 6) End of Line/Cap
- 7) Reducer
- 8) Junction Box
- 9) Grease Traps
- 10) Trash Racks
- 11) Water Cap

b) All blocks used in the STORM layers must be drawn as inserts. The blocks must be standard and symbolized using only FULCO CAD blocks provided on the FULCO CAD Digital Data Submission Standards template available through the Department of Public Works website <http://www.fultoncountyga.gov/county/dpw>.

- 1) Single Wing Catch Basin
- 2) Double Wing Catch Basin
- 3) Square Catch Basin
- 4) Rectangular Catch Basin
- 5) Grate Cover Inlet
- 6) Catch Basin with Grate
- 7) Curb Inlet
- 8) Circular Weir Inlet
- 9) Rectangular Weir Inlet
- 10) Straight Headwall
- 11) U-type Headwall
- 12) Tapered Headwall
- 13) L-type Headwall
- 14) Flared-End Section

- 15) Straight Wingwall
- 16) Angled Wingwall
- 17) Bare End
- 18) BMP Outlet
- 19) Junction Box
- 20) Rectangular Weir Inlet

6) Annotations

- a) Any non-standard water and sewer lines must be annotated as such. Line diameter, material, ownership, etc. that does not conform to standard practice should be noted in the corresponding annotation layer. For example, standard subdivision sewer lines are 8" in diameter. Any other diameter must be annotated on the SEWER_LINE_TEXT layer.
- b) All addresses and lot numbers must be number data type (that is no text or symbols: #, -, ft, _, ", ', etc.). If the lot does not have a number, this layer should be blank.
- c) All required text must be single line text. Project (Development) name shall be on one line.
- d) All annotation for polyline (polygon) features must be bounded by the polyline it annotates. For example, the project name must be within the project boundary, and not extend beyond it.

7) File naming and revisions

- a) File names should correspond exactly to the subdivision or project name and should be consistent from one version to the next. The file name should contain the drawing revision date (in YYMMDD format) as part of the name. There should be no blank spaces in the name, only underscores. An example file name for the May 12, 2008 revision for the third phase of the Peaceful Valley subdivision is: "Peaceful_Valley_3_080512". If a development name changes from that of indicated in the originally approved plans, the original name shall also be provided with the submittal of the as-built.
- b) File revision dates should only be updated by the contractor/developer and not by FULCO or Fulton County.

8) Deliverable Format

- a) All files shall be delivered in AutoCAD (release 14 or higher), DXF or DWG format (for projects created in Microstation) in a single flash drive. Files should not be spanned over more than one drive.
- b) All deliverables will be labeled with the file name, company name, contact name, and phone number. A transmission letter restating this information along with a statement requesting as-built review will also accompany the disk

SECTION 01 79 00

DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:

1. Demonstration of operation of systems, subsystems, and equipment.
2. Training in operation and maintenance of systems, subsystems, and equipment.

B. Furnish demonstration and training instruction time as a subsidiary obligation of the price bid.

1.03 QUALITY ASSURANCE

A. Facilitator Qualifications: A firm or individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.

B. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Section 01 40 00 "Quality Requirements," experienced in operation and maintenance procedures and training.

1.04 COORDINATION

A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations and to ensure availability of Owner's personnel.

B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.

C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data has been reviewed and approved by Engineer.

PART 2 - PRODUCTS

2.01 INSTRUCTION PROGRAM

A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual Specification Sections.

B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participants are expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:

1. Basis of System Design, Operational Requirements, and Criteria: Include the following:
 - a. System, subsystem, and equipment descriptions.
 - b. Performance and design criteria if Contractor is delegated design responsibility.
 - c. Operating standards.
 - d. Regulatory requirements.
 - e. Equipment function.
 - f. Operating characteristics.
 - g. Limiting conditions.
 - h. Performance curves.
2. Documentation: Review the following items in detail:
 - a. Emergency manuals.
 - b. Operations manuals.
 - c. Maintenance manuals.
 - d. Project record documents.
 - e. Identification systems.
 - f. Warranties and bonds.
 - g. Maintenance service agreements and similar continuing commitments.
3. Emergencies: Include the following, as applicable:
 - a. Instructions on meaning of warnings, trouble indications, and error messages.

Section 4
Scope of Work and Technical Specifications
SECTION 01 79 00-3 DEMONSTRATION AND TRAINING

- b. Instructions on stopping.
 - c. Shutdown instructions for each type of emergency.
 - d. Operating instructions for conditions outside of normal operating limits.
 - e. Sequences for electric or electronic systems.
 - f. Special operating instructions and procedures.
- 4. Operations: Include the following, as applicable:
 - a. Startup procedures.
 - b. Equipment or system break-in procedures.
 - c. Routine and normal operating instructions.
 - d. Regulation and control procedures.
 - e. Control sequences.
 - f. Safety procedures.
 - g. Instructions on stopping.
 - h. Normal shutdown instructions.
 - i. Operating procedures for emergencies.
 - j. Operating procedures for system, subsystem, or equipment failure.
 - k. Seasonal and weekend operating instructions.
 - l. Required sequences for electric and electronic systems.
 - m. Special operating instructions and procedures.
- 5. Adjustments: Include the following:
 - a. Alignments.
 - b. Checking adjustments.
 - c. Noise and vibration adjustments.
 - d. Economy and efficiency adjustments.
- 6. Troubleshooting: Include the following:
 - a. Diagnostic instructions.
 - b. Test and inspection procedures.

7. Maintenance: Include the following:
 - a. Inspection procedures.
 - b. Types of cleaning agents to be used and methods of cleaning.
 - c. List of cleaning agents and methods of cleaning detrimental to product.
 - d. Procedures for routine cleaning.
 - e. Procedures for preventive maintenance.
 - f. Procedures for routine maintenance.
 - g. Instruction on use of special tools.
8. Repairs: Include the following:
 - a. Diagnosis instructions.
 - b. Repair instructions.
 - c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 - d. Instructions for identifying parts and components.
 - e. Review of spare parts needed for operation and maintenance.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Section 01 78 23 "Operation and Maintenance Data."
- B. Set up instructional equipment at instruction location. Provide videos of each training session.

3.02 INSTRUCTION

- A. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor and Owner for number of participants, instruction times, and location.
- B. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.

Section 4
Scope of Work and Technical Specifications
SECTION 01 79 00-5 DEMONSTRATION AND TRAINING

1. Engineer will furnish an instructor to describe the basis of system design, operational requirements, criteria, and regulatory requirements.
 2. Owner will furnish an instructor to describe Owner's operational philosophy.
 3. Owner will furnish Contractor with names and positions of participants.
- C. Scheduling: Provide instruction at mutually agreed-on times. For equipment that requires seasonal operation, provide similar instruction at the start of each season.
1. Schedule training with Owner, through Engineer, with at least seven days' advance notice.
- D. Training Location and Reference Material: Conduct training on-site in the completed and fully operational facility using the actual equipment in place. Conduct training using final operation and maintenance data submittals.
- E. Cleanup: Restore systems and equipment to condition existing before initial training use.

END OF SECTION

SECTION 01 99 90

REFERENCE FORMS

PART 1 – Forms

Description

- A. The forms listed below and included in this section are referenced from other sections of the project manual:

Form No.	Title
01 33 00-A	Submittal Transmittal Form
01 78 23-A	Operation and Maintenance Transmittal Form
01 78 23-B	Equipment Record Form
01 78 23-C	Equipment Record Form
43 05 11-A	Manufacturer's Installation Certification Form

Section 4
Scope of Work and Technical Specifications
SECTION 01 99 90-2 REFERENCE FORMS

1. 01 33 0-A. SUBMITTAL TRANSMITTAL FORM

Submittal Transmittal

Submittal Description:	Submittal No: ¹	Spec Section:

	Routing	Sent	Received
Owner:	Contractor/CM		
Project:	CM/Engineer		
	Engineer/CM		
Contractor:	CM/Contractor		

We are sending you:

- ☐ Attached
☐ Under separate cover via _____
☐ Submittals for review and comment
☐ Product data for information only

Remarks: _____

Item	Copies	Date	Section No.	Description	Review Action ^a	Reviewer Initials	Review Comments Attached

^aNote: NET = No exceptions taken; MCN = Make corrections noted; A&R = Amend and resubmit; R = Rejected
 Attach additional sheets if necessary.

Contractor

Certify either a or b:

- a. ☐ We have verified that the material or equipment contained in this submittal meets all the requirements, including coordination with all related work, specified (no exceptions).
 b. ☐ We have verified that the material or equipment contained in this submittal meets all the requirements specified except for the attached deviations.

No.	Deviation

¹See Section 01 33 00-1.04. A, Transmittal Procedure.

Certified by:	
Contractor's Signature:	

Section 4
Scope of Work and Technical Specifications
SECTION 01 99 90-4 REFERENCE FORMS

2. 01 78 23-A. OPERATION AND MAINTENANCE TRANSMITTAL FORM

Date:	Submittal No.: ²
To:	Contract No:
	Spec. Section:
	Submittal Description:
Attention:	From:

Checklist	Contractor		Construction Manager	
	Satisfactory	N/A	Accept	Deficient
1. Table of contents				
2. Equipment record forms				
3. Manufacturer information				
4. Vendor information				
5. Safety precautions				
6. Operator prestart				
7. Start-up, shutdown, and post-shutdown procedures				
8. Normal operations				
9. Emergency operations				
10. Operator service requirements				
11. Environmental conditions				
12. Lubrication data				
13. Preventive maintenance plan and schedule				
14. Troubleshooting guides and diagnostic techniques				
15. Wiring diagrams and control diagrams				
16. Maintenance and repair procedures				
17. Removal and replacement instructions				
18. Spare parts and supply list				
19. Corrective maintenance man-hours				
20. Parts identification				
21. Warranty information				
22. Personnel training requirements				
23. Testing equipment and special tool information				

² See Section 01 33 00-1.04.A, Transmittal Procedure.

Remarks:

Contractor's Signature :

Section 4
Scope of Work and Technical Specifications
SECTION 01 99 90-6 REFERENCE FORMS

3. 01 78 23-B. EQUIPMENT RECORD FORM

Eqpt Description		Eqpt Location	
Eqpt No.	Shop Dwg No.	Date Installed	Cost
Mfr		Mfr Contact	
Mfr Address			Phone
Vendor		Vendor Contact	
Vendor Address			Phone

Maintenance Requirements	D	W	M	Q	S	A	Hours

Lubricants: Recommended:

Alternative:

Misc. Notes:

Recommended Spare Parts				Electrical Nameplate Data			
Part No	Quantity	Part Name	Cost	Equipment			
				Make			
				Serial No.		Id No.	
				Model No.		Frame No.	
				HP	V	Amp	Hz
				Ph	Rpm	Sf	Duty
				Code	Insl. Cl	Des	Type
				Nema Des	C Amb	Temp Rise	Rating
				Misc.			
				Mechanical Nameplate Data			
				Eqpt			
				Make			
				Serial No.		Id No.	
				Model No.		Frame No.	
				HP	RPM	Cap	Size
				TDH	Imp Size	Belt No.	Cfm
				PSI	Assy No.	Case No.	
				Misc			

Eqpt Description		Eqpt Location	
Eqpt No.	Shop Dwg No.	Date Installed	Cost
Mfr		Mfr Contact	
Mfr Address			Phone
Vendor		Vendor Contact	
Vendor Address			Phone

[illegible]

SECTION 02 22 21

DEMOLITION

PART 1 - GENERAL

1.01 WORK INCLUDES

- A. Remove existing trees on site and grind for use as mulch in between double row silt fence.
- B. Remove and replace existing storm lines in kind, unless otherwise called out on plans, along force main route.

1.02 RELATED WORK

- A. Section 31 23 00: Trench Excavation and Backfill.

1.03 SUBMITTALS

- A. Permit for transport and disposal of debris.
- B. Demolition procedures and operation sequence for review and acceptance by Engineer and Owner.

1.04 PHASING

- A. None.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Immediately remove from site.

PART 3 – EXECUTION

3.01 DEMOLITION

- A. Perform demolition in accordance with authorities having jurisdiction.
- B. Repair demolition performed in excess of that required.
- C. Do not burn materials on site.
- D. Pollution Controls: Comply with governing regulations for environmental protection.
 - 1. Use water sprinkling, temporary enclosures, and other suitable methods to limit amount of dust and dirt rising and scattering in air.
 - 2. Provide hoses and water main or hydrant connections.

3. Do not use water when it may create hazardous or objectionable conditions such as ice, flooding, and pollution.

E. Demolition: Completely demolish structure(s) and appurtenances in orderly and careful manner and remove materials from site.

1. Break up and remove concrete slabs-on-grade, unless otherwise indicated to remain.
2. Locate demolition equipment throughout structure and remove materials so not to impose excessive loads to supporting walls, floors, or framing.
3. Demolish and remove below-grade construction and concrete slabs- on-grade.
4. Filling Basements and Voids:
 - a) Completely fill below-grade areas and voids resulting from demolition of structures.
 - b) Use soil materials consisting of stone, gravel, and sand; free from debris, trash, frozen materials, roots and other organic matter, and stones larger than 2 inches.
 - c) Prior to placement of fill materials, ensure that areas to be filled are free of standing water, frost, frozen material, trash, and debris.
 - d) Place fill materials in horizontal layers not exceeding 6 inches loose depth.
 - e) Compact each layer at optimum moisture content of fill material to density equal to original adjacent ground unless subsequent excavation for new work is required.
 - f) After fill placement and compaction, grade surface to meet adjacent contours and provide flow to surface drainage structures.

B. Leave site in condition acceptable to Owner.

C. Utility System Demolition: Completely remove all utility lines shown on the drawings, including electric, water, sanitary sewer, storm sewer, and spill control, etc. Repair pavement as necessary following demolition.

3.02 PROTECTION

A. Remove from site, contaminated, vermin-infested, or dangerous materials encountered; and dispose of so not to endanger health of workers and public.

END OF SECTION

SECTION 03 30 00

CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Concrete standards.
2. Concrete materials.
3. Admixtures.
4. Curing materials.
5. Accessories.
6. Repair materials.
7. Concrete mixture materials.
8. Concrete mixture class types.
9. Concrete mixing.
10. Form-facing material for cast-in-place concrete.
11. Shoring, bracing, and anchoring.
12. Steel reinforcement bars.
13. Welded-wire reinforcement.

B. Related Requirements:

1. Section 31 20 00 "Earthwork" for drainage course under slabs-on-ground.

1.02 DEFINITIONS

A. Cementitious Materials: Portland cement or blended hydraulic cement alone or in combination with one or more of the following:

1. Fly ash; materials subject to compliance with requirements.

B. Water/Cementitious Materials (w/cm) Ratio: The ratio by weight of mixing water to cementitious materials.

C. Form-Facing Material: Temporary structure or mold for the support of concrete while the concrete is setting and gaining sufficient strength to be self-supporting.

D. Formwork: The total system of support of freshly placed concrete, including the mold or sheathing that contacts the concrete, as well as supporting members, hardware, and necessary bracing.

1.03 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site with teleconference option.

1. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
 - a. Contractor's superintendent.
 - b. Independent testing agency responsible for inspections and acceptance testing of concrete at Project site.
 - c. Ready-mix concrete manufacturer.
 - d. Concrete Subcontractor.
 - e. Structural Engineer.
 - f. Special Inspector.
2. Review the following:
 - a. Special inspection and testing and inspecting agency procedures for field quality control.
 - b. Construction joints, control joints, isolation joints, and joint-filler strips.
 - c. Steel-reinforcement installation.
 - d. Anchor rod and anchorage device installation tolerances.
 - e. Cold- and hot-weather concreting procedures.
 - f. Concrete finishes and finishing.
 - g. Curing procedures.
 - h. Forms and form-removal limitations.
 - i. Shoring and reshoring procedures.
 - j. Concrete repair procedures.
 - k. Concrete protection.
 - l. Initial curing of standard-cured and field curing of field-cured test cylinders (ASTM C31/C31M.)

- m. Protection of field cured field test cylinders.
- n. Distribution of test reports.

1.04 ACTION SUBMITTALS

A. Product Data:

- 1. Portland cement.
- 2. Blended hydraulic cement.
- 3. Performance-based hydraulic cement.
- 4. Fly ash.
- 5. Aggregates.
- 6. Admixtures:
 - a. Include limitations of use. Admixtures that do not comply with reference ASTM International requirements must be submitted with test data for approval.
- 7. Curing materials.
- 8. Joint fillers.
- 9. Repair materials.
- 10. Exposed surface form-facing material.
- 11. Concealed surface form-facing material.
- 12. Form ties.
- 13. Waterstops.
- 14. Form-release agent.
- 15. Each type of steel reinforcement.
- 16. Bar supports.

B. Formwork Shop Drawings: Prepared by, and signed and sealed by, a qualified professional engineer responsible for their preparation, detailing fabrication, assembly, and support of forms.

- 1. For exposed vertical concrete walls, indicate dimensions and form tie locations.
- 2. Indicate dimension and locations of construction joints required to construct the structure in accordance with ACI 301.

Section 4
Scope of Work and Technical Specifications
SECTION 03 30 00-4 CAST-IN-PLACE CONCRETE

- a. Location of construction joints is subject to approval of the Engineer.
3. Indicate location of waterstops.
4. Indicate proposed schedule and sequence of stripping of forms, shoring removal, and reshoring installation and removal.
- C. Reinforcement Shop Drawings: Comply with ACI SP-066:
 1. Include placing drawings that detail fabrication, bending, and placement.
 2. Include bar sizes, lengths, materials, grades, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, location of splices, lengths of lap splices, details of mechanical splice couplers, details of welding splices, tie spacing, hoop spacing, and supports for concrete reinforcement.
- D. Construction Joint Layout: Indicate proposed construction joints required to build the structure.
 1. Location of construction joints is subject to approval of Engineer.
- E. Design Mixtures: For each concrete mixture, include the following:
 1. Mixture identification.
 2. Compressive strength at 28 days or other age as specified.
 3. Compressive strength required at stages of construction.
 4. Durability exposure classes for Exposure Categories F, S, W, and C.
 5. Maximum w/cm ratio.
 6. Slump or slump flow limit.
 7. Air content.
 8. Nominal maximum aggregate size.
 9. Intended placement method.
 10. Submit adjustments to design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant changes.
- F. Concrete Schedule: For each location of each class of concrete indicated in "Concrete Mixture Class Types" Article, including the following:
 1. Concrete class designation.
 2. Location within Project.
 3. Exposure class designation.

4. Formed surface finish designation and final finish.
5. Final finish for floors.

1.05 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For the following:
 1. Installer: Include copies of applicable ACI certificates.
- B. Material Test Reports: For the following, from a qualified testing agency:
 1. Steel Reinforcement.
- C. Material Certificates: For each of the following:
 1. Cementitious materials.
 2. Admixtures.
 3. Curing compounds.
 4. Bonding agents.
 5. Adhesives.
 6. Joint-filler strips.
 7. Repair materials.
- D. Material Test Reports: For the following:
 1. Portland cement.
 2. Blended hydraulic cement.
 3. Performance-based hydraulic cement.
 4. Fly ash.
 5. Aggregates.
 6. Admixtures.
- E. Research Reports:
 1. For concrete admixtures in accordance with ICC's Acceptance Criteria AC198.
- F. Preconstruction Test Reports: For each mix design.
- G. Minutes of preinstallation conference.

1.06 QUALITY ASSURANCE

A. **Installer Qualifications:** A qualified Installer who employs Project personnel qualified as an ACI-certified Concrete Flatwork Associate and Concrete Flatwork Finisher and a supervisor who is a certified ACI Advanced Concrete Flatwork Finisher/Technician or an ACI Concrete Flatwork Finisher with experience installing and finishing concrete.

1. **Post-Installed Concrete Anchors Installers:** ACI-certified Adhesive Anchor Installer.

B. **Ready-Mixed Concrete Manufacturer Qualifications:** A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94/C94M requirements for production facilities and equipment.

1. **Manufacturer's production facilities and delivery vehicles** certified in accordance with NRMCA's certification requirements or equivalent approval by a State DOT.

C. **Laboratory Testing Agency Qualifications:** A testing agency qualified in accordance with ASTM C1077 and ASTM E329 for testing that performs duties on behalf of the Architect/Engineer.

1. **Personnel performing laboratory tests** to be an ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician, Level 1. Testing agency laboratory supervisor tests to be an ACI-certified Concrete Laboratory Testing Technician, Level 2.

1.07 PRECONSTRUCTION TESTING

A. **Preconstruction Testing Service:** Engage a qualified testing agency to perform preconstruction testing on each concrete mixture.

1. **Include the following information in each test report:**

- a. **Admixture dosage rates.**
- b. **Slump.**
- c. **Air content.**
- d. **Seven-day compressive strength.**
- e. **28-day compressive strength.**
- f. **Evaluation of permeability-reducing admixtures.**

1.08 DELIVERY, STORAGE, AND HANDLING

A. **Comply with ASTM C94/C94M and ACI 301.**

B. **Waterstops:** Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

C. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage and to avoid damaging coatings on steel reinforcement.

1. Store reinforcement to avoid contact with earth.

1.09 FIELD CONDITIONS

A. Cold-Weather Placement: Comply with ACI 301 as follows:

1. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
2. When air temperature has fallen to, or is expected to fall below 40 deg F during the protection period, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
3. Do not use frozen materials or materials containing ice or snow.
4. Do not place concrete in contact with surfaces less than 35 deg F, other than reinforcing steel.

B. Hot-Weather Placement: Comply with ACI 301 and ACI 305.1, and as follows:

1. Maintain concrete temperature at time of discharge to not exceed 95 deg F.
2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

PART 2 - PRODUCTS

2.01 CONCRETE STANDARDS

A. ACI Publications: Comply with ACI 301 unless modified by requirements in the Contract Documents.

2.02 PERFORMANCE REQUIREMENTS

A. Concrete Formwork: Design, engineer, erect, shore, brace, and maintain formwork, shores, and reshores in accordance with ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads, so that resulting concrete conforms to the required shapes, lines, and dimensions.

1. Design wood panel forms in accordance with APA's "Concrete Forming Design/Construction Guide."
2. Design formwork to limit deflection of form-facing material to 1/240 of center-to-center spacing of supports.

2.03 FORM-FACING MATERIALS

A. As-Cast Surface Form-Facing Material:

1. Provide continuous, true, and smooth concrete surfaces.
2. Furnish in largest practicable sizes to minimize number of joints.
3. Acceptable Materials: As required to comply with Surface Finish designations specified in Section 03 30 00 "Cast-In-Place Concrete, and as follows:
 - a. Plywood, metal, or other approved panel materials.
 - b. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:
 - 1) APA HDO (high-density overlay).
 - 2) APA MDO (medium-density overlay); mill-release agent treated and edge sealed.
 - 3) APA Structural 1 Plyform, B-B or better; mill oiled and edge sealed.

B. Concealed Surface Form-Facing Material: Lumber, plywood, metal, plastic, or another approved material.

1. Provide lumber dressed on at least two edges and one side for tight fit.

2.04 WATERSTOPS

A. Flexible PVC Waterstops: U.S. Army Corps of Engineers CRD-C 572, for embedding in concrete to prevent passage of fluids through joints, with factory fabricate corners, intersections, and directional changes.

1. Profile: Flat dumbbell without center bulb.
2. Dimensions: 4 inches by 3/16 inch thick; nontapered.

2.05 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A615, Grade 60, deformed.

B. Plain-Steel Welded-Wire Reinforcement: ASTM A1064, plain, fabricated from as-drawn steel wire into flat sheets.

2.06 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.07 ACCESSORIES

- A. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.
- B. Form-Release Agent: Commercially formulated form-release agent that does not bond with, stain, or adversely affect concrete surfaces and does not impair subsequent treatments of concrete surfaces.
 - 1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
- C. Form Ties: Factory-fabricated, removable or snap-off, glass-fiber-reinforced plastic or metal form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
 - 1. Furnish units that leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.
 - 2. Furnish ties that, when removed, leave holes no larger than 1 inch in diameter in concrete surface.
- D. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire reinforcement in place.
 - 1. Manufacture bar supports from steel wire, plastic, or precast concrete in accordance with CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:
 - a. For concrete surfaces exposed to view, where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire, all-plastic bar supports, or CRSI Class 2 stainless steel bar supports.
- E. Steel Tie Wire: ASTM A1064, annealed steel, not less than 0.0508 inch in diameter.
 - 1. Finish: Plain.
- F. Expansion- and Isolation-Joint-Filler Strips: ASTM D1751, asphalt-saturated cellulosic fiber or ASTM D1752, cork or self-expanding cork.
- G. Bonding Agent: ASTM C1059, Type II, nonredispersible, acrylic emulsion or styrene butadiene.

2.08 CONCRETE MATERIALS

- A. Source Limitations:
 - 1. Obtain all concrete mixtures from a single ready-mixed concrete manufacturer for entire Project.
 - 2. Obtain each type of admixture from single source from single manufacturer.

B. Cementitious Materials:

1. Portland Cement: ASTM C150, Type I or Type II.
2. Blended Hydraulic Cement: ASTM C595, Type IL, portland-limestone cement.
3. Performance-Based Hydraulic Cement: ASTM C1157: Type GU, general use; Type HE, high early strength; Type MS, moderate sulfate resistance; Type HS, high sulfate resistance; Type MH, moderate heat of hydration; or Type LH, low heat of hydration.

C. Normal-Weight Aggregates:

1. Coarse Aggregate: ASTM C33, Class 3S.
2. Maximum Coarse-Aggregate Size: 3/4 inch nominal.
3. Fine Aggregate: ASTM C33.
4. Alkali-Silica Reaction: Comply with one of the following for each aggregate used:
 - a. Expansion Result of Aggregate: Not more than 0.04 percent at one year when tested in accordance with ASTM C1293.
 - b. Expansion Results of Aggregate and Cementitious Materials in Combination: Not more than 0.10 percent at an age of 16 days when tested in accordance with ASTM C1567. Do not use this option with fly ash with an alkali content greater than 4.0 percent. Submit supporting data for each aggregate showing expansion in excess of 0.10 percent when tested in accordance with ASTM C1260.
 - c. Alkali Content in Concrete: Not to exceed 4 lb./cu. yd. for aggregate with expansion greater than or equal to 0.04 percent and less than 0.12 percent or 3 lb./cu. yd. for aggregate with expansion greater than or equal to 0.12 percent and less than 0.24 percent. Test aggregate reactivity in accordance with ASTM C1293. Calculate alkali content of concrete in accordance with ACI 301. Do not use this option with natural pozzolan or fly ash that has a calcium oxide content greater than 18 percent or an alkali content greater than 4.0 percent; or for an aggregate with expansion at one year greater than or equal to 0.24 percent when tested in accordance with ASTM C1293.

2.09 ADMIXTURES

- A. Air-Entraining Admixture: ASTM C260.**

B. Chemical Admixtures: Do not use calcium chloride or admixtures containing calcium chloride.

1. Water-Reducing Admixture: ASTM C494, Type A.
2. Retarding Admixture: ASTM C494, Type B.
3. Water-Reducing and -Retarding Admixture: ASTM C494, Type D.
4. High-Range, Water-Reducing Admixture: ASTM C494, Type F.
5. High-Range, Water-Reducing and -Retarding Admixture: ASTM C494, Type G.
6. Admixtures with special properties, with documentation of claimed performance enhancement, ASTM C494, Type S.
7. Permeability-Reducing Admixture: ASTM C494, Type S, hydrophilic, permeability-reducing crystalline admixture, capable of reducing water absorption of concrete exposed to hydrostatic pressure (PRAH). Basis of Design product is as indicated in Drawings.
 - a. Basis of Design: Sika WT-240 P.

C. Mixing Water for Concrete Mixtures and Water Used to Make Ice: ASTM C1602. Include documentation of compliance with limits for alkalis, sulfates, chlorides, or solids content of mixing water from Table 2 in ASTM C1602.

2.10 CURING MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.

B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.

C. Moisture-Retaining Cover: ASTM C171, polyethylene film burlap-polyethylene sheet.

1. Color:
 - a. Ambient Temperature Below 50 deg F: Black.
 - b. Ambient Temperature between 50 and 85 deg F: Any color.
 - c. Ambient Temperature Above 85 deg F: White.

D. Curing Paper: 8 ft. wide paper, consisting of two layers of fibered kraft paper laminated with double coating of asphalt.

E. Water: Potable water that does not cause staining of the surface.

2.11 REPAIR MATERIALS

A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.

1. Cement Binder: ASTM C150 portland cement or hydraulic or blended hydraulic cement, as defined in ASTM C219.
2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand, as recommended by underlayment manufacturer.
4. Compressive Strength: Not less than 4100 psi at 28 days when tested in accordance with ASTM C109.

B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch and that can be filled in over a scarified surface to match adjacent floor elevations.

1. Cement Binder: ASTM C150 portland cement or hydraulic or blended hydraulic cement, as defined in ASTM C219.
2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.
4. Compressive Strength: Not less than 5000 psi at 28 days when tested in accordance with ASTM C109.

2.12 CONCRETE MIXTURE MATERIALS

A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, in accordance with ACI 301.

1. Use a qualified testing agency for preparing and reporting proposed mixture designs, based on laboratory trial mixtures.

B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland or hydraulic cement in concrete assigned to Exposure Class F3 as follows:

1. Fly Ash or Other Pozzolans: 25 percent by mass.

C. Admixtures: Use admixtures in accordance with manufacturer's written instructions.

1. Use permeability-reducing admixture in concrete mixtures where indicated.

2.13 CONCRETE MIXTURE CLASS TYPES

A. Class A: Normal-weight concrete used for pump station foundation slab, walls, and top slab.

1. Exposure Class: ACI 318 Class F2; Class W1; Class C1.
2. Minimum Compressive Strength: As indicated at 28 days.
3. Maximum w/cm Ratio: 0.42, or lower if required by permeability-reducing admixture manufacturer.
4. Minimum Cementitious Materials Content: 590 lb/cu. yd., or higher if required by permeability-reducing admixture manufacturer.
5. Slump Limit: 4 inches, plus or minus 1 inch for concrete.
6. Air Content:
 - a. Exposure Class F2: 6.0 percent, plus or minus 1.5 percent at point of delivery for concrete containing 3/4-inch nominal maximum aggregate size.
7. Use permeability-reducing admixture.
8. Limit water-soluble, chloride-ion content in hardened concrete to 0.30 percent by weight of cementitious materials.

B. Class B: Normal-weight concrete used for concrete toppings and overbuilt concrete.

1. Exposure Class: ACI 318 Class F2; Class W1; Class C1.
2. Minimum Compressive Strength: As indicated at 28 days.
3. Maximum w/cm Ratio: 0.45.
4. Slump Limit: 4 inches, plus or minus 1 inch for concrete.
5. Air Content:
 - a. Exposure Class F2: 6.0 percent, plus or minus 1.5 percent at point of delivery for concrete containing 3/4-inch nominal maximum aggregate size.
6. Use permeability-reducing admixture.

7. Limit water-soluble, chloride-ion content in hardened concrete to 0.30 percent by weight of cementitious materials.
- C. Class C: Normal-weight concrete used for auxiliary exterior foundation slabs, walls, and slabs-on-ground that are not part of the pump station.
1. Exposure Class: ACI 318 Class F2; Class W1; Class C1.
 2. Minimum Compressive Strength: As indicated at 28 days.
 3. Maximum w/cm Ratio: 0.45.
 4. Slump Limit: 4 inches, plus or minus 1 inch for concrete.
 5. Air Content:
 - a. Exposure Class F2: 6.0 percent, plus or minus 1.5 percent at point of delivery for concrete containing 3/4-inch nominal maximum aggregate size.
 6. Limit water-soluble, chloride-ion content in hardened concrete to 0.30 percent by weight of cementitious materials.

2.14 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete in accordance with ASTM C94 and furnish delivery ticket.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verification of Conditions:
1. Before placing concrete, verify that installation of concrete forms, accessories, reinforcement, and embedded items is complete and that required inspections have been performed.
 2. Do not proceed until unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Provide reasonable auxiliary services to accommodate field testing and inspections, acceptable to testing agency, including the following:
1. Daily access to the Work.
 2. Incidental labor and facilities necessary to facilitate tests and inspections.
 3. Secure space for storage, initial curing, and field curing of test samples, including source of water and continuous electrical power at Project site during site curing period for test samples.

4. Security and protection for test samples and for testing and inspection equipment at Project site.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that reduce bond to concrete.

3.03 TOLERANCES

A. Comply with ACI 117.

3.04 INSTALLATION OF FORMWORK

A. Comply with ACI 301.

B. Construct formwork, so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117 and to comply with the Surface Finish designations specified in Section 033000 "Cast-In-Place Concrete" for as-cast finishes.

C. Limit concrete surface irregularities as follows:

1. Surface Finish-1.0: ACI 117 Class D, 1 inch.
2. Surface Finish-2.0: ACI 117 Class B, 1/4 inch.

D. Construct forms tight enough to prevent loss of concrete mortar.

1. Minimize joints.
2. Exposed Concrete: Symmetrically align joints in forms.

E. Construct removable forms for easy removal without hammering or prying against concrete surfaces.

1. Provide crush or wrecking plates where stripping may damage cast-concrete surfaces.
2. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
3. Install keyways, recesses, and other accessories, for easy removal.

F. Do not use rust-stained, steel, form-facing material.

G. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces.

1. Provide and secure units to support screed strips
2. Use strike-off templates or compacting-type screeds.

H. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible.

1. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar.
 2. Locate temporary openings in forms at inconspicuous locations.
- I. Chamfer exterior corners and edges of permanently exposed concrete.
- J. At construction joints, overlap forms onto previously placed concrete not less than 12 inches.
- K. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work.
1. Determine sizes and locations from trades providing such items.
 2. Obtain written approval of Architect prior to forming openings not indicated on Drawings.
- L. Construction Joints: See Section 03 30 00 "Cast-in-Place Concrete."
- M. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection.
1. Locate ports and openings in bottom of vertical forms, in inconspicuous location, to allow flushing water to drain.
 2. Close temporary ports and openings with tight-fitting panels, flush with inside face of form, and neatly fitted, so joints will not be apparent in exposed concrete surfaces.
- N. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- O. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- P. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.05 INSTALLATION OF STEEL REINFORCEMENT

- A. Comply with CRSI's "Manual of Standard Practice" for placing and supporting reinforcement.
- B. Accurately position, support, and secure reinforcement against displacement.
1. Locate and support reinforcement with bar supports to maintain minimum concrete cover.
 2. Do not tack weld crossing reinforcing bars.

- C. Preserve clearance between bars of not less than 1 inch, not less than one bar diameter, or not less than 1-1/3 times size of large aggregate, whichever is greater.
- D. Provide concrete coverage in accordance with ACI 318.
- E. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- F. Splices: Lap splices as indicated on Drawings or in accordance with ACI 318.
- G. Install welded-wire reinforcement in longest practicable lengths.
 - 1. Support welded-wire reinforcement in accordance with CRSI "Manual of Standard Practice."
 - a. For reinforcement less than W4.0 or D4.0, continuous support spacing to not exceed 12 inches.
 - 2. Lap edges and ends of adjoining sheets at least one wire spacing plus 2 inches for plain wire and 8 inches for deformed wire.
 - 3. Offset laps of adjoining sheet widths to prevent continuous laps in either direction.
 - 4. Lace overlaps with wire.

3.06 INSTALLATION OF EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining Work that is attached to or supported by cast-in-place concrete.
 - 1. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 2. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC 303.
 - 3. Clean embedded items immediately prior to concrete placement.

3.07 INSTALLATION OF WATERSTOPS

- A. Flexible Waterstops: Install in construction joints and at other joints indicated to form a continuous diaphragm.
 - 1. Install in longest lengths practicable.
 - 2. Locate waterstops in center of joint unless otherwise indicated on Drawings.
 - 3. Allow clearance between waterstop and reinforcing steel of not less than 2 times the largest concrete aggregate size specified in Section 03 30 00 "Cast-In-Place Concrete."

4. Secure waterstops in correct position at 12 inches on center.
5. Field fabricate joints in accordance with manufacturer's instructions using heat welding.
 - a. Miter corners, intersections, and directional changes in waterstops.
 - b. Weld adjoining waterstop segments as recommended by waterstop manufacturer.
6. Clean waterstops immediately prior to placement of concrete.
7. Support and protect exposed waterstops during progress of the Work.

3.08 INSTALLATION OF CAST-IN-PLACE CONCRETE

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections are completed.
- B. Notify Architect and testing and inspection agencies 24 hours prior to commencement of concrete placement.
- C. Water addition in transit or at the Project site must be in accordance with ASTM C94 and must not exceed the permitted amount indicated on the concrete delivery ticket.
- D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness.
 1. If a section cannot be placed continuously, provide construction joints as indicated.
 2. Deposit concrete to avoid segregation.
 3. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid inclined construction joints.
 4. Consolidate placed concrete with mechanical vibrating equipment in accordance with ACI 301.
 - a. Do not use vibrators to transport concrete inside forms.
 - b. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer.
 - c. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity.

- d. At each insertion, limit duration of vibration to time necessary to consolidate concrete, and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.
- E. Deposit and consolidate concrete for slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
 1. Consolidate concrete during placement operations, so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
 2. Maintain reinforcement in position on chairs during concrete placement.
 3. Screed slab surfaces with a straightedge and strike off to correct elevations.
 4. Level concrete, cut high areas, and fill low areas.
 5. Slope surfaces uniformly to drains where required.
 6. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface.
 7. Do not further disturb slab surfaces before starting finishing operations.

3.09 INSTALLATION OF JOINTS

- A. Construct joints true to line, with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Coordinate with concrete placement sequence.
 1. Install so strength and appearance of concrete are not impaired, at locations indicated on Drawings or as approved by Architect.
 2. Place joints perpendicular to main reinforcement.
 - a. Continue reinforcement across construction joints unless otherwise indicated.
 3. Locate joints for slabs at third points of spans.
 4. Locate horizontal joints in walls at underside of slabs and at the top of foundation slabs.
 5. Space vertical joints in walls as required to construct the structure; clearly indicate locations of joints on shop drawings.
 6. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

C. Control Joints in Slabs-on-Ground: Form weakened-plane control joints, sectioning concrete into areas as indicated. Construct control joints as indicated and as follows:

1. Grooved Joints: Form control joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of control joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.

D. Isolation Joints in Slabs-on-Ground: After removing formwork, install joint-filler strips at slab junctions with adjacent vertical surfaces, as indicated.

1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated on Drawings.
2. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface, where joint sealants are indicated.
3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

3.10 REMOVING AND REUSING FORMS

A. Support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 72 hours after placing concrete and after achieving at least 70 percent of its 28-day design compressive strength. Concrete must be hard enough to not be damaged by form-removal operations, and curing and protection operations need to be maintained.

1. Leave formwork for slabs and other structural elements that support weight of concrete in place until concrete has achieved at least 70 percent of its 28-day design compressive strength.
2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.

B. Clean and repair surfaces of forms to be reused in the Work.

1. Split, frayed, delaminated, or otherwise damaged form-facing material are unacceptable for exposed surfaces.
2. Apply new form-release agent.

C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints.

1. Align and secure joints to avoid offsets.
2. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.11 SHORING AND RESHORING INSTALLATION

- A. Comply with ACI 318 and ACI 301 for design, installation, and removal of shoring and reshoring.
 - 1. Do not remove shoring or reshoring until measurement of slab tolerances is complete.
- B. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

3.12 APPLICATION OF FINISHING FLOORS AND SLABS

- A. Scratch Finish:
 - 1. While still plastic, texture concrete surface that has been screeded and bull-floated or darbied.
 - 2. Use stiff brushes, brooms, or rakes to produce a profile depth of 1/4 inch in one direction.
 - 3. Apply scratch finish to surfaces to receive concrete toppings.
- B. Float Finish:
 - 1. When bleedwater sheen has disappeared and concrete surface has stiffened sufficiently to permit operation of specific float apparatus, consolidate concrete surface with power-driven floats or by hand floating if area is small or inaccessible to power-driven floats.
 - 2. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture and complies with ACI 117 tolerances for conventional concrete.
 - 3. Apply float finish to slab surfaces unless noted otherwise.
- C. Broom Finish: Apply a broom finish to exterior slabs and locations indicated on Drawings.
 - 1. Immediately after float finishing, slightly roughen trafficked surface by brooming with a fiber-bristle broom perpendicular to main traffic route.
 - 2. Coordinate required final finish with Architect before application.

3.13 APPLICATION OF FINISHING FORMED SURFACES

- A. As-Cast Surface Finishes:
 - 1. ACI 301 Surface Finish SF-1.0: As-cast concrete texture imparted by form-facing material.

- a. Patch voids larger than 1-1/2 inches wide or 1/2 inch deep.
- b. Remove projections larger than 1 inch.
- c. Tie holes do not require patching.
- d. Surface Tolerance: ACI 117, Class D.
- e. Apply to concrete surfaces that are buried or covered with subsequent installed surfaces.

2. ACI 301 Surface Finish SF-2.0: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams.

- a. Patch voids larger than 3/4 inch wide or 1/2 inch deep.
- b. Remove projections larger than 1/4 inch.
- c. Patch tie holes.
- d. Surface Tolerance: ACI 117, Class B.
- e. Locations: Apply to concrete surfaces exposed to view.

3.14 INSTALLATION OF MISCELLANEOUS CONCRETE ITEMS

A. Filling in:

- 1. Fill in holes and openings left in concrete structures after Work of other trades is in place unless otherwise indicated.
- 2. Mix, place, and cure concrete, as specified, to match color and texture with in-place construction exposed to view.
- 3. Provide other miscellaneous concrete filling indicated or required to complete the Work.

B. Equipment Foundation Slabs:

- 1. Coordinate sizes and locations of concrete bases with actual equipment provided.
- 2. Construct concrete bases as indicated on Drawings.

3.15 APPLICATION OF CONCRETE CURING

A. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

- 1. Comply with ACI 301 for cold weather protection during curing.

2. Comply with ACI 301 and ACI 305.1 for hot-weather protection during curing.
 3. Maintain moisture loss no more than 0.2 lb/sq. ft. x h, calculated in accordance with ACI 305R, before and during finishing operations.
- B. Curing Formed Surfaces: Comply with ACI 308.1 as follows:
1. Cure formed concrete surfaces, including underside of supported slabs and other similar surfaces.
 2. If forms remain during curing period, moist cure after loosening forms.
 3. If removing forms before end of curing period, continue curing for remainder of curing period as follows:
 - a. Continuous Fogging: Maintain standing water on concrete surface until final setting of concrete.
 - b. Continuous Sprinkling: Maintain concrete surface continuously wet.
 - c. Absorptive Cover: Pre-dampen absorptive material before application; apply additional water to absorptive material to maintain concrete surface continuously wet.
 - d. Water-Retention Sheeting Materials: Cover exposed concrete surfaces with sheeting material, taping, or lapping seams.
 - e. Membrane-Forming Curing Compound: Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's written instructions.
 - 1) Recoat areas subject to heavy rainfall within three hours after initial application.
 - 2) Maintain continuity of coating and repair damage during curing period.
- C. Curing Unformed Surfaces: Comply with ACI 308.1 as follows:
1. Begin curing after finishing concrete.
 2. Concrete Slabs:
 - a. Contractor has option of the following:
 - 1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.

- a) Lap edges and ends of absorptive cover not less than 12 inches.
- b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.
- 2) Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches (300 mm), and sealed by waterproof tape or adhesive.
 - a) Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
 - b) Cure for not less than seven days.
- 3) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following not in cold weather:
 - a) Water.
 - b) Continuous water-fog spray.

3.16 INSTALLATION OF JOINT FILLING

- A. Prepare, clean, and install joint filler in accordance with manufacturer's written instructions.
 - 1. Defer joint filling until concrete has aged at least one month(s).
- B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joints clean and dry.

3.17 INSTALLATION OF CONCRETE SURFACE REPAIRS

- A. Defective Concrete:
 - 1. Repair and patch defective areas when approved by Architect.
 - 2. Remove and replace concrete that cannot be repaired and patched to meet specification requirements.
- B. Patching Mortar: Mix dry-pack patching mortar, consisting of 1 part portland cement to 2-1/2 parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.
- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks in excess of 0.01 inch spalls, air bubbles exceeding surface finish limits, honeycombs, rock pockets, fins and other projections on the surface exceeding

surface finish limits, and stains and other discolorations that cannot be removed by cleaning.

1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete.
 - a. Limit cut depth to 3/4 inch.
 - b. Make edges of cuts perpendicular to concrete surface.
 - c. Clean, dampen with water, and brush-coat holes and voids with bonding agent.
 - d. Fill and compact with patching mortar before bonding agent has dried.
 - e. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement, so that, when dry, patching mortar matches surrounding color.
 - a. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching.
 - b. Compact mortar in place and match surrounding surface.
3. Repair defects on concealed formed surfaces that will affect concrete's durability and structural performance, as determined by Architect.

D. Repairing Unformed Surfaces:

1. Test unformed surfaces, such as floors and slabs, for finish, and verify surface tolerances specified for each surface.
 - a. Correct low and high areas.
 - b. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
2. Repair finished surfaces containing surface defects, including spalls, popouts, honeycombs, rock pockets, crazing, and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width.
3. After concrete has cured at least 14 days, correct high areas by grinding.
4. Correct localized low areas during, or immediately after, completing surface-finishing operations by adding patching mortar.

Section 4
Scope of Work and Technical Specifications
SECTION 03 30 00-26 CAST-IN-PLACE CONCRETE

- a. Finish repaired areas to blend into adjacent concrete.
5. Correct other low areas scheduled to receive floor coverings with a repair underlayment.
 - a. Prepare, mix, and apply repair underlayment and primer in accordance with manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
 - b. Feather edges to match adjacent floor elevations.
6. Correct other low areas scheduled to remain exposed with repair topping.
 - a. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations.
 - b. Prepare, mix, and apply repair topping and primer in accordance with manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
7. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete.
 - a. Remove defective areas with clean, square cuts, and expose steel reinforcement with at least a 3/4-inch clearance all around.
 - b. Dampen concrete surfaces in contact with patching concrete and apply bonding agent.
 - c. Mix patching concrete of same materials and mixture as original concrete, except without coarse aggregate.
 - d. Place, compact, and finish to blend with adjacent finished concrete.
 - e. Cure in same manner as adjacent concrete.
8. Repair random cracks and single holes 1 inch or less in diameter with patching mortar.
 - a. Groove top of cracks and cut out holes to sound concrete, and clean off dust, dirt, and loose particles.
 - b. Dampen cleaned concrete surfaces and apply bonding agent.
 - c. Place patching mortar before bonding agent has dried.
 - d. Compact patching mortar and finish to match adjacent concrete.
 - e. Keep patched area continuously moist for at least 72 hours.

E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.

F. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.18 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a special inspector to perform field tests and inspections and prepare testing and inspection reports.

B. Testing Agency: Owner will engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.

1. Testing agency to be responsible for providing curing facility for initial curing of strength test specimens on-site and verifying that test specimens are cured in accordance with standard curing requirements in ASTM C31.

2. Testing agency to immediately report to Architect, Contractor, and concrete manufacturer any failure of Work to comply with Contract Documents.

3. Testing agency to report results of tests and inspections, in writing, to Owner, Architect, Contractor, and concrete manufacturer within 48 hours of inspections and tests.

a. Test reports to include reporting requirements of ASTM C31, ASTM C39, and ACI 301, including the following as applicable to each test and inspection:

- 1) Project name.
- 2) Name of testing agency.
- 3) Names and certification numbers of field and laboratory technicians performing inspections and testing.
- 4) Name of concrete manufacturer.
- 5) Date and time of inspection, sampling, and field testing.
- 6) Date and time of concrete placement.
- 7) Location in Work of concrete represented by samples.
- 8) Date and time sample was obtained.
- 9) Truck and batch ticket numbers.
- 10) Design compressive strength at 28 days.
- 11) Concrete mixture designation, proportions, and materials.

Section 4
Scope of Work and Technical Specifications
SECTION 03 30 00-28 CAST-IN-PLACE CONCRETE

- 12) Field test results of fresh concrete, including slump or slump flow, air content, temperature and density.
 - 13) Information on storage and curing of samples at the Project site, including curing method and maximum and minimum temperatures during initial curing period.
 - 14) Type of fracture and compressive break strengths at seven days and 28 days.
4. Provide a space and source of power or other resources for curing and access to test specimens by the testing agency.
- C. Delivery Tickets: comply with ASTM C94.
- D. Inspections:
1. Inspect formwork for shape, location, and dimensions of the concrete member being formed.
 2. Steel-reinforcement placement.
 3. Headed bolts and studs.
 4. Verification of use of required design mixture.
 5. Concrete placement, including conveying and depositing.
 6. Curing procedures and maintenance of curing temperature.
 7. Verification of concrete strength before removal of shores and forms from beams and slabs.
 8. Batch Plant Inspections: On a random basis, as determined by Architect.
- E. Concrete Tests: Testing of composite samples of fresh concrete obtained in accordance with ASTM C 172 to be performed in accordance with the following requirements:
1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 150 cu. yd. or fraction thereof.
 - a. When frequency of testing provides fewer than five compressive-strength tests for each concrete mixture, testing is to be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
 2. Slump: ASTM C143:

Section 4
Scope of Work and Technical Specifications
SECTION 03 30 00-29 CAST-IN-PLACE CONCRETE

- a. One test at point of delivery for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 - b. Perform additional tests as needed.
3. Air Content: ASTM C231 pressure method, for normal-weight concrete.
 - a. One test for each composite sample when strength test specimens are cast, but not less than one test for each day's pour of each concrete mixture.
4. Concrete Temperature: ASTM C1064:
 - a. One test hourly when air temperature is 40 deg F and below or 80 deg F and above, and one test for each composite sample when strength test specimens are cast.
5. Concrete Density: ASTM C138:
 - a. One test for each composite sample when strength test specimens are cast.
6. Compression Test Specimens: ASTM C31:
 - a. Cast and standard cure two sets of three 4-inch by 8-inch cylindrical specimens for each composite sample, plus one spare cylinder.
 - b. When hot- or cold-weather procedures are used, cast, and field cure three companion sets of three standard cylindrical specimens for each composite sample.
7. Compressive-Strength Tests: ASTM C39.
 - a. Test one set of three standard cured specimens at seven days and one set of two specimens at 28 days. Reserve spare cylinder.
 - b. If used, test one set of three field-cured specimens at seven days and one set of two specimens at 28 days.
 - c. A compressive-strength test to be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
8. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor to evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
9. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests of standard cured cylinders

equals or exceeds specified compressive strength, and no compressive-strength test value falls below specified compressive strength by more than 500 psi if specified compressive strength is 5000 psi, or no compressive strength test value is less than 10 percent of specified compressive strength if specified compressive strength is greater than 5000 psi.

10. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.

11. Additional Tests:

a. Testing and inspecting agency to make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect.

b. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42 or by other methods as directed by Architect.

1) Acceptance criteria for concrete strength to be in accordance with ACI 301, Section 1.7.6.3.

12. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

13. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

3.19 PROTECTION

A. Protect concrete surfaces as follows:

1. Protect from petroleum stains.
2. Diaper hydraulic equipment used over concrete surfaces.
3. Prohibit vehicles from concrete slabs.
4. Prohibit use of pipe-cutting machinery over concrete surfaces.
5. Prohibit placement of steel items on concrete surfaces.
6. Prohibit use of acids or acidic detergents over concrete surfaces.
7. Protect concrete surfaces scheduled to receive surface hardener or polished concrete finish using floor slab protective covering.

END OF SECTION

SECTION 03 99 99

LINING FOR CONCRETE WASTEWATER STRUCTURES WITH ULTRA-HIGH BUILD STRUCTURAL EPOXY

PART 1 - GENERAL

1.01 SUMMARY

A. Scope:

1. A manufacturer certified Applicator shall provide all labor, materials, equipment, incidentals, and quality requirements for concrete for surface preparation, repair or resurfacing, and ultra-high build, Structural Epoxy lining work to the entire interior surfaces of the structures as shown on drawings and specified herein.
2. This Section's intent is to provide minimum requirements of an installation of an ultra-high build, high strength, structural epoxy system; and the lining of newly installed specified concrete structures and surfaces exposed to domestic wastewater and/or municipal sanitary sewage by an applied and bonded application of high performance, 100% solids, ultra-high build, structural grade, applied fiber-reinforced-polymer (FRP) epoxy coating/lining system (Structural Epoxy).
3. This Section's intent is for concrete structures which are exposed to or in contact with domestic wastewater service; constituting domestic municipal wastewater and plant treatment and municipal sanitary sewage from collection systems (sanitary sewer and/or stormwater), where sewage contact and exposure to hydrogen sulfide are present. Not intended for non-sewage applications or industrial waste.
4. Structural Epoxy minimum film thickness specified herein is designed and intended for applied and bonded coating/lining, delivering barrier protection with high mechanical strength with a reinforced film to bridge and seal against low pressure forces of effective lateral earth pressure, moisture vapor transmission (MVT), hydrostatic head pressure, and inflow and infiltration (I&I) once cured; while protecting from effluent and H₂S. Design thickness herein also accounts for long term performance; as unintentionally there may be circumstances that may prevent bonding in certain areas that an engineered Structural Epoxy is designed to bridge (with limitations), whereas non-structural coatings may not. Not intended: excessive or high-pressure forces and loading, or other force considerations for full structural reinstatement without a qualified assessment with calculated, verified and adjusted structural thickness calculations performed and certified by a registered Professional Engineer (film or system thicknesses

Section 4
Scope of Work and Technical Specifications

SECTION 03 99 99-2 LINING FOR CONCRETE WASTEWATER STRUCTURES WITH ULTRA-HIGH BUILD STRUCTURAL EPOXY

may change depending on types of forces, force values and other variables, engineering assessments and calculations).

B. Section Includes:

1. Structural epoxy lining.
2. Miscellaneous materials.

C. Coordination:

1. Coordinate surface preparation of substrates to avoid later difficulty or delay in performing the Work of this Section.
2. Review installation procedures under other Sections and coordinate the installation of items that must be installed prior to application of the Structural Epoxy lining.
3. The Contractor shall coordinate with Engineer regarding the availability of work areas, completion times, safety, access, and other factors which can impact plant operations.

D. Related Requirements:

1. Section 03 30 00 "Cast-in-Place Concrete".

1.02 REFERENCES

A. This Section contains references to the governing standards and documents listed below. They are a part of this Section as specified and modified; the current version shall apply unless otherwise noted. In case of conflict between the requirements of this section and those of the listed documents, the more stringent of the requirements shall prevail.

American Concrete Institute, (ACI)

1. ACI 301 – Specifications for Structural Concrete

ASTM International, (ASTM)

2. ASTM C 868 – Standard Test Method for Chemical Resistance of Protective Linings
3. ASTM C 1583/1583M – Standard Test Method for Tensile Strength of Concrete Surfaces and the Bond Strength or Tensile Strength of Concrete Repair and Overlay Materials by Direct Tension (Pull-off Method)
4. ASTM D 4060 – Standard Test Method for Abrasion Resistance of Organic Linings by the Taber Abraser

Section 4
Scope of Work and Technical Specifications

SECTION 03 99 99-3 LINING FOR CONCRETE WASTEWATER STRUCTURES WITH ULTRA-HIGH BUILD STRUCTURAL EPOXY

5. ASTM D 4285 – Standard Test Method for Indicating Water or Oil in Compressed Air
6. ASTM D 4414 – Standard Practice for Measurement of Wet Film Thickness by Notch Gages
7. ASTM D 7682 – Standard Test Method for Replication and Measurement of Concrete Surface Profiles Using Replica Putty
International Concrete Repair Institute, (ICRI)
8. Guideline No. 310.1R – Guide for Surface Preparation for the Repair of Deteriorated Concrete Resulting from Reinforcing Steel Corrosion
9. Guideline No. 310.2 – Selecting and Specifying Concrete Surface Preparation for Sealer, Linings, and Polymer Overlays
NACE International, (NACE)
10. NACE SP0188 – Standard Practice for Discontinuity (Holiday) Testing of Protective Linings
11. NACE No. 6/SSPC-SP13 – Surface Preparation of Concrete
Occupational Safety and health Administration, (OSHA)
12. Safety and health Standards (29 CFR 1910/1926)
SSPC: The Society for Protective Coatings, (SSPC)
13. SSPC-SP13/NACE No. 6 – Surface Preparation of Concrete
14. SSPC-Guide 12 – Guide for Illumination of Industrial Painting Projects

B. Unless otherwise specified, references to documents shall mean the documents in effect at the time of receipt of Bids. If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents, the last version of the document before it was discontinued.

1.03 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in the General Conditions and Section entitled "Submittals", the Contractor shall submit all required information as specified herein.
- B. Shop Drawings: Submit for approval prior to commencing any Work:
 1. Manufacturer's project reference lists with coating systems specified herein, stating project location, Owner contact information, Engineer contact information, Installer contact information, containing a minimum of 10 projects of similar capacity with a minimum of 5 years of satisfactory service.

Section 4
Scope of Work and Technical Specifications

SECTION 03 99 99-4 LINING FOR CONCRETE WASTEWATER STRUCTURES WITH ULTRA-HIGH BUILD STRUCTURAL EPOXY

2. Product Data Sheets: Copies of current technical data for each component specified and applied as outlined in this Section.
3. Safety Data Sheets: Copies of current SDS for any materials brought on-site including all clean-up solvents, repair or resurfacing mortars and lining materials.
4. Qualification Data: Approved Installer Certification from manufacturer.
5. Performance Testing Reports: Copies of test data for the entire physical, chemical, and permeation properties listed herein and as outlined within this Section.
6. Installation Instructions: Manufacturer's written installation instructions for the materials specified in this Section.

C. Product Substitution: The specified corrosion protection system is the basis of design and the minimum standard of quality for this project. Equivalent products by other manufacturers may be submitted for substitution only by approval of Engineer. Requests for material substitutions must be in accordance with requirements of this project specification.

1. Manufacturers of "or equal" products shall provide direct property comparison with the basis of design materials specified in addition to complying with all other requirements of these Specifications. "Or equal" products shall employ the same generic materials and system components as the Structural Epoxy lining specified and shall provide same intent by description and equivalent performance as the specified Structural Epoxy lining to protect against H₂S corrosion and seal from I&I.
2. "Or equal" products' manufacturer must provide documentation supporting product's success and history in severe wastewater environments for at least ten (10) years; must also provide samples of cured material covering at least one (1) square foot of surface, at the specified thickness; and must provide written repair instruction and a list of materials should a repair be needed in the future.

D. Jobsite Reports: Submit at the completion of Work

1. Daily Reports: Include surface preparation, substrate conditions, ambient conditions application procedures, lining materials applied, material quantities, material batch number(s), description of work completed and location thereof.
2. Quality Control Reports: Include all quality control testing and physical specimens.

Section 4
Scope of Work and Technical Specifications

SECTION 03 99 99-5 LINING FOR CONCRETE WASTEWATER STRUCTURES WITH ULTRA-HIGH BUILD STRUCTURAL EPOXY

3. Coating System Checklist: Included at the End of this Section. Conduct and maintain checklist during application, and submit to the Engineer and County following completion.
4. Contractor shall maintain a copy of records until the expiration of the specified warranty period.

1.04 QUALITY ASSURANCE

A. Applicator Qualifications:

1. Contractor shall be a certified Applicator by the Structural Epoxy manufacturer prior to bid date. Submit proof of Applicator certification by manufacturer to Engineer.
2. Installation equipment shall be acceptable to the Structural Epoxy manufacturer. If spraying Structural Epoxy, Applicator must utilize equipment approved by Structural Epoxy manufacturer.
3. Applicator shall establish quality control procedures and practices to monitor phases of surface preparation, storage, mixing, application, and inspection throughout the duration of the project. Contractor to provide a fulltime, on-site person whose dedicated responsibilities will include quality control of the Structural Epoxy linings and completed manufacturing certification training.
4. Applicator's quality control procedures and practices must include the following items:
 - a. Training of personnel in the proper surface preparation requirements.
 - b. Training of personnel in the proper storing, mixing, and application and quality control testing of the Structural Epoxy linings.
 - c. If spraying, training of personnel with the spray equipment to ensure proper film build, film quality, and ratio control.
5. Structural Epoxy Applicator must be certified according to AMPP QP8 or QP9.

B. Pre-Installation Conference:

1. Before commencing construction, Contractor, Installer and technical representative of the corrosion protection lining manufacturer shall meet on-site with Engineer to discuss approved products and workmanship to ensure proper application of the corrosion protection lining components and substrate preparation requirements.

Section 4
Scope of Work and Technical Specifications

SECTION 03 99 99-6 LINING FOR CONCRETE WASTEWATER STRUCTURES WITH ULTRA-HIGH BUILD STRUCTURAL EPOXY

2. Review foreseeable methods and procedures related to the Structural Epoxy lining of coating Work including but not necessarily limited to the following:

- a. Review Project requirements and the Contract Documents.
- b. Review required submittals, both completed and yet to be completed.
- c. Review status of substrate Work, including approval of surface preparations and similar considerations.
- d. Review requirements of on-Site quality control testing and requirements for preparing Site Quality Control Report as specified herein.
- e. Review availability of materials, tradesmen, equipment and facilities needed to make progress and avoid delays.
- f. Review required inspection and testing.
- g. Review environmental conditions, other Project conditions, and procedures for coping with unfavorable conditions.
- h. Review regulations concerning code compliance, environmental protection, health, safety, fire and similar considerations.
- i. Review procedures required for the protection of the Structural Epoxy lining during the remainder of the construction period.

3. Record the discussions of the Pre-Installation Conference and the decisions and agreements or disagreements reached and furnish a copy of the minutes to each party attending. Record any revision or changes agreed upon, reasons therefore, and parties agreeing or disagreeing with them.

4. Reconvene the conference at the earliest opportunity if additional information must be developed in order to conclude the subjects under consideration.

C. Performance Criteria: Structural Epoxy lining shall be capable of withstanding under constant exposure to raw wastewater, permeation from hydrogen sulfide and other sewer gases, and attack from organic acids generated by microbial sources with no adverse effects; cured film at specified thickness must withstand negative side film forces from inflow and infiltration. Products must have sufficient field history and accelerated laboratory testing to substantiate product viability for these exposures.

D. Source Quality Control: Provide each component of Structural Epoxy lining produced by a single manufacturer, including recommended repair mortar, repair overlay (resurfacer), base coat and topcoat materials.

Section 4
Scope of Work and Technical Specifications

SECTION 03 99 99-7 LINING FOR CONCRETE WASTEWATER STRUCTURES WITH ULTRA-HIGH BUILD STRUCTURAL EPOXY

E. Reference Standards: Comply with applicable provisions and recommendations of all standards listed in Section 1.2 except as otherwise shown or specified.

1.05 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Delivery of Materials:

1. Deliver material in manufacturer's original, unopened and undamaged packages.
2. Clearly identify manufacturer's, brand name, contents, color, batch number, and any personal safety hazards associated with the use of or exposure to the materials on each package.
3. Packages showing indications of damage that may affect condition of contents are not acceptable.

B. Storage of Materials:

1. Materials shall be stored in accordance with manufacturer's recommendations in enclosed structures and shall be protected from weather and adverse temperature conditions. Flammable materials shall be stored in accordance with state and local codes. Materials exceeding storage life as defined by the manufacturer shall be removed promptly from the site. Store all materials only in area or areas designated by the Engineer solely for this purpose.
2. Store in original packaging under protective cover and protect from damage.
3. Stack containers in accordance with manufacturer's recommendations.

C. Handling of Materials: Handle materials in such a manner as to prevent damage to products or finishes.

1.06 JOB CONDITIONS

A. Environmental Requirements:

1. Proceed with Work only when temperature and moisture conditions of substrates, air temperature, relative humidity, dew point and other conditions comply with the Structural Epoxy lining manufacturer's written recommendations and when no damaging environmental conditions are forecasted for the time when the material will be vulnerable to such environmental damage. Record all such conditions and include in final Site Quality Control Report.
2. Maintain substrate temperature and ambient temperature before, during and after installation above 45°F (8°C) and rising in accordance with Structural Epoxy lining material manufacturer's instructions.

Section 4
Scope of Work and Technical Specifications

SECTION 03 99 99-8 LINING FOR CONCRETE WASTEWATER STRUCTURES WITH ULTRA-HIGH BUILD STRUCTURAL EPOXY

3. Provide adequate ventilation during instillation and full curing periods of the Structural Epoxy lining.
4. Structural Epoxy lining shall not be applied when ambient air temperature is within 5°F (3°C) of the dew point.
5. Structural Epoxy lining shall not be applied when relative humidity is outside of material manufacturer's recommendations. Do not prepare surfaces or apply materials in rain, snow, fog, mist, or otherwise inclement weather as per material manufacturer's instructions.

B. Dust and Contaminants: Protect work and adjacent areas from excessive dust and airborne contaminants during Structural Epoxy lining application and curing. Schedule Work to avoid excessive dust and airborne contaminants.

1.07 WARRANTY

A. Structural Epoxy lining Manufacturer shall warranty its products as free from material defects for a minimum period of three (3) years. Manufacturer will repair/replace coating including any cost of work, cleaning, bypass pumping, etc. at no additional cost to the owner. Provide associated Warranty Certificate.

B. Contractor shall warranty the installed Structural Epoxy lining system as free from workmanship defects for a minimum period of three (3) years. Manufacturer will repair/replace coating including any cost of work, cleaning, bypass pumping, etc. at no additional cost to the owner.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Products and Manufacturer:

1. Materials specified are those that have been evaluated for the specific service. Products specified are to provide a standard of quality and basis of design. The specified basis of design is intended to provide the longest service life possible, lowest life cycle cost, and most sustainable solution.
2. Or Engineer Approved Equal. Basis of Design materials specified herein do not preclude consideration of equivalent or superior materials. Alternate materials must include the following:
 - a. Demonstration of performance equality. The burden of proof of performance equality is the responsibility of the Contractor submitting a substitution request. Standardized industry test methods in Appendix A shall be used in part for comparison.

Section 4
Scope of Work and Technical Specifications

SECTION 03 99 99-9 LINING FOR CONCRETE WASTEWATER STRUCTURES WITH ULTRA-HIGH BUILD STRUCTURAL EPOXY

- b. Materials must have a proven track record of successful installation. Provide Manufacturer's project reference lists with coating systems specified herein stating project location, Owner contact information, Engineer contact information, Installer contact information, containing a minimum of 10 projects of similar capacity with a minimum of 5 years of satisfactory service.
 - c. The Engineer and the County reserve the right to accept or reject submitted coating product(s).
- B. Contractor shall provide all accessory components, as specified or recommended by the manufacturer for optimal application of the Structural Epoxy lining system's adhesion to substrate and long-term service performance.
- C. Structural Epoxy Lining:
 - 1. Structural Epoxy shall be available in both trowel-version and spray-version to assist with various application needs or applications in limited access areas or perform any touch-ups.
 - 2. Structural Epoxy shall be 100% solids, highly thixotropic microfiber-reinforced, applied epoxy polycyclic polymer protective barrier material specifically designed to protect concrete and masonry surfaces in severe wastewater environments, including H₂S attack, while sealing inflow and infiltration (I&I).
 - 3. Structural Epoxy is to provide protection from H₂S corrosion and seal from I&I with applied and bonded high build Structural Epoxy; Structural Epoxy film thickness specified herein is designed and intended for applied and bonded coating, delivering barrier protection lining with high mechanical strength and a reinforced film to bridge and seal against moisture vapor transmission (MVT), hydrostatic head pressure, fine root intrusion, and seal inflow and infiltration (I&I).
 - 4. Structural Epoxy lining must be a verified technology of US Environmental Protection Agency's, Environmental Technology Verification Program for Infrastructure Rehabilitation Technologies (EPA ETV).
 - 5. Structural Epoxy lining shall be capable of achieving up to 375 mil. (3/8 inch) sag resistance, vertical and overhead.
 - 6. Structural Epoxy lining must have a long open recoat window without the need for abrasive or mechanical preparation for simple repair requirements.
 - 7. Structural Epoxy lining must be self-priming, able to be applied direct-to-concrete (DTC), requiring no primer.

Section 4
Scope of Work and Technical Specifications

SECTION 03 99 99-10 LINING FOR CONCRETE WASTEWATER STRUCTURES WITH ULTRA-HIGH BUILD STRUCTURAL EPOXY

8. Structural Epoxy lining must be able to bond to saturated-surface-dry (SSD) concrete, with moisture and relative humidity tolerances up to 85% and capable to fully cure underwater.

PART 3 - EXECUTION

3.01 GENERAL

- A. All work shall be in strict accordance with the specifications and recommendations including mixing, handling, storage, and application of all products as required and in accordance with manufacturer's published technical instructions, safety data sheets, including manufacturer's published PDS, design guidelines, and/or other written specifications.
- B. Contractor shall provide, erect, and maintain all required hoists, scaffolding, staging and planking, and perform all access related hoisting work required to complete the Work of this Section as specified.
- C. Contractor shall cover or otherwise protect finish work or other surfaces not being coated within the scope of this Section. Contractor shall erect and maintain protective tarps, enclosures and/or masking to contain debris, including dust or other airborne particles from surface preparation or application activities. This may include the use of dust or debris collection apparatus as required at no additional cost to Owner.

3.02 EXAMINATION

- A. Contractor shall examine the areas and conditions under which the Structural Epoxy coating Work is to be performed in accordance with SSPC-SP13/NACE No. 6, and notify Engineer in writing of conditions detrimental to the proper and timely completion of the Work.
- B. Commencement of the Work of this Section shall indicate that the substrate and other conditions of installation are acceptable to the Contractor and his Applicator and will produce a finished product meeting the requirements of the Specifications. All defects resulting from accepted conditions shall be corrected by Contractor at his own expense.
- C. Stopping Active Leaks: After surface cleaning, inspect substrate surfaces, and report any visible leaks or other water ingress to the Engineer for direction. Surface and grouting material may require additional surface preparation prior to application of Structural Epoxy lining.
- D. Prior to and during application, care should be taken to avoid exposure of direct sunlight or other intense heat source to the structure being coated. Where varying surface temperatures do exist, coating installation should be scheduled when the temperatures are falling versus rising.

Section 4
Scope of Work and Technical Specifications

SECTION 03 99 99-11 LINING FOR CONCRETE WASTEWATER STRUCTURES WITH ULTRA-HIGH BUILD STRUCTURAL EPOXY

3.03 PREPARATION

- A. Concrete surfaces to receive Structural Epoxy coating shall be cast with a Smooth Form Finish in accordance with ACI 301. Surfaces shall not be rubbed, sacked, troweled or otherwise finished in any manner that will obscure or cover the parent concrete surface with materials other than materials as specified in this Section.
- B. Allow cast-in-place concrete to cure for a minimum of 28 days at 75°F (24°C) and with adequate air movement before installing the corrosion protection lining system.
- C. All surface washing, abrasive blasting, water-jetting, grinding, patching, filling and preparation shall be completed by the Applicator in accordance with the Structural Epoxy lining Manufacturer's recommendations.
- D. Substrate: Concrete surfaces to be coated shall be free of curing compounds and form release agents, laitance and foreign particles that may inhibit bonding. Prior to start of Structural Epoxy coating systems application, pre-clean as required, and inspect the substrate in accordance with SSPC-SP13/NACE No. 6, Severe Service. Surface preparation procedures shall be in accordance with NACE No. 6/SSPC-SP13 and ICRI Guideline No. 310.2. Surface preparation shall expose aggregate and obtain a uniform surface texture resembling the minimum recommended concrete surface ICRI-CSP profile.
- E. Level or grind concrete substrates to produce a uniform and smooth surface, including removal of all sharp edges, ridges, form fins, and other concrete protrusions.
- F. Surface preparation of the substrate must be achieved immediately prior to utilizing any repair material and/or coating/lining material that will require bond to the substrate, re-inspection and/or subsequent surface preparation may need to be repeated should conditions change after initial preparation.
- G. Surface preparation will be required all concrete surfaces.
- H. The objective of surface preparation is to produce a surface that is suitable for application and adhesion of the specified repair materials and coating/lining material. Surfaces therefore are to be free of contaminants and loosely adhering or unsound concrete, and should provide a dry, sound, uniform substrate suitable for the application of repair and coating/lining material.
- I. Structures to receive Structural Epoxy lining system must be capable of withstanding imposed loads. All oil, grease, waste and chemical contaminants must be removed from the surface of the concrete prior to preparation in accordance with NACE No. 6/SSPC-SP13. Concrete surfaces must be sound and capable of supporting the Structural Epoxy Lining system as determined by the engineer. Surface preparation requirement is to expose a sound, uniform surface texture confirming to the minimum recommended ICRI-CSP amplitude. The appropriate cementitious repair mortar or

Section 4
Scope of Work and Technical Specifications

SECTION 03 99 99-12 LINING FOR CONCRETE WASTEWATER STRUCTURES WITH ULTRA-HIGH BUILD STRUCTURAL EPOXY

epoxy cementitious resurfacer material shall be applied to the entire, prepared surface to level surface suitable for coating.

J. Metal Application: Remove all visible contaminants per SSPC-SP1. Prepare the surfaces in accordance with SSPC/NACE surface preparation standards per the Manufacturer's instructions.

3.04 APPLICATION

A. Structural Epoxy lining systems shall be installed when ambient air and surface temperature is above 45°F. The substrate temperature shall be at least 5°F (3°C) above the dew point. Condition the material between 70-80°F (21-27°C) for 24 hours prior to use. Application when temperatures outside of this range will require written instruction from the Manufacturer and approval of the Engineer.

B. Application in direct sunlight and/or with rising surface temperatures is not advised, as this may result in blistering of the materials due to expansion of entrapped air or moisture in the concrete (induced outgassing). In such cases, it will be necessary to postpone the application until later in the day when the temperature of the substrate is falling or take precautionary steps as recommended by the Manufacturer. Concrete surfaces that have been in direct sunlight should be shaded for at least 24 hours prior to application. Consult the Manufacturer for application schedule guidelines specific to temperature conditions and possible sealer application recommendations to reduce outgassing.

C. Structural Epoxy Lining: Epoxytec CPP Sprayliner or Epoxytec CPP Trowel-Liner epoxy lining. Structural Epoxy coating shall be applied and in accordance with Manufacturer's written instructions as outlined in the product data sheet and application guide.

1. Thickness – Epoxy lining shall be applied to a minimum thickness of 125 mils (1/8" inch) dry film thickness.

3.05 FIELD QUALITY CONTROL, INSPECTION, AND TESTING

A. Contractor must perform the quality control procedures listed below in conjunction with the requirements of this Section.

B. Inspect all materials upon receipt to ensure that all are supplied by the approved Manufacturer.

C. Surface pH Testing: The pH of cement particles collected from the concrete substrate will be measured using pH indicating paper or pH meter. The pH testing is to be performed once every 500 square feet (5 square meters) for the first 500 square feet (46 square meters) and once every 1000 square feet (93 square meters) thereafter. Acceptable pH values shall be a minimum 9.0 as measured using color indicating pH paper with readable color calibrations and a scale at whole numbers or pH meter.

Section 4
Scope of Work and Technical Specifications

SECTION 03 99 99-13 LINING FOR CONCRETE WASTEWATER STRUCTURES WITH ULTRA-HIGH BUILD STRUCTURAL EPOXY

1. Collect 0.5 grams of cement paste from the surface and mix 1.0 mL of distilled or purified water into a vile; close lid and shake for 30 seconds and let mixture strand for 2 minutes.
 2. Insert the pH paper into mixture and determine pH by comparing to the scale and record or insert the pH meter into the mixture and record the stabilized pH.
- D. Surface Profile: Inspect and record substrate profile (anchor pattern) at least once every 50 square feet (5 square meters). If applying Structural Epoxy direct-to-concrete (DTC), surfaces shall be profiled equal to the CSP 5 amplitude as recommended by the coating manufacturer in accordance with ICRI Guideline 310.2 and SSPC-SP13/NACE No. 6; for Cementitious Repair Mortar work, surfaces shall be profiled equal to the CSP 6.
1. Replication of the concrete surface profile can also be performed at least once every 500 square feet (46 square meters) using replica putty in accordance with ASTM D7682.
- E. Measure and record ambient air temperature once every two hours of each work shift using a thermometer and measure and record substrate temperature once every two hours using an infrared or other surface thermometer.
- F. Measure and record relative humidity and dew point temperature every two hours of each work shift using a sling psychrometer in accordance with ASTM E 337.
- G. Provide verification of correct mixing of coating materials in accordance with the Manufacturer's instructions.
- H. Inspect and record that the "pot life" of coating materials is not exceeded during installation.
- I. Verify curing of the coating materials in accordance with the Manufacturer's instructions.
- J. Dry-Film Thickness:
1. Wet-Film Thickness shall be taken every 100 square feet (9 square meters) in accordance with ASTM D 4414 and recorded.
 2. The Dry-Film Thickness can be determined using a surface area calculation for material consumption.
- K. High-Voltage Holiday (Spark) Testing: Upon full cure, the installed lining system shall be checked by high voltage spark detection in accordance with NACE SP0188 and the Manufacturer's printed application guide to verify a pinhole-free surface. Areas which do not pass the spark detection test shall be corrected at no cost to the Owner.

Section 4
Scope of Work and Technical Specifications

SECTION 03 99 99-14 LINING FOR CONCRETE WASTEWATER STRUCTURES WITH ULTRA-HIGH BUILD STRUCTURAL EPOXY

L. Contractor is responsible for keeping the Engineer informed of all progress so that Engineer may provide additional quality control at his discretion.

M. Inspection by the Engineer or others does not absolve the Contractor from his responsibilities for quality control inspection and testing as specified herein or as required by the Manufacturer's instructions.

3.06 ACCEPTANCE CRITERIA

A. All surfaces shall be prepared, applied, and tested in accordance with the specification and referenced standards herein.

3.07 ADJUSTMENTS AND CLEANING

A. At the completion of the Work, Contractor shall remove all materials and debris associated with the Work of this Section.

B. Clean all surfaces not designated to receive Structural Epoxy coating. Restore all other work in a manner acceptable to Engineer.

C. All finished Structural Epoxy coating shall be protected from damage until Final Acceptance of the Work. Structural Epoxy coating damaged in any manner shall be repaired or replaced at the discretion of Engineer, at no additional cost to Owner.

END OF SECTION

SECTION 05 12 00

STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Structural-steel materials.
 - 2. Metal bar gratings.
 - 3. Metal grating stairs.
 - 4. Steel railings and guards.
 - 5. Shrinkage-resistant grout.
 - 6. Headed stud connectors.

1.02 DEFINITIONS

- A. Structural Steel: Elements of the structural frame indicated on Drawings and as described in ANSI/AISC 303.

1.03 COORDINATION

- A. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

1.04 ACTION SUBMITTALS

- A. Product Data:
 - 1. Structural-steel materials.
 - 2. High-strength, bolt-nut-washer assemblies.
 - 3. Headed stud connectors.
 - 4. Anchor rods.
 - 5. Threaded rods.
 - 6. Galvanized-steel primer.
 - 7. Etching cleaner.
 - 8. Galvanized repair paint.
 - 9. Shrinkage-resistant grout.

10. Bar gratings.
 11. Grating stairs.
 12. Clips and anchorage devices for gratings.
- B. Shop Drawings: Show fabrication of structural-steel components.
1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
 2. Include embedment Drawings.
 3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld.
 4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts.
 5. Include plans, sections, and attachment details of bar gratings and grating stairs.
 6. Indicate sizes of metal sections, thickness of metals, profiles, holes, and field joints.
 7. Indicate locations of anchors and weld plates.
- C. Welding Procedure Specifications (WPSs) and Procedure Qualification Records (PQRs): Provide in accordance with AWS D1.1 for each welded joint whether prequalified or qualified by testing, including the following:
1. Power source (constant current or constant voltage).
 2. Electrode manufacturer and trade name, for demand-critical welds.
- 1.05 INFORMATIONAL SUBMITTALS
- A. Qualification Data: For Installer and fabricator.
- B. Welding certificates.
- C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.
- D. Mill test reports for structural-steel materials, including chemical and physical properties.
- E. Product Test Reports: For the following:
1. Bolts, nuts, and washers, including mechanical properties and chemical analysis.
 2. Tension-control, high-strength, bolt-nut-washer assemblies.

3. Headed stud connectors.

1.06 QUALITY ASSURANCE

- A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category BU or is accredited by the IAS Fabricator Inspection Program for Structural Steel (Acceptance Criteria 172).
- B. Installer Qualifications: A qualified Installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category CSE.
- C. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.
 1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.
- B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.
 1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
 2. Clean and relubricate bolts and nuts that become dry or rusty before use.
 3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F3125, Grade F1852 bolt assemblies and for retesting bolt assemblies after lubrication.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Comply with applicable provisions of the following specifications and documents:
 1. ANSI/AISC 303.
 2. ANSI/AISC 360.
 3. RCSC's "Specification for Structural Joints Using High-Strength Bolts."
- B. Connection Design Information:

1. Option 1: Connection designs have been completed and connections indicated on the Drawings.

2.02 METAL BAR GRATINGS

- A. Metal Bar Grating Standards: Comply with NAAMM MBG 531.
- B. Welded Steel Grating:
 1. Grating Mark: As indicated.
 2. Traffic Surface: Serrated.
 3. Steel Finish: Hot-dip galvanized with a coating weight of not less than 1.8 oz./sq. ft. of coated surface.
- C. Shop Assembly: Fabricate grating sections in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
- D. Cut, drill, and punch material cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- E. Form from materials of size, thickness, and shapes indicated, but not less than that needed to support indicated loads.
- F. Fit exposed connections accurately together to form hairline joints.
- G. Welding: Comply with AWS recommendations and the following:
 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 2. Obtain fusion without undercut or overlap.
 3. Remove welding flux immediately.
- H. Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space the anchoring devices to secure gratings, frames, and supports rigidly in place and to support indicated loads.
- I. Fabricate cutouts in grating sections for penetrations indicated. Arrange cutouts to permit grating removal without disturbing items penetrating gratings.
 1. Edge-band openings in grating that interrupt four or more bearing bars with bars of same size and material as bearing bars.
- J. Do not notch bearing bars at supports to maintain elevation.
- K. Finish gratings, frames, and supports after assembly.

L. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A153 for steel and iron hardware and with ASTM A123 for other steel and iron products.

2.03 BAR GRATING FASTENERS

A. General: Provide Type 304 stainless steel fasteners for exterior use. Select fasteners for type, grade, and class required.

B. Stainless Steel Bolts and Nuts: Regular hexagon-head annealed stainless steel bolts, nuts, and, where indicated, flat washers; ASTM F593 (ISO 3506-1) for bolts and ASTM F594 for nuts, Alloy Group 1 (A1).

C. Fasteners for Anchoring Railings and Guards to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings and guards to other types of construction indicated and capable of withstanding design loads.

2.04 STRUCTURAL-STEEL MATERIALS

A. W-Shapes: ASTM A992.

B. Channels, Angles, S-Shapes: ASTM A36.

C. Plate and Bar: ASTM A36.

D. Cold-Formed Hollow Structural Sections: ASTM A500, Grade C structural tubing.

E. Steel Pipe: ASTM A53, Type E or Type S, Grade B.

1. Weight Class: As indicated.

2. Finish: Galvanized.

F. Welding Electrodes: Comply with AWS requirements.

G. Steel Bars for Grating: ASTM A36 or steel strip, ASTM A1011 or ASTM A1018.

H. Steel Wire Rod for Grating Crossbars: ASTM A510.

I. Steel Tubing for Railings and Guards: ASTM A500 (cold formed) or ASTM A513.

1. Provide galvanized finish for exterior installations and where indicated.

J. Steel Pipe for Railings and Guards: ASTM A53, Type F or Type S, Grade A, Standard Weight (Schedule 40), unless another grade and weight are required by structural loads.

K. Provide galvanized finish for exterior installations and where indicated.

2.05 BOLTS AND CONNECTORS

A. High-Strength A325 Bolts, Nuts, and Washers: ASTM F3125, Grade A325, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436, Type 1, hardened carbon-steel washers; all with plain finish.

B. Zinc-Coated High-Strength A325 Bolts, Nuts, and Washers: ASTM F3125, Grade A325, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436, Type 1, hardened carbon-steel washers.

1. Finish: Hot-dip zinc coating.

C. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F3125, Grade F1852, Type 1, heavy-hex or round head assemblies, consisting of steel structural bolts with splined ends; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436, Type 1, hardened carbon-steel washers.

1. Finish: Mechanically deposited zinc coating.

D. Headed Stud Connectors: ASTM A108, AISI C-1015 through C-1020, headed-stud type, cold-finished carbon steel; AWS D1.1, Type B.

E. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors qualified for the conditions used by an independent testing agency.

1. Material for Exterior Locations: Alloy Group 1 (A1) stainless steel bolts, ASTM F593, and nuts, ASTM F594.

2.06 RODS

A. Unheaded Anchor Rods: ASTM F1554, Grade as indicated.

1. Configuration: Straight.
2. Nuts: ASTM A563 heavy-hex carbon steel.
3. Plate Washers: ASTM A36 carbon steel.
4. Washers: ASTM F436, Type 1, hardened carbon steel.
5. Finish: Hot-dip zinc coating, ASTM A153, Class C.

B. Threaded Rods: ASTM A36.

1. Nuts: ASTM A563 heavy-hex carbon steel.
2. Washers: ASTM F436, Type 1, hardened carbon steel.
3. Finish: Hot-dip zinc coating, ASTM A153, Class C.

2.07 PRIMER

A. Galvanized-Steel Primer: MPI#26, MPI#80, or MPI#134.

1. Etching Cleaner: MPI#25, for galvanized steel.

2. Galvanizing Repair Paint: ASTM A780.

2.08 SHRINKAGE-RESISTANT GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C1107, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.09 FABRICATION

- A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate in accordance with ANSI/AISC 303 and to ANSI/AISC 360.
 1. Fabricate beams with rolling camber up.
 2. Identify high-strength structural steel in accordance with ASTM A6 and maintain markings until structural-steel framing has been erected.
 3. Mark and match-mark materials for field assembly.
- B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
 1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1.
- C. Bolt Holes: Cut, drill, or punch standard bolt holes perpendicular to metal surfaces.
- D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.
- E. Headed Stud Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Weld using automatic end welding of headed-stud shear connectors in accordance with AWS D1.1 and manufacturer's written instructions.
- F. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel members.
 1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
 2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
 3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.10 FABRICATION OF STEEL-FRAMED STAIRS

- A. NAAMM Stair Standard: Comply with NAAMM AMP 510, "Metal Stairs Manual," for Industrial Class, unless more stringent requirements are indicated.

- B. Provide complete stair assemblies, including metal framing, hangers, railings, guards, clips, brackets, bearing plates, and other components necessary to support and anchor stairs and platforms on supporting structure.
1. Join components by welding unless otherwise indicated.
 2. Use connections that maintain structural value of joined pieces.
- C. Assemble stairs, railings, and guards in shop to greatest extent possible.
1. Disassemble units only as necessary for shipping and handling limitations.
 2. Clearly mark units for reassembly and coordinated installation.
- D. Cut, drill, and punch metals cleanly and accurately.
1. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated.
 2. Remove sharp or rough areas on exposed surfaces.
- E. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- F. Form exposed work with accurate angles and surfaces and straight edges.
- G. Weld connections to comply with the following:
1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 2. Obtain fusion without undercut or overlap.
 3. Remove welding flux immediately.
 4. Weld exposed corners and seams continuously unless otherwise indicated.
 5. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Finish # 3 - Partially dressed weld with spatter removed.
- H. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible.
1. Where exposed fasteners are required, use Phillips flat-head (countersunk) screws or bolts unless otherwise indicated.
 2. Locate joints where least conspicuous.

3. Fabricate joints that are exposed to weather in a manner to exclude water.
 4. Provide weep holes where water may accumulate internally.
- I. Stair Framing:
1. Fabricate stringers of steel channels.
 - a. Stringer Size: As indicated on Drawings.
 - b. Provide closures for exposed ends of channel stringers.
 - c. Finish: Galvanized.
 2. Construct platforms and tread supports of steel channel headers and miscellaneous framing members as indicated on Drawings.
 - a. Provide closures for exposed ends of channel framing.
 - b. Finish: Galvanized.
 3. Weld or bolt stringers to headers; weld or bolt framing members to stringers and headers.
- J. Metal Bar-Grating Stairs: Form treads and platforms to configurations shown from metal bar grating; fabricate to comply with NAAMM MBG 531, "Metal Bar Grating Manual."
1. Fabricate treads and platforms from welded steel grating with 1-1/4-by-3/16-inch bearing bars at 15/16 inch o.c. and crossbars at 4 inches o.c.
 - a. Surface: Serrated.
 - b. Finish: Galvanized.
 2. Fabricate grating treads with cast-abrasive nosing and with steel angle or steel plate carrier at each end for stringer connections.
 - a. Secure treads to stringers with bolts.
 3. Fabricate grating platforms with nosing matching that on grating treads.
 - a. Secure grating to platform framing with bolts.
- K. Risers: Open.
- L. Toe Plates: Provide toe plates around openings and at edge of open-sided floors and platforms, and at open ends and open back edges of treads.
1. Material and Finish: Steel plate to match finish of other steel items.
- M. Fabricate to dimensions and details indicated.

2.11 FABRICATION OF STAIR RAILINGS AND GUARDS

- A. Fabricate railings and guards to comply with requirements indicated for design, dimensions, details, finish, and member sizes, including wall thickness of member, post spacings, wall bracket spacing, and anchorage, but not less than that needed to withstand indicated loads.
1. Rails and Posts: Top and intermediate rails and posts of size indicated.
- B. Welded Connections: Fabricate railings and guards with welded connections.
1. Fabricate connections that are exposed to weather in a manner that excludes water.
 - a. Provide weep holes where water may accumulate internally.
 2. Cope components at connections to provide close fit, or use fittings designed for this purpose.
 3. Weld all around at connections, including at fittings.
 4. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 5. Obtain fusion without undercut or overlap.
 6. Remove flux immediately.
 7. Finish welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Finish #3 - Partially dressed weld with spatter removed as shown in NAAMM AMP 521.
- C. Form changes in direction of railings and guards as follows:
1. As detailed.
 2. By bending or by inserting prefabricated elbow fittings.
- D. For changes in direction made by bending, use jigs to produce uniform curvature for each repetitive configuration required.
1. Maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.
- E. Close exposed ends of railing and guard members with prefabricated end fittings.
- F. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated.
1. Close ends of returns unless clearance between end of rail and wall is 1/4 inch or less.

G. Connect posts to stair framing by direct welding unless otherwise indicated.

H. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, end closures, flanges, miscellaneous fittings, and anchors for interconnecting components and for attaching to other work.

1. Furnish inserts and other anchorage devices for connecting to concrete or masonry work.
2. For galvanized railings and guards, provide galvanized fittings, brackets, fasteners, sleeves, and other ferrous-metal components.
3. Provide type of bracket with flange tapped for concealed anchorage to threaded hanger bolt and that provides 1-1/2-inch clearance from inside face of handrail to finished wall surface.

2.12 SHOP CONNECTIONS

A. Weld Connections: Comply with AWS D1.1 and AWS D1.8 for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

2.13 GALVANIZING

A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel in accordance with ASTM A123.

1. Fill vent and drain holes that are exposed in the finished Work unless they function as weep holes, by plugging with zinc solder and filing off smooth.
2. Galvanize all steel framing and connections unless otherwise noted.

B. Surface Preparation of Galvanized Steel: Prepare galvanized-steel surfaces for shop priming by thoroughly cleaning steel of grease, dirt, oil, flux, and other foreign matter, and treating with etching cleaner or in accordance with SSPC-SP 16.

2.14 SOURCE QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform shop tests and inspections.

1. Allow testing agency access to places where structural-steel work is being fabricated or produced to perform tests and inspections.
2. Welded Connections: Visually inspect shop-welded connections in accordance with AWS D1.1 and the following inspection procedures, at testing agency's option:
 - a. Liquid Penetrant Inspection: ASTM E165.

- b. Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
 - c. Ultrasonic Inspection: ASTM E164.
 - d. Radiographic Inspection: ASTM E94.
3. Prepare test and inspection reports.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify, with certified steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated on Drawings.

3.03 ERECTION

- A. Set structural steel accurately in locations and to elevations indicated and in accordance with ANSI/AISC 303 and ANSI/AISC 360.
- B. Baseplates, Bearing Plates, and Leveling Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.
 - 1. Set plates for structural members on wedges, shims, or setting nuts as required.
 - 2. Weld plate washers to top of baseplate.
 - 3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
 - 4. Promptly pack shrinkage-resistant grout solidly between bearing surfaces and plates, so no voids remain. Neatly finish exposed surfaces; protect grout and

allow to cure. Comply with manufacturer's written installation instructions for grouting.

- C. Maintain erection tolerances of structural steel within ANSI/AISC 303.
- D. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that are in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
 - 1. Level and plumb individual members of structure. Slope roof framing members to slopes indicated on Drawings.
 - 2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.
- E. Do not splice members.
- F. Do not use thermal cutting during erection.
- G. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

3.04 FIELD CONNECTIONS

- A. High-Strength Bolts: Install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for bolt and joint type specified.
 - 1. Joint Type: Snug tightened, unless otherwise noted on Drawings.
- B. Weld Connections: Comply with AWS D1.1 for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
 - 1. Comply with ANSI/AISC 303 and ANSI/AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.

3.05 INSTALLATION OF METAL BAR GRATINGS

- A. Install gratings to comply with recommendations of referenced metal bar grating standards that apply to grating types and bar sizes indicated, including installation clearances and standard anchoring details.
- B. Attach nonremovable units to supporting members by welding where both materials are same; otherwise, fasten by bolting as indicated above.
- C. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing gratings. Set units accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.

- D. Provide temporary bracing or anchors in formwork for items that are to be built into concrete or masonry.
- E. Fit exposed connections accurately together to form hairline joints.
- F. Attach toeplates to gratings by welding at locations indicated.
- G. Field Welding: Comply with AWS recommendations and the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.

3.06 INSTALLATION OF METAL STAIRS

- A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal stairs to in-place construction.
 - 1. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.
- B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal stairs. Set units accurately in location, alignment, and elevation, measured from established lines and levels and free of rack.
- C. Install metal stairs by welding stair framing to steel structure or to weld plates cast into concrete unless otherwise indicated.
 - 1. Grouted Baseplates: Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces.
 - a. Clean bottom surface of baseplates.
 - b. Set steel-stair baseplates on wedges, shims, or leveling nuts.
 - c. After stairs have been positioned and aligned, tighten anchor bolts.
 - d. Do not remove wedges or shims, but if protruding, cut off flush with edge of bearing plate before packing with grout.
 - e. Promptly pack grout solidly between bearing surfaces and plates to ensure that no voids remain.
 - 1) Neatly finish exposed surfaces; protect grout and allow to cure.
 - 2) Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.

- D. Fit exposed connections accurately together to form hairline joints.
 - 1. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations.
 - 2. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
 - 3. Comply with requirements for welding in "Fabrication, General" Article.

3.07 INSTALLATION OF RAILINGS AND GUARDS

- A. Adjust railing and guard systems before anchoring to ensure matching alignment at abutting joints with tight, hairline joints.
 - 1. Space posts at spacing indicated or, if not indicated, as required by design loads.
 - 2. Plumb posts in each direction, within a tolerance of 1/16 inch in 3 feet.
 - 3. Align rails and guards so variations from level for horizontal members and variations from parallel with rake of stairs for sloping members do not exceed 1/4 inch in 12 feet.
 - 4. Secure posts, rail ends, and guard ends to building construction as follows:
 - a. Anchor posts to steel by welding or bolting to steel supporting members.
 - b. Anchor handrail and guard ends to concrete and masonry with steel round flanges welded to rail and guard ends and anchored with post-installed anchors and bolts.

3.08 REPAIR

- A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing, and repair galvanizing to comply with ASTM A780.

3.09 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a special inspector to perform the following special inspections:
 - 1. Verify structural-steel materials and inspect steel frame joint details.
 - 2. Verify weld materials and inspect welds.
 - 3. Verify connection materials and inspect high-strength bolted connections.

END OF SECTION

SECTION 08 31 23
FLOOR ACCESS DOORS

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Included: Provide factory-fabricated floor access doors.

1.2 SUBMITTALS

- A. Product Data: Submit manufacturer's product data.
- B. Shop Drawings: Submit shop drawings including profiles, accessories, location, adjacent construction interface, and dimensions.
- C. Warranty: Submit executed copy of manufacturer's standard warranty.

1.3 QUALITY ASSURANCE

- A. Manufacturer: A minimum of 5 years' experience manufacturing similar products.
- B. Installer: A minimum of 2 years' experience installing similar products.
- C. Manufacturer's Quality System: Registered to ISO 9001:2008 Quality Standards including in-house engineering for product design activities.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Deliver products in manufacturer's original packaging. Store materials in a dry, protected, well-vented area. Inspect product upon receipt and report damaged material immediately to delivering carrier and note such damage on the carrier's freight bill of lading.

1.5 WARRANTY

- A. Manufacturer's Warranty: Provide manufacturer's standard warranty. Materials shall be free of defects in material and workmanship for a period of twenty-five years from the date of purchase. Should a part fail to function in normal use within this period, manufacturer shall furnish a new part at no charge.

PART 2 - PRODUCTS

2.1 MANUFACTURER

- A. Type FPG - Fall Protection Grating System by The Bilco Company, Type S1R or S2R Access Covers by Halliday Products, Inc., or approved equal.

2.2 FALL PROTECTION GRATING SYSTEM

- A. Furnish and install on vault access doors, where indicated on plans, fall protection grating system. Door manufacturer shall install the grating system when the door is fabricated, or field install (by others) on existing doors already in use. If field installation is necessary, grating system shall be installed per the manufacturer's instructions.
- B. Performance characteristics:
1. Grating panel(s) shall be high visibility safety yellow in color.
 2. Grating panel(s) shall lock automatically in the full open position.
 3. Grating system shall have a twenty-five-year warranty.
 4. Grating panel(s) shall have a provision for locking to prevent unauthorized opening.
- C. Grating: Panels shall be aluminum with a powder coat paint finish and designed to meet OSHA 29 CFR 1910.23 requirements for fall protection.
- D. Hold open feature: A Type 316 stainless hold open device shall be provided to lock the cover in the fully open 90-degree position.
- E. Hardware: All hardware shall be Type 316 stainless steel.
- F. Load Rating: 150 psf uniform live load or better.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and openings for compliance with requirements for installation tolerances and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install products in strict accordance with manufacturer's instructions and approved submittals. Locate units level, plumb, and in proper alignment with adjacent work.
1. Test units for proper function and adjust until proper operation is achieved.
 2. Repair finishes damaged during installation.
 3. Restore finishes so no evidence remains of corrective work.

3.3 ADJUSTING AND CLEANING

Section 4
Scope of Work and Technical Specifications
SECTION 08 31 23-3 FLOOR ACCESS DOORS

- A. Clean exposed surfaces using methods acceptable to the manufacturer which will not damage finish.

END OF SECTION

SECTION 09 90 00

PAINTING

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. The work covered by this Section includes furnishing all materials, equipment, and labor to accomplish all surface preparation, painting, and related work for satisfactory completion of the project.
- B. The terms "paint" or "painting" as used in this section, includes the use of emulsions, enamels, paints, sealers, and other coatings organic or inorganic whether used as prime, intermediate, or finish coats.
- C. Unless otherwise specified in the detailed equipment specifications, shop painting shall conform to the requirements of this Section.
- D. It is the intent of these Specification to field paint the following:
 - 1. All miscellaneous metals except as noted, structural steel, equipment, piping, fitting, valves, and specials.
 - 2. Work under this Section shall also include touch-up or repair of any damaged or defective painted surface.
 - 3. Building surfaces in accordance with the schedule in the Drawings.
- E. Aluminum and stainless steel shall not be painted unless specifically indicated.
- F. Mechanical equipment and electrical equipment on which a baked-on enamel finish is specified will not require field painting. Any damage or injury to such finishes shall be repaired to the satisfaction of the Engineer by the Contractor at no additional cost to the Owner prior to final acceptance.
- G. The omission of minor items in the schedule of work shall not relieve the Contractor of his obligation to include such items where they come within the general intent of the Specifications.
- H. Surfaces to be painted that presently have a coating of paint that is not deteriorated or damaged as determined by the Engineer will not be required to have a prime coat.

1.02 RELATED WORK

- A. Division 1: General Requirements

1.03 REFERENCE STANDARDS

- A. Steel Structures Painting Council (SSPC)

1.04 SUBMITTALS

A. Product data and samples shall be submitted in accordance with Section 01 33 00 and Section 01 33 23. The submission shall include but not be limited to the following:

1. A painting schedule listing the manufacturer, type of paint, and the manufacturer's recommendations for surface preparation, application, and dry film thickness.
2. A complete specification for each component used.
3. Color chart.

B. Operation and maintenance data shall be submitted. The data shall include, but not be limited to, the following:

1. Product name and number.
2. Name, address and telephone number of the manufacturer and the local distributor.
3. Detailed procedures for routine maintenance and cleaning.
4. Detailed procedures for light repairs such as dent, scratches, and staining.

1.05 WORKMANSHIP

A. It is intended that all painting work shall be of good quality. Materials shall be evenly spread without runs or sags. There shall be an easily perceptible difference in shades of successive coats of paint.

B. The painter shall examine the Specifications for the various other trades whose work is to be finished under this Section. Any materials requiring painting, which are left unfinished by the requirements for such other trades, shall be painted to completion under this Section unless specifically excluded. Any defects in such work which would have an adverse effect on the finish shall be corrected before any painting is started.

1.06 DELIVERY, STORAGE AND HANDLING

A. All materials shall be brought to the job site in the original sealed and unbroken, labeled containers of the paint manufacturer and shall be subject to inspection by the resident engineer on the job.

B. All materials used in the work shall be stored in an approved location. Such storage space shall be kept neat and clean and all damage thereto or to its surroundings shall be repaired prior to completion of the work. Oily rags, waste and similar articles shall be removed every night. The storage space shall be heated to the extent necessary to prevent damage to the materials by freezing. Every precaution shall be

taken to avoid danger of fire. An approved fire extinguisher shall be provided in this storage area. Proper outside containers shall be provided by the Contractor to be used for disposing of painting wastes. No plumbing fixtures shall be used for this purpose.

1.07 JOB CONDITIONS

A. The manufacturer's recommendations concerning environmental conditions under which a material can be applied shall be strictly followed. No finishes shall be applied in areas where dust is being generated.

B. The Contractor shall cover or otherwise protect the finished work of other trades, surfaces not being painted concurrently, and/or surfaces which are not to be painted. Any injury or damage to such surfaces shall be remedied to the satisfaction of the Engineer at the expense of the Contractor before final acceptance, and no separate payment therefor will be made.

C. Adequate ventilation shall be provided in all areas where painting is being conducted to protect workers against injurious or explosive concentrations of fumes, gases, dusts, or mists.

1.08 TESTING EQUIPMENT

A. The Contractor shall furnish and make available to the Engineer the following items of testing equipment for use in determining if the requirements of this Section are being satisfied. The following specified equipment shall be available for use at all times when field painting or surface preparation is in progress.

1. Wet film gauge.
2. Surface thermometer.
3. Keane-Tator surface profile comparator.
4. Set of National Association of Corrosion Engineers (NACE) visual standards.
5. Holiday (pin hole) detector.
6. Sling-Psychrometer.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. The paints and paint products shall be as manufactured by Tnemec Company, Inc. or approved equal. Paint applied to gypsum board substrates shall be as manufactured by Benjamin Moore, Duron, Kelly-Moore, Frazee or approved equal.

B. Products of manufacturers other than those named, which are comparable in quality to that specified, will be considered if said paints are offered by the Contractor

with satisfactory data on past performance of similar applications, composition, direction for use and other information required.

C. The painting schedule lists finishes acceptable for use in the work. The schedule is for identification as to type and quality of materials and shall be strictly followed unless the Contractor submits an alternate schedule to the Engineer for review. A painting schedule shall be submitted for review. Paint applied contrary to the specified schedule shall be corrected as directed by the Engineer. All rejected paint shall be removed from the job, and surfaces shall be repainted in strict accordance with the schedule and such other directions, as deemed necessary by the Engineer. Unless noted otherwise, each coat of paint shall be applied by appropriate methods to obtain the minimum dry film thickness recommended by the manufacturer for the intended use. The submitted schedule shall contain the manufacturers' recommendations for wet and dry film thickness.

D. Coating Contractor's staff shall be QP8 and QP9 certified. NACE certified is an acceptable alternative. Coating inspectors to be certified QP8 and QP9, or NACE.

2.02 PAINTING SCHEDULE

A. The following paint systems are intended to include surfaces to be painted. Any surface or item not specifically named herein but obviously required to be painted, shall be included under the system selected by the Engineer, or otherwise painted as directed by the Engineer. The dry film thicknesses shall be within the limits indicated in the manufacturer's specifications. Surface preparation shall be as specified herein and in accordance with the manufacturer's recommendations.

B. Metal Submerged, Subject to Splash or Buried in Ground: These items require surface preparation SSPC-SP10, "Near White Blast Cleaning" as recommended by the paint manufacturer. Non-submerged metal brackets used to hold grating require SSPC-SP5, "White Blast Cleaning".

1. Primer: Tnemec – Series 161-1211 @ 4-6 mils

2. 1st Coat:

a. Tnemec Series 69-Color @ 4-6 mils**

b. Tnemec Series 120 @ 12-18 mils (for metal brackets)

** For potable water contact, use Series 20 Pota-Pox in lieu of Series 69.

3. Field Finish:

a. Tnemec Series 69-Color @ 4-6 mils**

b. Tnemec Series 120 @ 12-18 mils (for metal brackets)

** For potable water contact, use Series 20 Pota-Pox in lieu of Series 69.

- C. All Non-Submerged Metal: Machinery, above ground piping, fittings, and valves.
 - 1. Primer: Tnemec – Series 161-1211 @ 3-4 mils
 - 2. 1st Coat: Tnemec Series 69 @ 2-3 mils
 - 3. Finish: Tnemec Series 73 @ 2-3 mils
- D. Submerged Concrete Surfaces:
 - 1. Finish: 1 coat Epoxeytech CPP @ 130 mils minimum
- E. Exposed Galvanized, Aluminum, and other Non-Ferrous Metals: Interior piping, fittings, valves, stands. These items require surface preparation SSPC-SP1, "Solvent Cleaning" as recommended by the paint manufacturer. Surfaces must be clean, dry, and free of all contaminants.
 - 1. 1st Coat: Tnemec Series 69 @ 3 mils minimum
 - 2. Finish: Tnemec Series 73 @ 2-3 mils dry
- F. Concrete Floors: Acid Etch or Brush-Off Blast Cleaning.
 - 1. Finish: 2 coats of Tnemec Series 161 @ 2-3.5 mils
- G. Insulated Pipe: Surface must be clean and dry.
 - 1. Finish: 2 coats of Series 6-Color Tnemec-Cryl @ 250-330 sf per gallon

2.03 MAINTENANCE MATERIAL

- A. The Contractor shall provide the Owner at final inspection one gallon of each type and final color of paint used on the project.

PART 3 - EXECUTION

3.01 PREPARATION OF SURFACE

- A. All surfaces to be painted shall be prepared with the objective of obtaining a smooth, clean, and dry surface. Surfaces which are not shop painted or which were improperly shop painted, and all abraded or rusted shop painted surfaces, which are to be painted shall be prepared as specified herein and shall be dry and clean before painting. Blast cleaning, where required, shall be done in a manner that will not contaminate other work. Blast cleaning is not required of any surfaces which have been properly shop painted previously. No painting shall be done in the field before the prepared surfaces are approved by the Engineer.
- B. Non-submerged ferrous metal surfaces to be painted shall be thoroughly cleaned using SSPC SP-6 Commercial Blast Cleaning in accordance with the Specifications of the Steel Structures Painting Council. Motors and like items that may be damaged by blast cleaning shall be prepared by other approved means.

C. Equipment and Metal Submerged, Subject to Splash or Buried in the Ground:

1. Surface preparation and special coatings shall be done only by crews experienced in this work and who have been approved by the Engineer. A representative of the paint company shall be present when work begins to instruct personnel in sandblasting and application techniques; that instruction shall be made in the presence of the Engineer.
2. Surfaces to be coated shall be sandblasted to the equivalent of "SSPC-SP-10, Near-White Metal Blast Cleaning" of the Steel Structures Painting Council. The Contractor shall furnish the Engineer a Sample No. 10 blast cleaning plate, suitably sealed in plastic, and purchased from the Steel Structures Painting Council, to be used as a field guide. Under no circumstances shall sandblasted surfaces be permitted to rust or have condensation to form thereon prior to coating. Surfaces sandblasted shall be coated the same day; if surfaces are allowed to remain uncoated overnight or longer, they shall be re-sandblasted before coating. All cleaning and coating application shall be performed only during daylight hours. No coating shall be applied when the temperature is below 50 degrees F, nor when the relative humidity is greater than 75 percent, nor when condensation is present on base and coated surfaces, nor when ambient air temperature is falling.
3. The following items subjected to the environments herein described shall receive the surface preparation specified in this subparagraph.
 - a. All submerged pumping equipment.
 - b. All flow and level control equipment.
 - d. All exposed pipe, valves, and fittings.
 - e. All ferrous metal gates and/or appurtenances.
 - f. All buried valves.
4. This does not include ductile iron piping in sewage or buried in the ground.

B. Metals coated with tar or bituminous products to be painted shall be clean and dry and free of oil and grease and shall be given two coats of Koppers Tar Stop or Tnemec No. 707 Tar Bar before application of the specified finish coat.

C. Concrete and grout surfaces to be painted shall have all uneven work, sharp corners and projections smoothed down. All defective surfaces showing aggregate or visible holes shall be cut out and coated with a special bonding coat and filled with grout. Surfaces shall be dry and cleaned from all dust, form oil, curing compounds and other objectionable matter.

D. Galvanized metal surfaces to be painted shall be thoroughly cleaned using SSPC-SP-1 Solvent Cleaning in accordance with Specifications of Steel Structures Painting Council.

E. Metal windows, doors, and frames shall have all rust and loose scale removed with a wire brush and surfaces shall be wiped clean. Caulk around frames and trim, allow to set, then smooth up for primer coat.

F. Use special care to leave all nameplates and non-ferrous finished trim unpainted. Complete instructions as to equipment requiring painting shall be obtained from the Engineer before starting the work. Control centers, meter panels, and pump control panels shall not be painted in the field. The painter shall apply clear plastic by spray can or brush to all metallic nameplates.

G. Equipment, such as motors, pumps, and other such items, which when installed, become an integral part of a system and which may be delivered fully factory-finished, that is, having finish coats in addition to the prime coating, shall be patch painted where damaged, sanded to a dull gloss and then painted with two coats of the specified finish material or as directed.

H. All copper piping shall be cleaned and polished to a bright uniform sheen and then painted with two coats of clear vinyl. Polishing shall be performed using an approved type of copper polish compound which will not abrade or scratch the surface of the pipe. The use of sandpaper or emery cloth will not be permitted for polishing.

3.02 PRIMING

A. Each coat of paint, as well as the required surface preparation, shall be considered as an essential part of a complete system of surface treatment. The painting work specified herein shall include spot-priming, shop-priming and other initial treatments necessary as recommended by the manufacturer of the finishing paint. In all cases, the priming material shall be compatible with the finishing material as recommended by the paint manufacturer. Prime coats specified herein will not be required on items which are delivered with prime, or shop coats already applied; however, the Contractor shall determine that such primers are compatible with the specified finish coats. Where the priming material is not specifically indicated, and where a finishing material different from the specified material is approved for use in the work, then the primer shall be of the type recommended by the manufacturer for such material as applied to the particular surface. If any item, which is to be painted under this Contract, is delivered to the site bearing a prime coat which is incompatible with the specified finishing material or is improper for the purpose, then such prime coat shall be removed, and the surface prepared for painting as recommended by the manufacturer and reviewed by the Engineer.

3.03 APPLICATION OF PAINT

A. On metal surfaces the painter shall apply each coat of paint at the rate specified by the manufacturer to the minimum dry film thickness required by the manufacturer. If material has thickened or must be diluted for application by spray gun, the coating shall be built up to the same film thickness achieved with undiluted material. In other words, one gallon of paint as originally furnished by the manufacturer must not cover a greater square foot area when applied by spray gun than when applied un-thinned by brush. Deficiencies in film thickness shall be corrected by the application of additional coats of paint. On porous surfaces, it shall be the painter's responsibility to achieve a protective and decorative finish either by increasing the coverage rate or by applying additional coats of paint.

B. Paint shall not be applied when the temperature of the air or of the surface is below 50 degrees F. or above 95 degrees F. nor when the relative humidity is greater than 75 percent, nor when condensation is present on base and coated surfaces, nor when ambient temperature is falling.

C. Drying time shall be construed to mean "Under normal conditions." Where conditions are other than normal because of the weather or because painting must be done in confined spaces, longer drying time will be necessary. Additional coats of paint shall not be applied, nor shall units be put in service until paints are thoroughly dry.

D. Where thinning is necessary, only the products of the manufacturer furnishing the paint, and for the particular purpose, shall be allowed and all such thinning shall be done strictly in accordance with the manufacturer's instructions as well as with the full knowledge of the Engineer.

3.04 CONTRACTOR'S INSPECTION

A. The Contractor shall use a wet film gauge to check each application, about every 15 minutes in order to correct low or heavy film build immediately.

B. A dry film gauge shall be used to check each coat when dry, and the total system when completed.

C. The Contractor shall use a holiday or pin hole detector on metal systems to detect and correct voids.

D. A sling-psychrometer shall be used for periodic checks on relative humidity and temperature.

E. The temperature of the substrate shall be checked at regular intervals to be certain the surface is 5 degrees F above the dew point.

3.05 CLEAN-UP

A. At the completion of the work, the Contractor shall remove all paint spots and oil, or grease stains caused by this work from floors, walls, fixtures, hardware, and equipment, leaving their finishes in a satisfactory condition. All materials and debris shall

be removed, and the site of the work left in a clean condition so far as this work is concerned.

3.06 FINAL INSPECTION

A. The Contractor shall protect all painted surfaces against damage until the date of final acceptance of the work. The Engineer will conduct a final inspection of all work and the Contractor will be required to repaint or retouch any areas found which do not comply with the requirements of this Section.

END OF SECTION

SECTION 10 44 16

FIRE EXTINGUISHERS

PART 1 – GENERAL

1.01 DESCRIPTION

- A. Base Bid:
 - 1. Fire extinguisher and accessories.

1.02 RELATED WORK

- B. Specified elsewhere.

1.03 REFERENCES

- A. NFPA 10 - Portable Fire Extinguishers.

1.04 QUALITY ASSURANCE

- A. Provide fire extinguisher cabinets and accessories by one manufacturer for entire project to the greatest extent possible.

1.05 SUBMITTALS

- A. Submit in accord with Section 01 33 00.
- B. Product Data:
 - 1. Portable fire extinguishers: Submit manufacturer's technical data and installation instructions for fire extinguisher cabinets including rough-in dimensions, and details showing mounting methods, relationships to surrounding construction, door hardware, cabinet type and materials, trim style and door construction, style, and materials.
 - 2. Where color selections are specified, include color charts showing full range of manufacturer's standard colors and designs available.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS/PRODUCTS

- A. Fire Extinguisher Cabinets:
 - 1. J.L. Industries, Ambassador
 - 2. Larsen's Manufacturing Company, Architectural Series
 - 3. Amerex
 - 4. Kidde

5. Ansul

2.02 FIRE EXTINGUISHER CABINETS

- A. General: Provide fire extinguisher cabinets where show, of suitable size for housing fire extinguisher of type and capacity shown.
- B. Construction: Manufacturer's standard enameled steel box, with trim, frame, door, and hardware to suit cabinet type, trim style, and door style specified. Weld all joints and grind smooth. Miter and weld perimeter door frames.
- C. Cabinet type: surface mounted.
- D. Trim:
 - 1. Trim Style: Fabricate trim in one piece with corners mitered, welded, and ground smooth.
 - 2. Exposed Trim: One-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend).
 - a. Flat Trim: Square edges with backbend of dimension required by extinguisher size and dimension available for cabinet recess.
 - b. Trim Metal: Same metal as door.
- E. Cabinet Door
 - 1. Door Material and Construction: Manufacturer's standard door construction, of material specified, coordinated with cabinet types and trim styles specified.
 - a. Enameled Steel: Manufacturer's standard flush, hollow steel door construction with tubular stiles and rails.
 - b. Solid Panel: Full flush opaque panel.
 - 1) Provide silk screen lettering.
 - 2) Color selected by Owner from manufacturer's standards.
 - 2. Door Hardware: Manufacturer's standard door operating hardware of proper type for cabinet trim style, door material and style specified. Provide either lever handle with cam action, latch; or door pull, exposed, or concealed, and friction latch. Provide concealed or continuous type hinge permitting door to open 180 degrees.

2.03 FACTORY FINISHING OF FIRE EXTINGUISHER CABINETS

- A. General

1. Comply with NAAMM "Metal Finishes Manual" for finish designations and application recommendations except as otherwise indicated.
 2. Apply finishes in factory after products are assembled.
 3. Protect cabinets with plastic or paper covering.
- B. Preparation:
1. Clean surfaces of dirt, grease, and loose rust or mill scale.
 2. Apply finish to surfaces of fabricated and assembled units, whether exposed to concealed when installed; except those surfaces specified to receive another finish.
- C. Painted Finishes:
1. Baked Enamel Finish: Immediately following cleaning and pretreatment, apply manufacturer's standard baked enamel coating.
 - a. Color: Selected by Owner from manufacturer's standard colors.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install fire extinguisher cabinets at locations and mounting heights shown on drawings. Where not indicated, install at heights complying with regulations of governing authorities.
1. Prepare openings in walls for fire extinguisher cabinets required by type and size of cabinet and style of trim. Comply with manufacturer's instructions.
 2. Securely fasten fire extinguisher cabinets to structure, square and plumb, to comply with manufacturer's instructions.

3.02 IDENTIFICATION

- A. Identify fire extinguisher in cabinet with lettering "FIRE EXTINGUISHER" painted on door by silk-screen process with lettering selected by Owner from manufacturer's standard sized, styles, colors, and layouts.

END OF SECTION

SECTION 11 90 00

WET WELL MIXING

PART 1 - GENERAL

1.01 WORK INCLUDED

A. The work covered by this section includes furnishing all labor, equipment, and materials required to furnish and install all mixing equipment, including blower, piping, hoses, and mixing unit as specified herein, shown on the Drawings, or required for proper completion of the work under these Contract Documents.

B. The Contractor's attention is called to the fact that all components, especially in the smaller sizes, are not necessarily shown completely on the Drawings. However, the Contractor shall furnish and install all equipment indicated or required for proper operation of the equipment.

C. The equipment shall include, but not be limited to, the following:

1. Blower
2. Air Feed Hose
3. Aeration Tube

1.02 SUBMITTALS

A. Complete shop drawings and engineering data shall be submitted to the Engineer in accordance with the requirements of Section 01 33 00.

B. Submit complete operation and maintenance data on the mixing equipment in accordance with the requirements of Section 01 78 23.

1.03 DESCRIPTION OF SYSTEMS

A. All of the equipment and materials specified herein are intended to be standard for use in mixing the wet well and combating the cap formation of fats, oils, and greases by aerating and vigorously agitating sewer or lift station wet wells or similar applications on a continuous basis.

1.04 QUALIFICATIONS

A. All equipment and appurtenances shall be products of well established reputable firms who are fully experienced, reputable and qualified in the manufacture of the particular equipment to be furnished. The equipment shall be designed, constructed and installed in accordance with the best practices and methods and shall comply with these Specifications as applicable.

1.05 TOOLS

- A. Special tools, if required for normal operation and maintenance, shall be supplied with the equipment and remain on-site for owner/operator use.

PART 2 - PRODUCTS

2.01 ACCEPTABLE PRODCUTS

- A. Wet Well Mixer shall be by Reliant Water Technologies 5670 Hayne Blvd. New Orleans, LA 70126.

2.02 BLOWER

- A. The air source must be a side channel, two stage, low volume, high pressure regenerative blower with an air release valve, plumbing for one or more wet well aeration tube devices, and a weather-proof pressure gauge for the purpose of aerating and agitating the liquid in a sewer or lift station wet well. The blower motor and flywheel specifications must be sized to accommodate the necessary pressure and air volume to properly aerate and agitate the water in a specific wet well, taking into consideration the well surface area, altitude, and water depths, including low water and high water depths. The wet well water agitation must be aggressive enough to continuously cause continuous wave surges across the entire wet well surface. A single blower must be capable of supplying enough air volume and pressure for enough aeration tubes to completely affect the entire surface of the wet well. It is important that no air from the air source can reach the intakes of underwater pumps in the wet well.

- B. The air source with have a galvanized steel manifold with the necessary number of air outlet ports to supply air to the required number of aeration tubes identified in this specification. Each port will utilize stainless steel cam lock hose connectors to accommodate the required number of air feed hoses. There will be an Inches of Water gauge located on the primary manifold feed pipe.

- C. The regenerative blower shall be factory installed within the NoVault aluminum enclosure, to protect it from adverse weather conditions. The enclosure shall limit noise to 75 dB at the fence line of the facility.

2.02 AIR FEED HOSE

- A. A 1" OD, 3/4" ID, reinforced, double walled, PVC and polyurethane hose of variable lengths for the connection of the regenerative blower to the wizard tube in the wet well. Each end of the air feed hose must terminate with a mating stainless steel cam lock fitting for the air source manifold and the aeration tube or tubes.
- B. The hose shall be supported from a location directly above the final resting place of the aeration tube. This support location shall also discourage any travel towards the wet well pumps to protect them from cavitation.

C. All nipples and cam lock fittings for the hose between the regenerative blower and the aeration device in the wet well are to be made of either stainless steel.

2.03 AERATION TUBE

A. An 18" HDPE tube fitted to a stainless steel support atop a 5" diameter stainless steel base weighing no less than 10 lbs. The interior of the tube will be fitted with no less than 4 circular antipodal bubble cleaving disks made of HDPE with 1 flat edge each, situated in such a manner as to cleave and spin large bubbles as they rise through the tube. The reinforced, double walled hose, (noted above) must enter the tube from the dorsal end and pass through each cleaving disk, ending below the bottom disk in such a way as to terminate with a brass outlet nipple held in place with a stainless steel clamp. All hardware holding the cleaving disks in place must be stainless steel and welded to the cleaving disks. The tube must be positioned in a vertical orientation in the wet well and there will be no holes in the tube other than at the dorsal and bottom ends of the tube. No air entering the tube can escape the bottom end of the tube near the intakes of pumps situated in the bottom of the wet well.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Installation of the Mixing system shall be in accordance with all manufacturer's instructions.

3.05 FIELD INSPECTION AND TESTING

A. Following installation, the system shall be tested by the Contractor under the anticipated operating conditions. The ability of the system to operate properly without leakage, binding, aeration tube travel in the wet well shall be demonstrated to the satisfaction of the Manufacturer's Representative and the Engineer.

B. During system test, a decibel meter shall be used to ensure the sound leaving the area is reduced to 75 dB when measured at the fence line and 40 dB when measured at the property line. The measurements shall be taken from the nearest fence line and the nearest property line.

END OF SECTION

SECTION 22 05 29

PIPE HANGERS AND SUPPORTS

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. Furnish hangers to support the required loads. Where necessary, supports shall be designed to permit movement due to expansion and contraction. Where drawings show details of supports and anchors, conform to details shown. Where details are not shown, conform to general requirements specified herein.
- B. "C" CLAMPS shall not be used to support piping.
- C. Do not pierce waterproofing with support bolts.
- D. All ferrous metal hangers and supports, not otherwise coated shall be provided with a field applied coat of zinc chromate primer prior to installation. In lieu of field painting the contractor may furnish cadmium plated, or galvanized hangers and supports.

1.02 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General Conditions, Supplemental Conditions apply to work of this section.

1.03 QUALITY ASSURANCE

- A. All hangers, support, anchors, and guides shall be in accordance with the American National Standard Code for Pressure Piping, ANSI B31.1 with addenda 31.1 OA-69.
- B. Provide an adequate suspension system in accordance with recognized engineering practices, using where possible, standard commercially accepted pipe hangers and accessories.
- C. Horizontal suspended pipe shall be hung using adjustable pipe hangers with bolted hinged loops or turnbuckles. Chains, wire, perforated strap iron or flat steel strap are not acceptable.
- D. Submit fastening methods to the engineer for review.
- E. For the purpose of this specification figure numbers for Grinnell products are given, equal products by Carpenter & Patterson Inc. and Elson are acceptable.

PART 2 - PRODUCTS

2.01 UPPER ATTACHMENTS

A. New Concrete Construction:

1. Support piping in new concrete construction with adjustable type inserts, Grinnell Fig. 282. Where the pipe load exceeds the recommended load of the insert, use two inserts with a trapeze- type connecting member below the concrete.
2. Where hangers are required between structural members, (beams) provide side beam brackets, Grinnell Fig. 202, attached to the upper 1/3 of the beam, and all auxiliary steel for the installation of the pipe hangers. Supports shall be designed in accordance with the AISC Steel Handbook and shall receive a field coat of zinc chromate primer.

B. Existing Concrete Construction:

1. Support piping in existing concrete construction with Cadmium plated, malleable iron, expansion case, Grinnell Fig. 117.
2. Where hangers are required between structural member (beams) side beam brackets Grinnell Fig. 202, attached to the upper 1/3 of the beam, and all auxiliary steel for the installation of the pipe hanger. Supports shall be designed in accordance with the AISC Steel Handbook and shall receive a field coat of zinc chromate primer.

C. Steel Construction:

1. Support piping in steel construction with adjustable beam clamps and tie rods, Grinnell Fig. 218., or side beam brackets bolted or welded to the side of the beam.
2. Where hangers are required between structural members (beams or joists) provide all auxiliary steel for the installation of the pipe hanger. Supports shall be designed in accordance with the AISC Steel Handbook and shall receive a field coat of zinc chromate primer.

D. Wood Construction:

1. Support piping in wood construction with Side Beam Bracket, Grinnell Fig. 202 or Hanger Flange, Grinnell Fig. 128R, using lag screws.

2.02 WALL SUPPORTS

- A.** Where piping is run adjacent to walls or steel columns, welded steel brackets Grinnell Fig. 195 and 199 may be used. The bracket shall be bolted to the wall and have a back plate of such size and thickness as to properly distribute the weight. Pipe supports and hardware in the wetwell are required to be stainless steel.

2.03 FLOOR SUPPORTS

- A. Where pipelines runs are located next to the floor and no provision for expansion are required, support piping with Grinnell Fig. 258, or approved equal pipe rest with nipple and floor flange.
- B. Where provisions for expansion are required, support piping with Grinnell adjustable pipe stand Fig. 274, or pipe roll stand Fig. 271, or approved equal.
- C. Vertical piping shall be supported at every other floor using riser clamps Grinnell Fig. 261, for steel and cast-iron pipe, and copper clad riser clamp Grinnell Fig. CT.121, for all copper piping, or approved equal.

2.04 SUPPORT FOR PIPING OUTSIDE THE STRUCTURE

- A. Support piping outside the structure on adjustable pipe supports Grinnell Fig. 264, or approved equal.

2.05 PIPE INSULATION PROTECTIVE SHIELDS AND SADDLES FOR HORIZONTAL PIPING

- A. Provide galvanized sheet metal pipe insulating protection shields at each pipe hanger for all horizontal insulated water pipes and condensate drainpipes. Shield sizes shall be:
 - 1. Pipes 2" and smaller: 18-gauge x 12" long
 - 2. Pipes 2-1/2" and larger: 16-gauge x 18" long
- B. Shields shall be 180-degree type at all pipe hangers, except that on trapeze hangers, pipe racks and on floor supported horizontal pipes shields shall be 360-degree type. Use foamglass inserts at all shields, hangers, sleeves, etc.

2.06 FACTORY-FABRICATED FRAMING CHANNELS AND FITTINGS

- A. Factory-fabricated framing channels and fittings shall be used for constructing pipe racks and trapeze type hangers for supporting multiple horizontal pipes where indicated.
- B. Framing channels and fittings shall be provided with factory applied baked enamel finish.
- C. Galvanized pipe clamps, including bolts and nuts shall be provided with the framing channels and shall be used for securing pipes to channels. Pipe clamps on insulated pipes shall fit around pipe and pipe insulation protection shield.
- D. Framing channels and fitting shall be F&S Mfg. Co. Series F Metal Framing, Fee & Mason FAMET Channel and Fitting, Carpenter & Patterson Channel Strut or Unistrut P-Series.

2.07 INTERMEDIATE ATTACHMENTS

- A. Supports for horizontal piping shall be all threaded carbon steel, ASTM A- 107, Grinnell Fig. 146., of the following sizes:

Pipe Size	Hanger Rod Diameter
2" and smaller	3/8"
2-1/2" and 3"	1/2"
4" and 5"	5/8"
6"	3/4"
8" to 12"	7/8"
14" and 16"	1"

2.08 PIPE ATTACHMENTS

- A. Hangers and supports for fire protection and sprinkler system shall conform the requirements of NFPA 13, and be UL listed.
- B. Hangers for insulated pipe shall be sized to bear on the outside of the insulation.
- C. Hangers for steel and cast-iron horizontal piping where provision for expansion are not required shall be Grinnell Fig. 260., clevis type with vertical adjustment.
- D. Hangers for uninsulated copper pipe 4" and smaller shall be copper plated adjustable band hangers Grinnell Fig. CT. 99C., clevis type hanger with a 4 psf lead saddle at each hanger location.
- E. Hanger for PVC pipe shall be Grinnell Fig. CT.99., adjustable band hanger.
- F. Hangers for steel and copper piping where provisions for expansion are required shall be Grinnell Fig. 171 or Fig 181., adjustable roller hanger with Grinnell Fig. 160., pipe covering protection saddles.
- G. Support domestic hot and cold-water piping in spaces behind plumbing fixtures with plastic coated brackets and plastic-coated U bolts.
- H. Pipe guide shall be Grinnell Fig. 256.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Support horizontal equipment such as in-line pumps, strainers, air separators, etc., independently of the piping system.
- B. Hang pipe from substantial building structure. Pipe shall not be hung from other piping.
- C. Support each horizontal length of NO-HUB cast iron pipe within 2-1/2' of each joint and a maximum of 5'-0" on centers.
- D. Provide a hanger within one foot of each elbow.

Section 4
Scope of Work and Technical Specifications
SECTION 22 05 29-5 PIPE HANGERS AND SUPPORTS

E. Provide a hanger within one foot of each riser in addition to the riser clamp support at every other floor.

F. Unless specified otherwise provide the following support spacing.

Pipe Size	Support Spacing

1" and smaller	5'-0"

1-1/4" and larger	10'-0"

END OF SECTION

SECTION 22 13 29

SUBMERSIBLE WASTEWATER PUMPS

PART 1 – GENERAL

1.01 SUMMARY

A. This section addresses supervision, labor, materials and equipment in the work for furnishing and installing wet-pit submersible chopper pumps.

B. General Contractor shall provide all labor, materials, tools, equipment, and incidentals as shown, specified, and required to furnish, install, adjust, and test submersible chopper pumps as shown on the Plans and as described in these Specifications.

C. All submersible sewage pumps shall be provided by a single manufacturer.

D. Pump manufacturer scope of supply:

1. Pump motors
2. Power and sensor cable
3. Volutes
4. Impellers
5. Other pump component parts
6. Spare parts
7. Technical services
8. Breakaway Fitting System
9. Breakaway Fitting System guide rails
10. Bearings
11. Mechanical seals
12. Pump shafts
13. Striker plate
14. Slicing blade
15. Extra materials as specified

E. Contractor scope of supply: Provide materials, equipment, appurtenances, and services not supplied as part of the system, including but not limited to

1. Unloading, storing, and protecting equipment at the site in accordance with supplier's recommendations
2. Installation of pump, motor, equipment appurtenances, including but not limited to the breakaway fitting system with guide rails.

1.02 REFERENCES

A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only. The referenced publications shall be the current effective edition.

1. Hydraulic Institute Standards (HI)
2. American Society for Testing Materials (ASTM)
3. ASTM A48/A48M – 03 Standard Specification for Gray Iron Castings
4. ASTM A470 Standard Specification for Vacuum-Treated Carbon and Alloy Steel Forgings for Turbine Rotors and Shafts
5. American Iron and Steel Institute (AISI)
6. Insulated Cable Engineers Association (ICEA)
7. American Society of Mechanical Engineers (ASME)/American National Standards Institute (ANSI)
8. B16.1 Gray Iron Pipe Flanges and Flanged Fittings
9. National Electrical Manufacturers Association (NEMA)
10. Institute of Electrical and Electronics Engineers (IEEE)
11. National Electric Code (NEC)
12. American Bearing Manufacturers Association (ABMA)
13. American Society for Testing and Materials International (ASTM)

1.03 SUBMITTALS

- A. General: Submit in accordance with Section 01 33 00
- B. Action submittals:
 1. The manufacturer will supply the standard submittal, consisting of:
 - a. Pump Catalog Data, including motor data, and pump dimensional drawing with appurtenances
 - b. Materials of construction list

Section 4
Scope of Work and Technical Specifications
SECTION 22 13 29-3 SUBMERSIBLE WASTEWATER PUMPS

- c. Mounting Accessory details
 - d. Access Cover data
 - e. Typical installation drawing
 - f. Electrical schematics and diagrams
 - g. Certified copies of test data from factory testing when specified, only after pumps have been ordered and manufactured
- C. Informational submittals:
 - 1. Descriptive information on material and equipment furnished
 - 2. Anchorage requirements
 - 3. Installation instructions
 - 4. Manufacturer's certificate of acceptance of installation and testing
 - 5. List of manufacturer's recommended spare parts
 - 6. Installation & Operation Manual with parts list
 - 7. Warranty documents
 - 8. Name and address of factory authorized service facility
- D. Closeout submittals:
 - 1. Comply with Section 01 78 39
 - 2. Project record documents: Record actual locations of pumps and appurtenances on the contract drawing, reflecting all post-bid changes.
 - 3. Section 01 78 23, Operations and Maintenance Data: Submit maintenance instructions for equipment and accessories.
- E. The following submittals shall be available for no extra charge
 - 1. Critical Speed Analysis
 - 2. Natural Frequency Analysis
 - 3. Structural Dynamics
 - 4. Torsional Analysis
 - 5. Anchor Bolt Design
 - 6. Torsional Shaft Stress Analysis
 - 7. Shaft Deflection Calculations

8. Contact the manufacturer for submittals not listed.

1.04 QUALITY ASSURANCE

A. Warranty

1. The pumps shall come with a 5-year, pro-rated warranty, that begins from the date of startup.
2. A 5-year full coverage warranty is available as an option.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Comply with provisions of Section 01 62 00.

1. List the special storage and handling requirements for the products specified, including location and environmental conditions to protect from damage.
2. Store materials to permit easy access for inspection and identification. Keep all material off the ground, using pallets, platforms, or other supports. Protect steel members and packaged materials from corrosion and deterioration.
3. All parts shall be properly protected so that no damage or deterioration will occur during a prolonged delay from the time of shipment until installation is completed and the unit and equipment are ready for operation.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Manufacturer Qualifications

1. Pump(s) shall be manufactured by a company regularly engaged in the manufacture and assembly of similar units for a minimum of (5) years.
2. The pumps shall be assembled and tested in the United States of America.
3. The pumps shall be Barnes envie3 model 6XESCDK100044 or approved equal.
4. CONTRACTOR will provide OWNER with location and description of manufacturer's Service Centers and spare parts stock.
5. Manufacturer shall be certified to ISO 9001 and shall provide a valid certificate upon request.

2.02 PRODUCT DETAILS

A. Service Conditions:

Section 4
Scope of Work and Technical Specifications
SECTION 22 13 29-5 SUBMERSIBLE WASTEWATER PUMPS

1. The pumps shall be submersible end suction centrifugal chopper type, installed in a:
 - a. Wet Pit submersible installation, with a permanently installed guide rail system, with a slide that automatically connects to the discharge piping when lowered into place. The pump will be suitable for submergence up to a depth of 66 ft.
2. Each pump shall be capable of handling raw, unscreened domestic sewage consisting of water and fibrous materials. The impellers will be capable of passing up to 3" diameter spherical solids without the chopping mechanism. The chopping mechanism shall modify the solids prior to reaching the impeller inlet. The pump (s) shall be driven by a Premium Efficient/ IE3 motor capable of operating in a 40°C/104° F environment and handling liquids with temperatures to 40°C/104° F continuously. The motor will be capable of operating continuously when fully submerged, partially submerged, or unsubmerged.
3. Each pump will be capable of the following performance:

Primary Flow	1141	US GPM
Primary Head	137.51	TDH - Feet
Min. Hydraulic Efficiency	95.2%	
Discharge Size	4	In
Suction Size	6	In
Motor Speed	1750	RPM
Motor HP	100	HP
Frequency	60	Hz
Voltage	460	V
Phase	3	ph
Motor Service Factor	1.15	SF

2.03 PUMP AND MOTOR MATERIALS

A. Component Materials

Volute	ASTM A48 Class 30 Cast Iron
Impeller	Standard: ASTM A536, 65-45-12 Ductile Iron Optional: ASTM A532 Class III Type A White Iron
Motor Housing	ASTM A48 Class 35B Cast Iron
External Hardware	304 Stainless Steel
Shaft	416 Stainless Steel
Cooling Jacket	304 Stainless Steel
Seals	Standard: Carbon/Silicon Carbide/Buna Upper, Silicon Carbide/Silicon Carbide/Buna Lower Optional: Silicon Carbide/Silicon Carbide/Buna Upper Seal, Tungsten

Section 4
Scope of Work and Technical Specifications
SECTION 22 13 29-6 SUBMERSIBLE WASTEWATER PUMPS

	Carbide/Tungsten Carbide/Buna for both Upper and Lower Seals
Coating	Liquid End: Two coats of Axalta Corlar® amidoamine epoxy, 10 mil minimum thickness, in the manufacturer's standard color
Motor Cap	Resicoat® R4 Powder Coat Epoxy, in the manufacturer's standard color
Gaskets	Buna-N
O-Rings	Buna-N
Motor Rotor Bars	Die Cast Aluminum
Motor Cooling Liquid	Monopropylene Glycol and Distilled or Deionized Water
Elastomeric plug holding plate	ASTM A48 Class 30 Cast Iron
Cable Entry Housing	ASTM A48 Class 30 Cast Iron
Nameplate	304 stainless steel
Lifting Bail	304 stainless steel
Wear Ring	ASTM B505 C95400 Lead Free Bronze
Striker Plate	ASTM A276 440C Stainless Steel, Heat Treated to 53-60 HRC
Slicing Blade	ASTM A276 440C Stainless Steel, Heat Treated to 53-60 HRC

B. Pump Components

1. The open center chopping mechanism shall consist of a stationary striker plate and a rotating slicing blade. The pump end components will be ASTM A48 Class 30 Cast Iron, aside from the impeller. The volute shall be a single piece non-concentric design, with smooth passages of sufficient size to pass solids that may enter through the impeller. The volute shall include a drain port connection. The volute discharge connection shall be a standard 125 lb. flange, slotted to accommodate ANSI or MM ISO Flanges used in sewage applications, and shall be a centerline connection. The suction connection shall be a standard ANSI 125 lb. flange. The volute shall be designed to withstand 1.5x the maximum shutoff head.

2. The slicing blade-impeller assembly will be dynamically balanced to ISO G6.3 specifications, and will be capable of handling solids, fibrous materials, and other matter typically found in raw wastewater. The impeller shall be keyed to the shaft and shall have a taper lock connection. The impeller will be a:

- a. Dual-vane design with pump out vanes on both sides. The matching volute will include a replaceable volute wear ring at the inlet. Larger models shall utilize an impeller wear ring as well.

3. Both blades shall be constructed of high quality, ASTM A276 440C stainless steel, heat treated to 53-60 HRC. The slicing blade shall be press fitted

Section 4
Scope of Work and Technical Specifications
SECTION 22 13 29-7 SUBMERSIBLE WASTEWATER PUMPS

on to the impeller suction, and secured with four stainless steel pins. The striker plate shall be fixed to the volute suction, and shall be an ANSI flange design. The clearance between the striker plate and slicing blade shall be adjustable, in order to maintain a clearance of 0.003" to 0.010". The striker plate shall be sealed internally against the volute with an O-ring. This design shall allow for a solids handling pump to be easily upgraded to a chopper pump. Designs that utilize a chopping nut, impeller without a separate slicing mechanism, upper cutters, or that cannot easily upgrade a solids handling pump to a chopper will not be accepted.

4. The pump and motor shaft will be a solid, continuous piece of 416 stainless steel, keyed and tapered for the matching impeller fit to reduce rotor imbalance and minimize stress risers associated with stepped shafts. Shafts utilizing a coupling or other attachment method will not be acceptable. The shaft will have a maximum allowable deflection of 0.002 inches at the lower mechanical seal during operation.

5. The mechanical seals will be a tandem system, consisting of two totally independent mechanical seals, each with its own single spring system acting in a common direction. The upper seal will have a carbon rotating face and a silicon carbide stationary face and will be located between the coolant chamber and the motor housing. The lower seal will have a silicon carbide rotating face and a silicon carbide stationary face and will be located between the pump and the lubricant chamber. Both seals will have 300 series stainless steel hardware and Buna-N elastomers.

a. Alternate seal materials include a silicon carbide/silicon carbide upper seal, tungsten carbide/tungsten carbide upper seal, and tungsten carbide/tungsten carbide lower seal. Combination of these seal configurations will be acceptable. Seal faces with materials other than those specified above will not be acceptable.

6. Both seals shall be pinned in place to prevent rotation of the stationary seat and shall seal to the pump housing and must operate in a coolant chamber which shall provide superior heat transfer & seal cooling. The coolant must be environmentally safe non-toxic material. The seals must not require routine maintenance or adjustment but should be easily replaced. The seal shall be commercially available and not a pump manufacturer's proprietary design. Double mechanical seals with a single or double spring and/or cartridge seals will not be accepted.

7. The common pump and motor shaft shall rotate on two bearings. These bearings shall be high quality and commercially available. The bearings will be sealed, permanently grease lubricated for superior lubrication, cooling, and life. The lower bearing shall be of the double row ball type, locked in position to

Section 4
Scope of Work and Technical Specifications
SECTION 22 13 29-8 SUBMERSIBLE WASTEWATER PUMPS

accept radial and axial thrust loads and the upper bearing shall be of the pre-loaded single ball type for radial loads as needed to provide a minimum L10 Life of 50,000 hours at -50% to +50% of BEP.

8. Gaskets except for seal gland and bearing retainer shall be of the angular gland compression O-ring type eliminating critical slip fits and the possibility of damage during service associated with sliding O-ring sealing arrangements. Mating surfaces where watertight sealing is required shall be machined and fitted with O-rings.

9. The exterior of the pump liquid end will be coated per Article 2.04 FINISHES below.

10. The pump shall be equipped with a stainless steel nameplate, located in an easily accessible location. The following data will be included on the nameplate:

- a. Manufacturer's Name
- b. Pump Part Number, Model Number and Serial Number
- c. Motor Horsepower Rating
- d. Voltage, Phase and Frequency
- e. Motor Speed
- f. Motor Service Factor
- g. Motor Full Load Amps
- h. Ambient Temperature Rating
- i. Code Letter
- j. Pump Weight
- k. Impeller Diameter
- l. Motor Insulation Class

11. Spare Parts

- a. One spare full diameter impeller-slicing blade assembly for each pump model
- b. one spare set of mechanical seals,
- c. all gaskets,
- d. all O-Rings.
- e. Spare wear rings for each pump model

C. Motor Components

1. The major driver components will be ASTM A48 Class 35B Cast Iron.
2. The motor shall be a squirrel cage induction motor housed in an air filled, watertight enclosure. The motor shall be NEMA Type B. The stator windings shall be insulated with moisture resistant Class H insulation, rated for 180°C (356°F). The motor shall be 460 volts, 60 Hz, 3 phase, and shall have a voltage tolerance of +/- 10% from nominal voltage. The motor shall be designed to run continuously in a 40° (104°F) ambient environment.
3. The stator shall be press fit into the motor housing, for mechanical stability and optimal heat transfer. The use of bolts or pins to secure the stator into the housing will not be acceptable.
4. The motor shall be inverter duty rated, in accordance with NEMA MG-1, Part 31, and shall have a minimum 1.15 service factor. The motor shall be designed for usage in submersible or dry applications, where the motor shall operate fully submerged, partially submerged, or completely unsubmerged. The motor horsepower shall be non-overloading throughout the entire pump performance curve.
5. The rotor bars shall be die cast aluminum with integral cooling fins.
6. The motor will be capable of operating at a maximum submergence depth of 66 ft (20m), and shall be IP68 protection rated.
7. The motor will be IE3 rated in accordance with IEC 60034-30 at nominal voltage and frequency, with testing per CSA C390/IEEE114. The motor will be capable of 15 evenly spaced starts per hour without overheating.
8. The motor shall include a factory installed closed loop cooling system. The cooling system shall be completely self-contained. The cooling liquid shall be a mixture of 30% monopropylene glycol and 70% distilled or deionized water, and shall be circulated between a stainless steel jacket and the cast iron motor housing by a secondary, independent impeller. This secondary impeller shall be mounted directly to the motor shaft between the mechanical seals. The bearing bracket shall act as a heat exchanger to move the heat from the motor to the coolant liquid. The seal plate shall be finned and act as a heat exchanger to move the heat from the coolant to the pumped media. The system shall have at minimum one fill port and one drain port. An external coolant source, a cooling system circulating the pumped media or a design without a cooling system will not be acceptable.

D. Sensors

1. A moisture sensor detection system shall be integrated within the bearing bracket and liquid ingress must trigger an alarm before reaching the bearings. A

normally open float sensor with a circuit verification resistor must be installed in the seal leakage chamber to detect presence of liquid. Units sensing moisture within the motor chamber are not considered acceptable. It is recommended to use the pump monitor relay (PMR) installed inside the control panel which will trigger a warning light and shuts the pump down due to ingress of liquid.

2. The motor shall be equipped with thermal sensors:

a. Single Phase: A thermal sensor shall be embedded in the end coil of the stator winding. It shall be used to monitor stator temperature, in conjunction with an external motor overload protection device and wired to the control panel through the power cable. The thermal switches shall open at 120°C (248°F). Start and run capacitors with the starting relay shall be provided on a factory supplied backplate for mounting in the control panel.

E. Cable

1. The pump shall be equipped with 75 ft of a CSA qualified submersible power cable constructed in accordance with Type W guidelines. The power cable will also include the moisture and temperature sensor leads in one common jacket for most models. Power cable shall be rated for variable frequency drive use.

a. For E21 and E28 frame pumps, the cable entry system will be Barnes Plug & Play design, consisting of a voltage selectable expanding elastomeric plug, held in place by a cast stainless steel plate indicating the voltage and max amperage. By using this plug, pumps 20HP and below will be capable of switching between voltages with only a cord change. Pumps requiring internal wiring modifications to change voltage will not be acceptable.

b. For E32 and E36 frame pumps, the cable entry system will be Barnes Plug & Play design, consisting of a potted cast iron housing, held in place by stainless steel hardware. The power cord shall be easily removed and replaced. Pumps with power cords that cannot be easily removed or replaced will not be acceptable.

2. The pumps shall be capable of being easily removed and replaced without the removal of the pump power cord from the electrical conduit.

2.04 FINISHES

A. The exterior of the pump liquid end will be coated with two coats Axalta Corlar ® two-part amidoamine epoxy, with a minimum thickness of 10 mils. The motor cap will be powder coated with Resicoat ® R4 epoxy. Coating of the pump interior to gain hydraulic efficiency will not be accepted.

2.05 ACCESSORIES

A. For Wet Pit pumps:

1. The pump shall be supplied with a Break Away Fitting assembly (BAF), which will allow the pump to be installed and operate continuously in a vertical submerged condition. The stationary portion of the BAF shall be installed in the wet pit, thus removing the need for personnel to enter the wet well. The stationary portion of the BAF shall consist of a cast iron base elbow, guide rails, an upper guide bracket, and an optional intermediate guide bracket. The intermediate guide bracket is only required for depths of 13 ft (4m) or more. The cast iron base elbow shall be bolted to the wet well floor. The movable portion of the BAF shall consist of a cast iron slide, which bolts to the pump discharge flange. This slide guides the pump up and down the guide rails, and includes a gasket, which ensures a complete seal. The two guide rails must be provided by others, and should be 2" schedule 40 metallic pipe in a non-corrosive material, such as stainless steel. These guide rails shall be attached to the base elbow at one end, and the upper guide bracket at the other. The upper guide bracket shall be attached to the underside of the wet well cover. The bracket shall have elastomer plugs, which reduce noise and rail vibration. The guide rails serve only to guide the pump, and do not carry the weight of the pump. Designs that do not use a movable gasket, use guide chain, or use a single guide rail shall not be accepted.

a. Contractor shall supply chain or cable for removal of pump.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's printed instructions (and state/municipal, and other governing standards).

1. Wet Pit: The pump shall be capable of operating continuous in a vertical submerged condition.
2. Contractor shall complete all piping and supports, make all electrical power and control connections, and install all safety devices and instrumentation prior to equipment start-up.
3. All anchor bolts, nuts, washers, and sleeves shall be Type 316 stainless steel furnished by the contractor and shall be of ample size and strength for the purpose intended
4. See also 2.05 ACCESSORIES above.

3.02. QUALITY CONTROL

A. Factory Tests:

1. The pump manufacturer shall perform a pump performance test to verify hydraulic performance as standard.
2. Factory certified testing is required. The manufacturer shall offer testing in accordance with Hydraulic Institute Standards 11.6 and 14.6. Additionally, the following tests are also available:
 - a. A check of the motor voltage and frequency
 - b. A motor and cable insulation test for moisture content or insulation defects, in accordance with CSA criteria
 - c. Contact the manufacturer for tests not listed here.
3. Each motor shall be dielectric tested to verify the motor insulation integrity.

B. Manufacturer's Representative

1. The Manufacturer's representative shall inspect the equipment, carry out the equipment start-up procedures, and provide training to the operators in how to effectively operate and maintain the equipment. The manufacturer's representative may be an employee of the manufacturer's distributor.
2. Prior to Operational Testing, the CONTRACTOR shall have the manufacturer's representative perform the following:
 - a. Megger test the stator and power cables.
 - b. Check proper rotation.
 - c. Check power supply voltage.
 - d. Measure motor operating load and no-load current.
3. During Final Acceptance Testing, the manufacturer's service representative shall review recommended operation and maintenance procedures with the OWNER'S personnel.
4. The manufacturer's representative shall be present for a period of not less than one (1) day to complete the following:
 - a. Inspect completed installation
 - b. Observe equipment testing
 - c. Observe equipment start-up

Section 4
Scope of Work and Technical Specifications
SECTION 22 13 29-13 SUBMERSIBLE WASTEWATER PUMPS

d. Instruct operational personnel on equipment operation and maintenance.

C. Field Tests:

1. After installation, the pumping system shall be field tested using potable water for a minimum of 30 minutes and check for correct direction of rotation in the presence of the manufacturer's representative and the Engineer. The CONTRACTOR shall be responsible for providing water and for conveying the water to the site and providing required meter and back-flow prevention check valve assembly. Each pump shall be cycled through the sequence of operation "pump on" as the level rises in the wet well and then "pump off" during draw down. Once each pump has been tested separately, the pumps will be operated in parallel.

2. Each pump shall operate over its intended operating range without undue noise, vibration, or cavitation. The CONTRACTOR shall monitor and record vibration at three symmetrically located points on each pump at maximum and minimum speed and supply data to the OWNER.

D. Inspections

1. Upon completion of the installation and on-site testing, and before acceptance by the OWNER, the Pump Manufacturer or the authorized Pump Manufacturer's Representative shall submit a written statement that the pump installation has been inspected and is completed in accordance with the manufacturer's recommendations.

3.03 ADJUSTING

A. Adjust parts for smooth, uniform operation.

3.04 CLEANING

A. Clean as recommended by manufacturer. Do not use materials or methods which may damage finish (surface) or surrounding construction.

END OF SECTION

Section 4
Scope of Work and Technical Specifications

SECTION 23 05 13-1 COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

SECTION 23 05 13

COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.01 RELATED REQUIREMENTS

- A. Section 26 05 05 – Conductors

1.02 REFERENCE STANDARDS

- A. ABMA STD 9 - Load Ratings and Fatigue Life for Ball Bearings 2015.
- B. IEEE 112 - IEEE Standard Test Procedure for Polyphase Induction Motors and Generators 2017.
- C. NEMA MG 1 - Motors and Generators 2018.
- D. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.03 SUBMITTALS

- A. See Section 01 33 00 - Submittal Procedures.
- B. Product Data: Provide wiring diagrams with electrical characteristics and connection requirements.
- C. Test Reports: Indicate test results verifying nominal efficiency and power factor for three phase motors larger than 1/2 horsepower.
- D. Manufacturer's Installation Instructions: Indicate setting, mechanical connections, lubrication, and wiring instructions.
- E. Operation Data: Include instructions for safe operating procedures.
- F. Maintenance Data: Include assembly drawings, bearing data including replacement sizes, and lubrication instructions.

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacture of electric motors with minimum five years documented product development, testing, and manufacturing experience.
- B. Comply with NFPA 70.
- C. Provide certificate of compliance from Authority Having Jurisdiction indicating approval of high efficiency motors.

Section 4
Scope of Work and Technical Specifications
SECTION 23 05 13-2 COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

D. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Protect motors stored on site from weather and moisture by maintaining factory covers and suitable weather-proof covering. For extended outdoor storage, remove motors from equipment and store separately.

1.06 WARRANTY

A. See Section 01 78 36 - Warranties.

B. Provide five year manufacturer warranty for motors larger than 20 horsepower.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Baldor Electric Company/ABB Group

B. US Motors

C. Leeson Electric Corporation

D. Regal-Beloit Corporation (Century)

2.02 GENERAL CONSTRUCTION AND REQUIREMENTS

A. Electrical Service:

1. Motors 1/2 HP and Smaller: 115 volts, single phase, 60 Hz.
2. Motors Larger than 1/2 Horsepower: 460 volts, three phase, 60 Hz.

B. Construction:

1. Open drip-proof type except where specifically noted otherwise.
2. Design for continuous operation in 104 degrees F environment.
3. Design for temperature rise in accordance with NEMA MG 1 limits for insulation class, service factor, and motor enclosure type.
4. Motors with frame sizes 254T and larger: Energy efficient type.

C. Explosion-Proof Motors: UL approved and labelled for hazard classification, with over temperature protection.

D. Visible Nameplate: Indicating motor horsepower, voltage, phase, cycles, RPM, full load amps, locked rotor amps, frame size, manufacturer's name and model number, service factor, power factor, efficiency.

Section 4
Scope of Work and Technical Specifications

SECTION 23 05 13-3 COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

- E. Wiring Terminations:
1. Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70, threaded for conduit.
 2. For fractional horsepower motors where connection is made directly, provide threaded conduit connection in end frame.

2.03 APPLICATIONS

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install securely on firm foundation. Mount ball bearing motors with shaft in any position.
- C. Check line voltage and phase and ensure agreement with nameplate.

END OF SECTION

SECTION 23 05 29

HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Support and attachment components for equipment, piping, and other HVAC/hydronic work.

1.02 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete: Concrete equipment pads.
- B. Section 05 12 00 – Structural Steel Framing: Materials and requirements for fabricated metal supports.

1.03 REFERENCE STANDARDS

- A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products 2017.
- B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware 2016a.
- C. ASTM A181/A181M - Standard Specification for Carbon Steel Forgings, for General - Purpose Piping 2014 (Reapproved 2020).
- D. ASTM A36/A36M - Standard Specification for Carbon Structural Steel 2019.
- E. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings 1999, with Editorial Revision (2018).
- F. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel 2019.
- G. ASTM D635 - Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position 2018.
- H. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2021a.
- I. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials 2016.
- J. MFMA-4 - Metal Framing Standards Publication 2004.
- K. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation 2018.

Section 4
Scope of Work and Technical Specifications
SECTION 23 05 29-2 HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

- L. NFPA 101 - Life Safety Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- M. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate sizes and arrangement of supports and bases with the actual equipment and components to be installed.
 - 2. Coordinate the work with other trades to provide additional framing and materials required for installation.
 - 3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
 - 4. Coordinate the arrangement of supports with ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
 - 5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Sequencing:
 - 1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured in accordance with Section 03 30 00.

1.05 SUBMITTALS

- A. See Section 01 33 00 - Submittal Procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for channel (strut) framing systems, nonpenetrating rooftop supports, post-installed concrete and masonry anchors, and thermal insulated pipe supports.
 - 1. Fiberglass Channel (Strut) Framing Systems: Include requirements for strength derating according to ambient temperature.
- C. Shop Drawings: Include details for fabricated hangers and supports where materials or methods other than those indicated are proposed for substitution.
 - 1. Application of protective inserts, saddles, and shields at pipe hangers for each type of insulation and hanger.
- D. Derating Calculations for Fiberglass Channel (Strut) Framing Systems: Indicate load ratings adjusted for applicable service conditions.

Section 4
Scope of Work and Technical Specifications

SECTION 23 05 29-3 HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

E. Installer's Qualifications: Include evidence of compliance with specified requirements.

F. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.06 QUALITY ASSURANCE

A. Comply with applicable building code.

B. Installer Qualifications for Field-Welding: As specified in Section 05 12 00.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 - PRODUCTS

2.01 SUPPORT AND ATTACHMENT COMPONENTS

A. General Requirements:

1. Comply with MSS SP-58.
2. Provide all required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for the complete installation of plumbing work.
3. Provide products listed, classified, and labeled as suitable for the purpose intended, where applicable.
4. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported with adequate safety factor. Include consideration for vibration, equipment operation, and shock loads where applicable.
5. Do not use wire, chain, perforated pipe strap, or wood for permanent supports unless specifically indicated or permitted.
6. Steel Components: Use corrosion resistant materials suitable for the environment where installed.
 - a. Indoor Dry Locations: Use zinc-plated steel or approved equivalent unless otherwise indicated.
 - b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel, stainless steel, or approved equivalent unless otherwise indicated.

Section 4
Scope of Work and Technical Specifications

SECTION 23 05 29-4 HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

- c. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
 - d. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.
- B. Materials for Metal Fabricated Supports: Comply with Section 05 12 00.
- C. Metal Channel (Strut) Framing Systems: Factory-fabricated continuous-slot metal channel (strut) and associated fittings, accessories, and hardware required for field-assembly of supports.
 - 1. Manufacturers:
 - a. Cooper B-Line, a division of Eaton Corporation
 - b. Ferguson Enterprises Inc.
 - c. Thomas & Betts Corporation
 - d. Unistrut, a brand of Atkore International Inc.
 - 2. Provide factory-fabricated continuous-slot metal channel (strut) and associated fittings, accessories, and hardware required for field-assembly of supports.
 - 3. Comply with MFMA-4.
 - 4. Channel Material:
 - a. Indoor Dry Locations: Use painted steel, zinc-plated steel, or galvanized steel.
 - b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel.
 - 5. Minimum Channel Thickness: Steel sheet, 12 gauge, 0.1046 inch.
 - 6. Minimum Channel Dimensions: 1-5/8 inch width by 13/16 inch height.
- D. Fiberglass Channel (Strut) Framing Systems: Factory-fabricated continuous-slot fiberglass channel (strut) and associated fittings, accessories, and hardware required for field-assembly of supports.
 - 1. Manufacturers:
 - a. Enduro Composites or equal
 - b. Source Limitations: Furnish channels (struts) and associated fittings, accessories, and hardware produced by a single manufacturer.
 - 2. Channel Material: Use polyester resin or vinyl ester resin.
 - 3. Minimum Channel Dimensions: 1-5/8 inch width by 1 inch height.

Section 4
Scope of Work and Technical Specifications

SECTION 23 05 29-5 HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

4. Flammability: Fire retardant with NFPA 101, Class A flame spread index (maximum of 25) when tested in accordance with ASTM E84; self-extinguishing in accordance with ASTM D635.
- E. Hanger Rods: Threaded zinc-plated steel unless otherwise indicated.
1. Minimum Size, Unless Otherwise Indicated or Required:
 - a. Equipment Supports: 1/2 inch diameter.
 - b. Piping up to 1 inch (27 mm) nominal: 1/4 inch diameter.
 - c. Piping larger than 1 inch (27 mm) nominal: 3/8 inch diameter.
 - d. Trapeze Support for Multiple Pipes: 3/8 inch diameter.
- F. Steel Cable:
1. Manufacturers:
 - a. Ductmate Industries, Inc., ; Clutcher Cable Hanging System
 - b. Source Limitations: Furnish associated fittings, accessories, and hardware produced by a single manufacturer.
- G. Thermal Insulated Pipe Supports:
1. Manufacturers:
 - a. Buckaroos, Inc.
 - b. KB Enterprises
 2. General Construction and Requirements:
 - a. Insulated pipe supports to be provided at hanger, support, and guide locations on pipe requiring insulation or additional support.
 - b. Surface Burning Characteristics: Flame spread index/smoke developed index of 5/30, maximum, when tested in accordance with ASTM E84 or UL 723.
 - c. Pipe supports to be provided for nominally sized, 1/2 inch to 30 inch iron pipes.
 - d. Insulation inserts to consist of rigid phenolic foam insulation surrounded by a 360 degree, PVC jacketing.
 3. PVC Jacket:
 - a. Pipe insulation protection shields to be provided with a ball bearing hinge and locking seam.

Section 4
Scope of Work and Technical Specifications

SECTION 23 05 29-6 HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

- b. Minimum Service Temperature: Minus 40 degrees F.
 - c. Maximum Service Temperature: 180 degrees F.
 - d. Moisture Vapor Transmission: 0.0071 perm inch, when tested in accordance with ASTM E96/E96M.
 - e. Thickness: 60 mil.
 - f. Connections: Brush on welding adhesive.
- 4. Pipe insulation protection shields to be provided at the hanger points and guide locations on pipes requiring insulation as indicated on drawings.
- 5. Products:
 - a. Buckaroos, Inc., or equal.
- H. Pipe Supports:
 - 1. Liquid Temperatures Up To 122 degrees F:
 - a. Overhead Support: MSS SP-58 Types 1, 3 through 12.
 - b. Support From Below: MSS SP-58 Types 35 through 38.
 - 2. Operating Temperatures from 122 to 446 degrees F:
 - a. Overhead Support: MSS SP-58 Type 1 or 3 through 12, with appropriate saddle of MSS SP-58 Type 40 for insulated pipe.
 - b. Roller Support: MSS SP-58 Types 41 or 43 through 46, with appropriate saddle of MSS SP-58 Type 39 for insulated pipe.
 - c. Sliding Support: MSS SP-58 Types 35 through 38.
- I. Pipe Stanchions: For pipe runs, use stanchions of same type and material where vertical adjustment is required for stationary pipe.
 - 1. Manufacturers:
 - a. Anvil International or equal
 - b. Source Limitations: Furnish channels (struts) and associated fittings, accessories, and hardware produced by a single manufacturer.
 - 2. Material: Malleable iron, ASTM A47/A47M; or carbon steel, ASTM A36/A36M.
 - 3. Provide coated or plated saddles to isolate steel hangers from dissimilar metal tube or pipe.

Section 4
Scope of Work and Technical Specifications
SECTION 23 05 29-7 HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

J. Beam Clamps: MSS SP-58 Types 19 through 23, 25 or 27 through 30 based on required load.

1. Manufacturers:
 - a. Ferguson Enterprises Inc., or equal
 - b. Source Limitations: Furnish channels (struts) and associated fittings, accessories, and hardware produced by a single manufacturer.
2. Material: ASTM A36/A36M carbon steel or ASTM A181/A181M forged steel.
3. Provide clamps with hardened steel cup-point set screws and lock-nuts for anchoring in place.

K. Riser Clamps:

1. Manufacturers:
 - a. Ferguson Enterprises Inc., or equal
 - b. Source Limitations: Furnish channels (struts) and associated fittings, accessories, and hardware produced by a single manufacturer.
2. Provide copper plated clamps for copper tubing support.
3. For insulated pipe runs, provide two bolt-type clamps designed for installation under insulation.

L. Offset Pipe Clamps: Double-leg design two-piece pipe clamp.

M. Strut Clamps: Two-piece pipe clamp.

1. Manufacturers:
 - a. Ferguson Enterprises Inc., or equal
 - b. Source Limitations: Furnish channels (struts) and associated fittings, accessories, and hardware produced by a single manufacturer.

N. Insulation Clamps: Two bolt-type clamps designed for installation under insulation.

1. Manufacturers:
 - a. Ferguson Enterprises Inc., or equal
 - b. Source Limitations: Furnish channels (struts) and associated fittings, accessories, and hardware produced by a single manufacturer.

O. Pipe Hangers: For a given pipe run, use hangers of the same type and material.

Section 4
Scope of Work and Technical Specifications

SECTION 23 05 29-8 HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

1. Manufacturers:
 - a. Ferguson Enterprises Inc., or equal
 - b. Source Limitations: Furnish channels (struts) and associated fittings, accessories, and hardware produced by a single manufacturer.
 2. Material: Malleable iron, ASTM A47/A47M; or carbon steel, ASTM A36/A36M.
 3. Provide coated or plated hangers to isolate steel hangers from dissimilar metal tube or pipe.
- P. Nonmetallic Pipe Hangers:
1. Manufacturers:
 - a. DecoShield Systems, Inc; Snap-2 Hangers
- Q. Intermediate Pipe Guides: Use pipe clamps with oversize pipe sleeve that provides clearance around pipe.
1. Manufacturers:
 - a. Anvil International
 - b. Source Limitations: Furnish channels (struts) and associated fittings, accessories, and hardware produced by a single manufacturer.
 2. Pipe Diameter 6 inches and Smaller: Provide minimum clearance of 0.16 inch.
 3. Pipe Diameter 8 inches: Provide U-bolts with double nuts providing minimum clearance of 0.28 inch.
 4. Pipe Diameter 8 inches: 0.625 inch U-bolt.
 5. Pipe Diameter 10 inches: 0.75 inch U-bolt.
 6. Pipe Diameter 12 to 16 inches: 0.875 inch U-bolt.
 7. Pipe Diameter 18 to 30 inches: 1 inch U-bolt.
- R. Pipe Alignment Guides: Galvanized steel.
1. Manufacturers:
 - a. Source Limitations: Furnish channels (struts) and associated fittings, accessories, and hardware produced by a single manufacturer.
 2. Pipe Diameter 8 inches and Smaller: Spider or sleeve type.
 3. Pipe Diameter 10 inches and Larger: Roller type.

Section 4
Scope of Work and Technical Specifications
SECTION 23 05 29-9 HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

4. Pipe Diameter 18 to 30 inches: 1 inch U-bolt.
- S. Dielectric Barriers: Provide between metallic supports and metallic piping and associated items of dissimilar type; acceptable dielectric barriers include rubber or plastic sheets or coatings attached securely to pipe or item.
- T. Pipe Shields for Insulated Piping:
1. Manufacturers:
 - a. Anvil International
 - b. Source Limitations: Furnish channels (struts) and associated fittings, accessories, and hardware produced by a single manufacturer.
 2. General Construction and Requirements:
 - a. Surface Burning Characteristics: Comply with ASTM E84 or UL 723.
 - b. Shields Material: UV-resistant polypropylene with glass fill.
 - c. Maximum Insulated Pipe Outer Diameter: 12-5/8 inch.
 - d. Minimum Service Temperature: Minus 40 degrees F.
 - e. Maximum Service Temperature: 178 degrees F.
 - f. Pipe shields to be provided at hanger, support, and guide locations on pipe requiring insulation or additional support.
- U. Anchors and Fasteners:
1. Manufacturers - Mechanical Anchors:
 - a. Hilti, Inc.
 - b. ITW Red Head, a division of Illinois Tool Works, Inc.
 - c. Powers Fasteners, Inc.
 - d. Simpson Strong-Tie Company Inc.
 2. Manufacturers - Powder-Actuated Fastening Systems:
 - a. Hilti, Inc.
 - b. ITW Ramset, a division of Illinois Tool Works, Inc.
 - c. Powers Fasteners, Inc.
 - d. Simpson Strong-Tie Company Inc.

Section 4
Scope of Work and Technical Specifications

SECTION 23 05 29-10 HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

3. Unless otherwise indicated and where not otherwise restricted, use the anchor and fastener types indicated for the specified applications.
4. Concrete: Use preset concrete inserts, expansion anchors, or screw anchors.
5. Solid or Grout-Filled Masonry: Use expansion anchors or screw anchors.
6. Hollow Masonry: Use toggle bolts.
7. Hollow Stud Walls: Use toggle bolts.
8. Steel: Use beam clamps, machine bolts, or welded threaded studs.
9. Sheet Metal: Use sheet metal screws.
10. Wood: Use wood screws.
11. Plastic and lead anchors are not permitted.
12. Preset Concrete Inserts: Continuous metal channel (strut) and spot inserts specifically designed to be cast in concrete ceilings, walls, and floors.
 - a. Comply with MFMA-4.
 - b. Channel Material: Use galvanized steel.
 - c. Manufacturer: Same as manufacturer of metal channel (strut) framing system.

V. Pipe Installation Accessories:

1. Copper Pipe Supports:
 - a. Manufacturers:
 - 1) HoldRite
2. Thermal Insulated Pipe Supports:
 - a. Manufacturers:
 - 1) HoldRite
3. Overhead Pipe Supports:
 - a. Manufacturers:
 - 1) HoldRite
4. Plenum Pipe Supports:
 - a. Manufacturers:

Section 4
Scope of Work and Technical Specifications

SECTION 23 05 29-11 HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

- 1) HoldRite
5. Telescoping Pipe Supports:
 - a. Manufacturers:
 - 1) HoldRite
 6. Inserts and Clamps:
 - a. Manufacturers:
 - 1) HoldRite

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that mounting surfaces are ready to receive support and attachment components.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Provide independent support from building structure. Do not provide support from piping, ductwork, conduit, or other systems.
- C. Unless specifically indicated or approved by Architect, do not provide support from suspended ceiling support system or ceiling grid.
- D. Unless specifically indicated or approved by Architect, do not provide support from roof deck.
- E. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.
- F. Field-Welding (where approved by Architect): Comply with Section 05 50 00.
- G. Provide thermal insulated pipe supports complete with hangers and accessories. Install thermal insulated pipe supports during the installation of the piping system.
- H. Equipment Support and Attachment:
 1. Use metal fabricated supports or supports assembled from metal channel (strut) to support equipment as required.

Section 4
Scope of Work and Technical Specifications

SECTION 23 05 29-12 HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

2. Use metal channel (strut) secured to studs to support equipment surface-mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.
 3. Use metal channel (strut) to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
 4. Unless otherwise indicated, mount floor-mounted equipment on properly sized 3 inch high concrete pad constructed in accordance with Section 03 30 00.
 5. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.
- I. Preset Concrete Inserts: Use manufacturer-provided closure strips to inhibit concrete seepage during concrete pour.
- J. Secure fasteners according to manufacturer's recommended torque settings.
- K. Remove temporary supports.
- 3.03 FIELD QUALITY CONTROL
- A. See Section 01 40 00 - Quality Requirements, for additional requirements.
- B. Inspect support and attachment components for damage and defects.
- C. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.
- D. Correct deficiencies and replace damaged or defective support and attachment components.

END OF SECTION

SECTION 23 05 53

IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Nameplates.
- B. Tags.
- C. Adhesive-backed duct markers.
- D. Stencils.
- E. Pipe markers.
- F. Ceiling tacks.

1.02 RELATED REQUIREMENTS

- A. Section 09 90 00 - Painting

1.03 REFERENCE STANDARDS

- A. ASME A13.1 - Scheme for the Identification of Piping Systems 2020.
- B. ASTM D709 - Standard Specification for Laminated Thermosetting Materials 2017.

1.04 SUBMITTALS

- A. See Section 01 33 00 - Submittal Procedures.
- B. List: Submit list of wording, symbols, letter size, and color coding for mechanical identification.
- C. Chart and Schedule: Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.
- D. Product Data: Provide manufacturers catalog literature for each product required.
- E. Manufacturer's Installation Instructions: Indicate special procedures, and installation.

PART 2 - PRODUCTS

2.01 IDENTIFICATION APPLICATIONS

- A. Air Handling Units: Nameplates.

Section 4
Scope of Work and Technical Specifications
SECTION 23 05 53-2 IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

- B. Control Panels: Nameplates.
- C. Dampers: Ceiling tacks, where located above lay-in ceiling.
- D. Instrumentation: Tags.
- E. Major Control Components: Nameplates.
- F. Piping: Tags.
- G. Relays: Tags.
- H. Thermostats: Nameplates.
- I. Valves: Tags and ceiling tacks where located above lay-in ceiling.

2.02 NAMEPLATES

- A. Manufacturers:
 - 1. Advanced Graphic Engraving, LLC.
 - 2. Brimar Industries, Inc.
 - 3. Craftmark Pipe Markers.
 - 4. Kolbi Pipe Marker Co.
 - 5. Seton Identification Products, a Tricor Direct Company.
- B. Letter Color: White.
- C. Letter Height: 1/4 inch.
- D. Background Color: Black.
- E. Plastic: Comply with ASTM D709.

2.03 TAGS

- A. Manufacturers:
 - 1. Advanced Graphic Engraving.
 - 2. Brady Corporation.
 - 3. Brimar Industries, Inc.
 - 4. Craftmark Pipe Markers.
 - 5. Kolbi Pipe Marker Co.
 - 6. Seton Identification Products, a Tricor Company.

Section 4
Scope of Work and Technical Specifications
SECTION 23 05 53-3 IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

- B. Plastic Tags: Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2 inch diameter.
- C. Metal Tags: Brass with stamped letters; tag size minimum 1-1/2 inch diameter with smooth edges.
- D. Valve Tag Chart: Typewritten letter size list in anodized aluminum frame.

2.04 STENCILS

- A. Manufacturers:
 - 1. Brady Corporation.
 - 2. Craftmark Pipe Markers.
 - 3. Insite Solutions, LLC.
 - 4. Kolbi Pipe Marker Co.
 - 5. Seton Identification Products, a Tricor Company.
- B. Stencils: With clean cut symbols and letters of following size:
 - 1. 3/4 to 1-1/4 inch Outside Diameter of Insulation or Pipe: 8 inch long color field, 1/2 inch high letters.
 - 2. 1-1/2 to 2 inch Outside Diameter of Insulation or Pipe: 8 inch long color field, 3/4 inch high letters.
 - 3. 2-1/2 to 6 inch Outside Diameter of Insulation or Pipe: 12 inch long color field, 1-1/4 inch high letters.
 - 4. 8 to 10 inch Outside Diameter of Insulation or Pipe: 24 inch long color field, 2-1/2 inch high letters.
 - 5. Over 10 inch Outside Diameter of Insulation or Pipe: 32 inch long color field, 3-1/2 inch high letters.
 - 6. Equipment: 2-1/2 inch high letters.
- C. Stencil Paint: Semi-gloss enamel, colors complying with ASME A13.1.

2.05 PIPE MARKERS

- A. Manufacturers:
 - 1. Brady Corporation.
 - 2. Brimar Industries, Inc.
 - 3. Craftmark Pipe Markers.

Section 4
Scope of Work and Technical Specifications
SECTION 23 05 53-4 IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

- 4. Kolbi Pipe Marker Co
 - 5. Seton Identification Products, a Tricor Company.
 - B. Color: Comply with ASME A13.1.
 - C. Plastic Pipe Markers: Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.
 - D. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.
 - E. Color code as follows:
 - 1. Heating, Cooling, and Boiler Feedwater: Green with white letters.
- 2.06 CEILING TACKS
- A. Description: Steel with 3/4 inch diameter color coded head.
 - B. Color code as follows:
 - 1. HVAC Equipment: Yellow.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.
- B. Prepare surfaces for stencil painting.

3.02 INSTALLATION

- A. Install nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.
- B. Install tags with corrosion resistant chain.
- C. Install plastic pipe markers in accordance with manufacturer's instructions.
- D. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.
- E. Use tags on piping 3/4 inch diameter and smaller.
 - 1. Identify service, flow direction, and pressure.
 - 2. Install in clear view and align with axis of piping.

Section 4
Scope of Work and Technical Specifications

SECTION 23 05 53-5 IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

3. Locate identification not to exceed 20 feet on straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or enclosure, and at each obstruction.

END OF SECTION

Section 4
Scope of Work and Technical Specifications
SECTION 23 05 93-1 TESTING, ADJUSTING, AND BALANCING FOR ODOR CONTROL

SECTION 23 05 93

TESTING, ADJUSTING, AND BALANCING FOR ODOR CONTROL

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Testing, adjustment, and balancing of air systems.
- B. Measurement of final operating condition of Odor Control systems.
- C. Sound measurement of equipment operating conditions.
- D. Vibration measurement of equipment operating conditions.

1.02 REFERENCE STANDARDS

- A. AABC (NSTSB) - AABC National Standards for Total System Balance, 7th Edition 2016.
- B. ASHRAE Std 111 - Measurement, Testing, Adjusting, and Balancing of Building HVAC Systems 2008 (Reaffirmed 2017).
- C. NEBB (TAB) - Procedural Standards for Testing Adjusting and Balancing of Environmental Systems 2015, with Errata (2017).
- D. SMACNA (TAB) - HVAC Systems Testing, Adjusting and Balancing 2002.

1.03 SUBMITTALS

- A. See Section 01 33 00 - Submittal Procedures.
- B. Installer Qualifications: Submit name of adjusting and balancing agency and TAB supervisor for approval within 30 days after award of Contract.
- C. TAB Plan: Submit a written plan indicating the testing, adjusting, and balancing standard to be followed and the specific approach for each system and component.
 - 1. Submit six weeks prior to starting the testing, adjusting, and balancing work.
 - 2. Include certification that the plan developer has reviewed Contract Documents, the equipment and systems, and the control system with the Architect and other installers to sufficiently understand the design intent for each system.
 - 3. Include at least the following in the plan:
 - a. Preface: An explanation of the intended use of the control system.

Section 4
Scope of Work and Technical Specifications

SECTION 23 05 93-2 TESTING, ADJUSTING, AND BALANCING FOR ODOR CONTROL

- b. List of all air flow, water flow, sound level, system capacity and efficiency measurements to be performed and a description of specific test procedures, parameters, formulas to be used.
 - c. Copy of field checkout sheets and logs to be used, listing each piece of equipment to be tested, adjusted and balanced with the data cells to be gathered for each.
 - d. Identification and types of measurement instruments to be used and their most recent calibration date.
 - e. Discussion of what notations and markings will be made on the duct and piping drawings during the process.
 - f. Final test report forms to be used.
 - g. Detailed step-by-step procedures for TAB work for each system and issue, including:
 - 1) Terminal flow calibration (for each terminal type).
 - 2) Branch/submain proportioning.
 - 3) Total flow calculations.
 - 4) Rechecking.
 - 5) Diversity issues.
 - h. Criteria for using air flow straighteners or relocating flow stations and sensors.
 - i. Details of how TOTAL flow will be determined; for example:
 - 1) Air: Sum of terminal flows via control system calibrated readings of all terminals.
 - j. Proposed selection points for sound measurements and sound measurement methods.
 - k. Procedures for field technician logs of discrepancies, deficient or uncompleted work by others, contract interpretation requests and lists of completed tests (scope and frequency).
 - l. Procedures for formal deficiency reports, including scope, frequency and distribution.
- D. Final Report: Indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.

Section 4
Scope of Work and Technical Specifications

SECTION 23 05 93-3 TESTING, ADJUSTING, AND BALANCING FOR ODOR CONTROL

1. Revise TAB plan to reflect actual procedures and submit as part of final report.
 2. Submit draft copies of report for review prior to final acceptance of Project. Provide final copies for Architect and for inclusion in operating and maintenance manuals.
 3. Provide reports in soft cover, letter size, 3-ring binder manuals, complete with index page and indexing tabs, with cover identification at front and side. Include set of reduced drawings with air outlets and equipment identified to correspond with data sheets, and indicating thermostat locations.
 4. Include actual instrument list, with manufacturer name, serial number, and date of calibration.
 5. Form of Test Reports: Where the TAB standard being followed recommends a report format use that; otherwise, follow ASHRAE Std 111.
 6. Units of Measure: Report data in both I-P (inch-pound) and SI (metric) units.
 7. Include the following on the title page of each report:
 - a. Name of Testing, Adjusting, and Balancing Agency.
 - b. Address of Testing, Adjusting, and Balancing Agency.
 - c. Telephone number of Testing, Adjusting, and Balancing Agency.
 - d. Project name.
 - e. Project location.
 - f. Project Engineer.
 - g. Project Contractor.
 - h. Project altitude.
 - i. Report date.
- E. Project Record Documents: Record actual locations of flow measuring stations and balancing valves and rough setting.

PART 2 - PRODUCTS

PART 3 - EXECUTION

3.01 GENERAL REQUIREMENTS

- A. Perform total system balance in accordance with one of the following:

Section 4
Scope of Work and Technical Specifications

SECTION 23 05 93-4 TESTING, ADJUSTING, AND BALANCING FOR ODOR CONTROL

1. AABC (NSTSB), AABC National Standards for Total System Balance.
 2. ASHRAE Std 111, Practices for Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation, Air-Conditioning, and Refrigeration Systems.
 3. SMACNA (TAB).
 4. Maintain at least one copy of the standard to be used at project site at all times.
- B. Begin work after completion of systems to be tested, adjusted, or balanced and complete work prior to Substantial Completion of the project.
- C. Where HVAC systems and/or components interface with life safety systems, including fire and smoke detection, alarm, and control, coordinate scheduling and testing and inspection procedures with the authorities having jurisdiction.
- D. TAB Agency Qualifications:
1. Company specializing in the testing, adjusting, and balancing of systems specified in this section.
 2. Having minimum of five years of documented experience.
 3. Certified by one of the following:
 - a. AABC, Associated Air Balance Council
 - b. NEBB, National Environmental Balancing Bureau
 - c. TABB, The Testing, Adjusting, and Balancing Bureau of National Energy Management Institute: www.tabbcertified.org/#sle.
- E. TAB Supervisor and Technician Qualifications: Certified by same organization as TAB agency.

3.02 EXAMINATION

- A. Verify that systems are complete and operable before commencing work. Ensure the following conditions:
1. Systems are started and operating in a safe and normal condition.
 2. Temperature control systems are installed complete and operable.
 3. Proper thermal overload protection is in place for electrical equipment.
 4. Filters are clean and in place.
 5. Duct systems are clean of debris.
 6. Fans are rotating correctly.

Section 4
Scope of Work and Technical Specifications

SECTION 23 05 93-5 TESTING, ADJUSTING, AND BALANCING FOR ODOR CONTROL

7. Volume dampers are in place and open.
8. Access doors are closed and duct end caps are in place.
9. Air outlets are installed and connected.
10. Duct system leakage is minimized.

B. Submit field reports. Report defects and deficiencies that will or could prevent proper system balance.

C. Beginning of work means acceptance of existing conditions.

3.03 PREPARATION

A. Hold a pre-balancing meeting at least one week prior to starting TAB work.

1. Require attendance by all installers whose work will be tested, adjusted, or balanced.

B. Provide instruments required for testing, adjusting, and balancing operations. Make instruments available to Architect to facilitate spot checks during testing.

C. Provide additional balancing devices as required.

3.04 ADJUSTMENT TOLERANCES

A. Adjust to within plus or minus 5 percent of design airflows.

3.05 RECORDING AND ADJUSTING

A. Field Logs: Maintain written logs including:

1. Running log of events and issues.
2. Discrepancies, deficient or uncompleted work by others.
3. Contract interpretation requests.
4. Lists of completed tests.

B. Ensure recorded data represents actual measured or observed conditions.

C. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.

D. Mark on drawings the locations where traverse and other critical measurements were taken and cross reference the location in the final report.

E. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.

Section 4
Scope of Work and Technical Specifications

SECTION 23 05 93-6 TESTING, ADJUSTING, AND BALANCING FOR ODOR CONTROL

F. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

G. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by the Owner.

H. Check and adjust systems approximately six months after final acceptance and submit report.

3.06 AIR SYSTEM PROCEDURE

A. Make air quantity measurements in ducts by Pitot tube traverse of entire cross sectional area of duct.

B. Measure air quantities at air inlets and outlets.

C. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.

D. Use volume control devices to regulate air quantities only to extend that adjustments do not create objectionable air motion or sound levels. Effect volume control by duct internal devices such as dampers and splitters.

E. Vary total system air quantities by adjustment of fan speeds. Provide drive changes required. Vary branch air quantities by damper regulation.

F. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.

3.07 SCOPE

A. Test, adjust, and balance the following:

1. Odor Control Systems

3.08 MINIMUM DATA TO BE REPORTED

A. Electric Motors:

1. Manufacturer.
2. Model/Frame.
3. HP/BHP.
4. Phase, voltage, amperage; nameplate, actual, no load.
5. RPM.
6. Service factor.
7. Starter size, rating, heater elements.

Section 4
Scope of Work and Technical Specifications

SECTION 23 05 93-7 TESTING, ADJUSTING, AND BALANCING FOR ODOR CONTROL

8. Sheave Make/Size/Bore.
- B. V-Belt Drives:
1. Identification/location.
 2. Required driven RPM.
 3. Driven sheave, diameter and RPM.
 4. Belt, size and quantity.
 5. Motor sheave diameter and RPM.
 6. Center to center distance, maximum, minimum, and actual.
- C. Exhaust Fans:
1. Location.
 2. Manufacturer.
 3. Model number.
 4. Serial number.
 5. Air flow, specified and actual.
 6. Total static pressure (total external), specified and actual.
 7. Inlet pressure.
 8. Discharge pressure.
 9. Sheave Make/Size/Bore.
 10. Number of Belts/Make/Size.
 11. Fan RPM.
- D. Mist Eliminator:
1. Location.
 2. Manufacturer.
 3. Model number.
 4. Serial number.
 5. Area
 6. Design Velocity
 7. Test Velocity

Section 4
Scope of Work and Technical Specifications

SECTION 23 05 93-8 TESTING, ADJUSTING, AND BALANCING FOR ODOR CONTROL

8. Design Air flow.
 9. Test Air flow
 10. Pressure at the Inlet.
 11. Pressure at Outlet.
 12. Pressure Drop.
- E. Sound Level Reports:
1. Location.
 2. Octave bands - equipment off.
 3. Octave bands - equipment on.
- END OF SECTION

SECTION 26 05 02

BASIC ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.01 SUMMARY

A. Requirements specified within this section apply to Division 26, Electrical. Work specified herein shall be performed as if specified in the individual sections.

B. Summary of work:

The project consists of electrical work for a new sanitary sewer lift station and force main as shown on the drawings. Major elements of the work include, but are not limited to the following:

1. Provide, install, and test one (1) new 480/277V, 3Ph Switchboard (SWBD-1)
2. Provide, install, and test one (1) new 450kW diesel Generator. Diesel generator shall include 72-hr rated sub-base fuel tank, weather protection enclosure, electrical connections for block heater and battery charger.
3. Provide, install, and test various standalone adjustable frequency drives, Control Panels, Starters as shown on the drawings.
4. Provide, install, and test various electrical components, such as dry-type transformers, panelboards, etc. as shown on the drawings.
5. Provide and install new site lighting around process equipment as shown on the design drawings.
6. Provide, install and test grounding system shown on drawings.
7. Provide and install a complete electrical system to provide power to the new odor control system, in ground water well, and eye wash station.
8. Provide and install electrical raceways shown on drawings.

1.02 ACTION SUBMITTALS

A. Provide Data For:

1. Electrical service components.
2. Internet service components.
3. Nameplates, signs, and labels.

B. Provide preliminary submittal for sequence of construction 14 days in advance of coordination meeting. Preliminary submittal shall include items listed in special project requirements.

1.03 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. National Electrical Contractors Association (NECA): National Electrical Installation Standards.
2. National Electrical Manufacturers Association (NEMA):
 - a. 250, Enclosures for Electrical Equipment (1,000 Volts Maximum).
 - b. Z535.4, Product Safety Signs and Labels.
3. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).
4. Underwriters Laboratories, Inc. (UL).

1.04 QUALITY ASSURANCE

A. Provide the Work in accordance with NFPA 70. Where required by Authority Having Jurisdiction (AHJ), material and equipment shall be labeled or listed by a nationally recognized testing laboratory or other organization acceptable to the AHJ, in order to provide a basis for approval under the NEC.

B. Materials and equipment manufactured within the scope of standards published by Underwriters Laboratories Inc. shall conform to those standards and shall have an applied UL listing mark or label.

C. Provide materials and equipment acceptable to AHJ for Class, Division, and Group of hazardous area indicated.

PART 2 - PRODUCTS

2.01 GENERAL

A. Where two or more units of the same class of material or equipment are required, provide products of a single manufacturer. Component parts of materials or equipment need not be products of the same manufacturer.

B. Material and equipment installed in heated and ventilated areas shall be capable of continuous operation at their specified ratings within an ambient temperature range of 40 degrees F to 104 degrees F.

C. Materials and equipment installed outdoors shall be capable of continuous operation at their specified rating within the site ambient temperature range.

2.02 EQUIPMENT FINISH

- A. Manufacturer's standard finish color, except where specific color is indicated. If manufacturer has no standard color, finish equipment in accordance with, light gray color finish as approved by Owner.

2.03 NAMEPLATES

- A. Material: Laminated plastic.
- B. Attachment Screws: Stainless steel.
- C. Color: White, engraved to a black core.
- D. Letter Height:
 - 1. Pushbuttons/Selector Switches: 1/8 inch.
 - 2. Other electrical equipment: 1/4 inch.

2.04 SIGNS AND LABELS

- A. Sign size, lettering, and color shall be in accordance with NEMA Z535.4.

PART 3 - EXECUTION

3.01 GENERAL

- A. Electrical Drawings show general locations of equipment, devices, and raceway, unless specifically dimensioned. Contractor shall be responsible for actual location of equipment and devices and for proper routing and support of raceways, subject to approval of Engineer.
- B. Check approximate locations of light fixtures, switches, electrical outlets, equipment, and other electrical system components shown on Drawings for conflicts with openings, structural members, and components of other systems and equipment having fixed locations. In the event of conflicts, notify Engineer in writing.
- C. Install work in accordance with NECA Standard of Installation, unless otherwise specified.
- D. Keep openings in boxes and equipment closed during construction.
- E. Lay out work carefully in advance. Do not cut or notch any structural member or building surface without specific approval of Engineer. Carefully perform cutting, channeling, chasing, or drilling of floors, walls, partitions, ceilings, paving, or other surfaces required for the installation, support, or anchorage of conduit, raceways, or other electrical materials and equipment. Following such work, restore surfaces to original condition.

3.02 ANCHORING AND MOUNTING

Section 4
Scope of Work and Technical Specifications
SECTION 26 05 02-4 BASIC ELECTRICAL REQUIREMENTS

A. Equipment anchoring and mounting shall be in accordance with manufacturer's requirements.

3.03 COMBINING CIRCUITS INTO COMMON RACEWAY

A. Homerun circuits shown on Drawings indicate functional wiring requirements for power and control circuits. Circuits may be combined into common raceways in accordance with the following requirements:

1. Analog control circuits from devices in same general area to same destination.
 - a. No power or AC discrete control circuits shall be combined in same conduit with analog circuits.
 - b. No Class 2 or Class 3 circuits including, but not limited to, HVAC control circuits, fire alarm circuits, paging system circuits shall be combined with power or Class 1 circuits.
 - c. Analog circuits shall be continuous from source to destination. Do not add TJB, splice, or combine into a multi-pair cable without authorization of Engineer.
 - d. Raceways: shall be sized per General Circuit and Raceway Schedule and do not exceed 40 percent fill or National Electrical Code requirements.
 - e. Changes shall be documented on Record Drawings.
2. Discrete control circuits from devices in the same general area to the same destination.
 - a. No power or analog control circuits shall be combined in same conduit with discrete circuits.
 - b. No Class 2 or Class 3 circuits including, but not limited to, HVAC control circuits, fire alarm circuits, and paging system circuits shall be combined with power or Class 1 circuits.
 - c. Raceways shall be sized per the General Circuit and Raceway Schedule and do not exceed 40 percent fill or National Electrical Code requirements.
 - d. Changes shall be documented on Record Drawings.
3. Power circuits from loads in same general area to same source location (such as: panelboard, switchboard, low voltage motor control center).

Section 4
Scope of Work and Technical Specifications
SECTION 26 05 02-5 BASIC ELECTRICAL REQUIREMENTS

- a. Lighting Circuits: Combine no more than three circuits to a single raceway. Contractor shall be responsible for increasing conduit and conductor size if derating is required by NEC.
- b. Receptacle Circuits, 120-Volt Only: Combine no more than three circuits to a single raceway. Provide a separate neutral conductor for each circuit. Contractor shall be responsible for increasing conduit and conductor size if derating is required by NEC.
- c. All Other Power Circuits: Do not combine power circuits without authorization of Engineer.

3.04 NAMEPLATES, SIGNS, AND LABELS

- A. Arc Flash Protection Warning Signs:
 - 1. Field mark Switchgear, switchboards, motor control centers, and panelboards to warn qualified persons of potential arc-flash hazards. Locate marking so to be clearly visible to persons before working on energized equipment.
 - 2. Use arc flash hazard boundary, energy level, PPE level and description, shock hazard, bolted fault current, and equipment name from study required in Section 26 05 74, Arc Flash Study as basis for warning signs.
- B. Equipment Nameplates:
 - 1. Provide a nameplate to label electrical equipment including switchgear, switchboards, motor control centers, panelboards, motor starters, transformers, terminal junction boxes, disconnect switches, switches and control stations.
 - 2. Switchgear, motor control center, transformer, and terminal junction box nameplates shall include equipment designation.
 - 3. Disconnect switch, starter, and control station nameplates shall include name and number of equipment powered or controlled by that device.
 - 4. Switchboard and panelboard nameplates shall include equipment designation, service voltage, and phases.

3.05 LOAD BALANCE

- A. Drawings and Specifications indicate circuiting to electrical loads and distribution equipment.
- B. Balance electrical load between phases as nearly as possible on switchboards, panelboards, motor control centers, and other equipment where balancing is required.

Section 4
Scope of Work and Technical Specifications
SECTION 26 05 02-6 BASIC ELECTRICAL REQUIREMENTS

C. When loads must be reconnected to different circuits to balance phase loads, maintain accurate record of changes made, and provide circuit directory that lists final circuit arrangement.

3.06 CLEANING AND TOUCHUP PAINTING

A. Cleaning: Throughout the Work, clean interior and exterior of devices and equipment by removing debris and vacuuming. Includes all electrical gear and cabinets.

B. Touchup Paint:

1. Touchup scratches, scrapes and chips on exterior and interior surfaces of devices and equipment with finish matching type, color, and consistency and type of surface of original finish.
2. If extensive damage is done to equipment paint surfaces, refinish entire equipment in a manner that provides a finish equal to or better than factory finish, that meets requirements of Specification, and is acceptable to Engineer.

3.07 PROTECTION FOLLOWING INSTALLATION

A. Protect materials and equipment from corrosion, physical damage, and effects of moisture on insulation and contact surfaces.

B. When equipment intended for indoor installation is installed at Contractor's convenience in areas where subject to dampness, moisture, dirt or other adverse atmosphere until completion of construction, ensure adequate protection from these atmospheres is provided and acceptable to Engineer.

END OF SECTION

SECTION 26 05 04

BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.01 SUMMARY

- A. This section includes basic materials and methods common to all sections of Division 26

1.02 ACTION SUBMITTALS

- A. Product Data For:
 - 1. Control devices.
 - 2. Control relays.
 - 3. Circuit breakers.
 - 4. Fused switches.
 - 5. Nonfused switches.
 - 6. Timers.
 - 7. Fuses.
 - 8. Enclosures: Include enclosure data for products having enclosures.

1.03 EXTRA MATERIALS

- A. Furnish, tag, and box for shipment and storage the following spare parts and special tools:
 - 1. Fuses, 0 to 600 Volts: Six of each type and each current rating installed.

1.04 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. ASTM International (ASTM):
 - a. A167, Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
 - b. A1011/A1011M, Standard Specification for Steel, Sheet, and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low Alloy and High-Strength Low Alloy with Improved Formability and Ultra-High Strength.
 - c. E814 Standard Test Method for Fire Tests of Penetration Firestop Systems.

Section 4
Scope of Work and Technical Specifications
SECTION 26 05 04-2 BASIC ELECTRICAL MATERIALS AND METHODS

2. Canadian Standards Association (CSA).
3. Institute of Electrical and Electronics Engineers, Inc. (IEEE): 18, Standard for Shunt Power Capacitors.
4. Instrumentation, Systems, and Automation Society (ISA): RP12.06.01, Wiring Practices for Hazardous (Classified) Locations Instrumentation–Part 1: Intrinsic Safety.
5. National Electrical Manufacturers Association (NEMA):
 - a. 250, Enclosures for Electrical Equipment (1,000 Volts Maximum).
 - b. AB 1, Molded Case Circuit Breakers, Molded Case Switches, and Circuit-Breaker Enclosures.
 - c. C12.1 Code for Electricity Metering
 - d. C12.6 Phase-Shifting Devices Used in Metering, Marking and Arrangement of Terminals
 - e. CP 1, Shunt Capacitors.
 - f. ICS 2 Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts.
 - g. ICS 5, Industrial Control and Systems: Control Circuit and Pilot Devices.
 - h. KS 1 Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum)
6. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).
7. Underwriters Laboratories Inc. (UL):
 - a. 98, Standard for Enclosed and Dead-Front Switches.
 - b. 248, Standard for Low Voltage Fuses.
 - c. 486E, Standard for Equipment Wiring Terminals for use with Aluminum and/or Copper Conductors.
 - d. 489, Standard for Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit Breaker Enclosures.
 - e. 508, Standard for Industrial Control Equipment.
 - f. 810, Standard for Capacitors.
 - g. 943, Standard for Ground-Fault Circuit-Interrupters.

- h. 1059, Standard for Terminal Blocks.
- i. 1479, Standard for Fire Tests of Penetration Firestops.

PART 2 - PRODUCTS

2.01 MOLDED CASE CIRCUIT BREAKER THERMAL MAGNETIC, LOW VOLTAGE

- A. General:
 - 1. Type: Molded case.
 - 2. Trip Ratings: 15-800 amps.
 - 3. Voltage Ratings: 120, 240, 277, 480, and 600V ac.
 - 4. Suitable for mounting and operating in any position.
 - 5. NEMA AB 1 and UL 489.
- B. Operating Mechanism:
 - 1. Overcenter, trip-free, toggle type handle.
 - 2. Quick-make, quick-break action.
 - 3. Locking provisions for padlocking breaker in open position.
 - 4. ON/OFF and TRIPPED indicating positions of operating handle.
 - 5. Operating handle to assume a center position when tripped.
- C. Trip Mechanism:
 - 1. Individual permanent thermal and magnetic trip elements in each pole.
 - 2. Variable magnetic trip elements with a single continuous adjustment 3X to 10X for frames greater than 100 amps.
 - 3. Two and three pole, common trip.
 - 4. Automatically opens all poles when overcurrent occurs on one pole.
 - 5. Test button on cover.
 - 6. Calibrated for 40 degrees C ambient, unless shown otherwise.
 - 7. Do not provide single-pole circuit breakers with handle ties where multi-pole circuit breakers are shown.
- D. Short Circuit Interrupting Ratings:
 - 1. Equal to, or greater than, available fault current or interrupting rating shown.

Section 4
Scope of Work and Technical Specifications
SECTION 26 05 04-4 BASIC ELECTRICAL MATERIALS AND METHODS

2. Equal to rating of existing equipment.
 3. Not less than the following RMS symmetrical currents for the indicated trip ratings:
 - a. Up to 100A, less than 250V ac: 14000 amps.
 - b. Up to 100A, 250-600V ac: 22,000 amps.
 - c. Over 100A: 65,000 amps.
 4. Series Connected Ratings: Do not apply series connected short circuit.
- E. Ground Fault Circuit Interrupter (GFCI): Where indicated, equip breaker as specified above with ground fault sensor and rated to trip on 5-mA ground fault within 0.025 second (UL 943, Class A sensitivity, for protection of personnel).
1. Ground fault sensor shall be rated same as circuit breaker.
 2. Push-to-test button.
- F. Equipment Ground Fault Interrupter (EGFI): Where indicated, equip breaker specified above with ground fault sensor and rated to trip on 30-mA ground fault (UL-listed for equipment ground fault protection).
- G. Magnetic Only Type Breakers: Where shown; instantaneous trip adjustment which simultaneously sets magnetic trip level of each individual pole continuously through a 3X to 10X trip range.
- H. Connections:
1. Supply (line side) at either end.
 2. Mechanical wire lugs, except crimp compression lugs where shown.
 3. Lugs removable/replaceable for breaker frames greater than 100 amperes.
 4. Suitable for 75 degrees C rated conductors without derating breaker or conductor ampacity.
 5. Use bolted bus connections, except where bolt-on is not compatible with existing breaker provisions.
- I. Enclosures for Independent Mounting:
1. See Article Enclosures.
 2. Service Entrance Use: Breakers in required enclosure and required accessories shall be UL 489 listed.

3. Interlock: Enclosure and switch shall interlock to prevent opening cover with switch in the ON position. Provide bypass feature for use by qualified personnel.

2.02 DISCONNECT SWITCHES

- A. Disconnect Switches: UL-98 and NEMA KS-1; heavy duty, quick make, quick break type; horsepower and i2t rated. Provide lever type operating handle directly connected to the switch mechanism; rocker types are not acceptable. Include padlocking provisions and nameplate clearly indicating "ON" and "OFF" positions. Equip all switches with a ground lug and, where neutral conductors are scheduled, provide insulated neutral lugs.
- B. Fusible Switches: Equip with rejection clips for fuse types noted. Fuses shall be Class R, J, or L where required with 200,000A short circuit rating.
- C. Connections:
 1. Mechanical lugs, except crimp compression lugs where shown.
 2. Lugs removable/replaceable.
 3. Suitable for 75 degrees C rated conductors at NEC 75 degrees C ampacity.
- D. Enclosures: As indicated on the drawings.
- E. Interlock: Enclosure and switch to prevent opening cover with switch in ON position. Provide bypass feature for use by qualified personnel.
- F. Acceptable Manufacturers: Eaton, General Electric/ABB, Square D or Siemens.
- G. Hazardous Areas: Where Division 1 or 2 classified areas are indicated, provide switches equal to Crouse-Hinds type FLS.

2.03 FUSES

- A. Fuses: Current limiting, non-renewable type, rated 200,000 AIC, with rejection feature; Class J or as required by load for ratings 600 amp and below and Class L for ratings 601 amp and above.
- B. Acceptable Manufacturers: Bussmann, Chase-Shawmut, or Littelfuse.

2.04 WIRING DEVICES

- A. Wall Switches: NEMA WD 1; FS W S 896; 20 amp, 120/277 volt, specification grade; horsepower rated; quiet type; back and side wiring provisions; toggle handle.
- B. Convenience Receptacles: NEMA WD 1; FS W C 596; 15 amp, 125 volt, specification grade; impact resistant nylon face; back and side wiring provisions; grounding screw. Where CR or NEMA 4X is indicated, provide corrosion resistant

Section 4
Scope of Work and Technical Specifications
SECTION 26 05 04-6 BASIC ELECTRICAL MATERIALS AND METHODS

receptacle, yellow nylon body, one-piece brass contacts. Exception: Provide 5-20R receptacles for branch circuits serving one device.

C. Specific Use Receptacles: NEMA WD 1 or WD 5; type as indicated. For branch circuits serving a single device, match device rating to branch circuit rating.

D. Receptacle, Ground Fault Interrupter: Duplex, specification grade, tripping at 5-milliamperes; 125-volt, configuration 5-20R.

E. Device Colors: Gray, unless otherwise selected by the Architect for specific use devices.

F. Indoor Device Plates: Type 302 stainless steel, 0.030 inch thick minimum, satin finish.

G. Indoor Corrosion Resistant (NEMA 4X) Cover Plates: Type 302 stainless steel, specification grade, gasketed, with silicone rubber mat, equal to Pass & Seymour 4515 or 4515FS for toggle switches. Cast aluminum, gasketed, equal to Pass & Seymour CA Series receptacles. For devices which are continuously plugged in, provide cast aluminum, suitable for wet locations while-in-use, equal to Hubbell WP26.

H. Outdoor Weatherproof (NEMA 3R and NEMA 4X) Cover Plates: Stainless steel, specification grade, gasketed equal to Sierra WP Series. For heat tape, instruments, or other devices which are continuously plugged in, provide die cast aluminum, suitable for wet locations while in use, equal to Hubbell WP26.

2.05 INDIVIDUAL MOTOR STARTERS

A. Manual Starters: NEMA ICS-2; general purpose type; trip-free mechanism; with overload relays. Provide pushbutton operation for integral horsepower sizes, and toggle switch or lever for fractional sizes.

B. Magnetic Starters: NEMA ICS-2; NEMA size 1 minimum; magnetically held contactor with field replaceable coil and contacts; solid state overload relay, manually reset. Starter shall be rated in accordance with NEMA size designations; fractional sizes and ratings per IEC recommendations are not acceptable.

C. Magnetic Starter Controls: All controls are 120 volts. Equip each starter with a control power transformer fused on the primary and secondary. Provide starter overload relay auxiliary contacts for red run light, green stop light and amber overload light on the enclosure door. Provide one spare normally open starter auxiliary contact, and door mounted start-stop pushbuttons or hand-off-auto selector switch as indicated.

D. Combination Starters: Molded case circuit breaker rated 22,000 AIC as a minimum or:

1. Equal to, or greater than, available fault current or interrupting rating shown.

Section 4
Scope of Work and Technical Specifications
SECTION 26 05 04-7 BASIC ELECTRICAL MATERIALS AND METHODS

- E. Enclosure: As shown on the drawings.
- F. Acceptable Manufacturers: Allen-Bradley, Eaton, General Electric/ABB, Siemens or Square D.
- G. Hazardous Areas: Where Division 1 or 2 classified areas are indicated, provide starters equal to Crouse-Hinds types EPC, EMG, EMN, or EFS/EFD.

2.06 CONTACTORS

- A. Control Relays: NEMA A600; heavy duty, machine tool type convertible contacts; electrically held 120 volt coil. Equal to Allen-Bradley Bulletin 700 Type P.
- B. General Purpose Contactors: NEMA ICS-2; electrically held; 2-wire control; 120 volt coil. Size and number of contacts as indicated.
- C. Lighting Contactors: NEMA ICS-2; mechanically held; 3 wire control; 120 volt coil. Size and number of contacts as indicated.
- D. Enclosure: NEMA ICS-6; Type 1 unless otherwise noted.
- E. Acceptable Manufacturers: General Electric, Square D, ASCO, or Cutler-Hammer.

2.07 CONTROL STATIONS

- A. Pushbuttons, Selectors and Pilot Lights: 600 volt, heavy duty, factory sealed.
- B. Enclosure: Stainless steel meeting NEMA 4X and NEC Class I, Division 2, Group C and D requirements.
- C. Acceptable Manufacturers: Equal to Allen-Bradley Bulletin 800T.
- D. Hazardous Areas: Where Division 1 classified areas are indicated, provide control stations equal to Crouse-Hinds EFS/EFD series.

2.08 SUPPORT AND FRAMING CHANNELS

- A. Carbon Steel Framing Channel:
 - 1. Material: Rolled, mild strip steel, 12-gauge minimum, ASTM A1011/A1011M, Grade 33.
 - 2. Finish: Hot-dip galvanized after fabrication.
- B. Paint Coated Framing Channel: Carbon steel framing channel with electro-deposited rust inhibiting acrylic or epoxy paint.
- C. PVC Coated Framing Channel: Carbon steel framing channel with 40-mil polyvinyl chloride coating.

Section 4
Scope of Work and Technical Specifications
SECTION 26 05 04-8 BASIC ELECTRICAL MATERIALS AND METHODS

- D. Stainless Steel Framing Channel: Rolled, ASTM A167, Type 316 stainless steel, 12-gauge minimum.
- E. Extruded Aluminum Framing Channel:
 - 1. Material: Extruded from Type 6063-T6 aluminum alloy.
 - 2. Fittings fabricated from Alloy 5052-H32.
- F. Nonmetallic Framing Channel:
 - 1. Material: Fire retardant, fiber reinforced vinyl ester resin.
 - 2. Channel fitting of same material as channel.
 - 3. Nuts and bolts of long glass fiber reinforced polyurethane.
- G. Manufacturers:
 - 1. B-Line Systems, Inc.
 - 2. Unistrut Corp.
 - 3. Aickinstrut.

2.09 ENCLOSURES

- A. Finish: Sheet metal structural and enclosure parts shall be completely painted using an electrode position process so interior and exterior surfaces as well as bolted structural joints have a complete finish coat on and between them.
- B. Color: Manufacturer's standard color (gray) baked-on enamel, unless otherwise shown.
- C. Barriers: Provide metal barriers within enclosures to separate wiring of different systems and voltage.

PART 3 - EXECUTION

3.01 GENERAL

- A. Install equipment in accordance with manufacturer's recommendations.

3.02 PUSHBUTTON, INDICATING LIGHT, AND SELECTOR SWITCH

- A. Unless otherwise shown, install heavy-duty, oil-tight type in nonhazardous, indoor, dry locations, including motor control centers, control panels, and individual stations.
- B. Unless otherwise shown, install heavy-duty, watertight and corrosion-resistant type in nonhazardous, outdoor, or normally wet areas.

3.03 SUPPORT AND FRAMING CHANNEL

Section 4
Scope of Work and Technical Specifications
SECTION 26 05 04-9 BASIC ELECTRICAL MATERIALS AND METHODS

- A. Install where required for mounting and supporting electrical equipment, raceway, and cable tray systems.
- B. Channel Type:
 - 1. Interior, Wet or Dry (Noncorrosive) Locations:
 - a. Raceways: Carbon Steel (Hot-dip galvanized).
 - b. Conduits: Carbon Steel (Hot-dip galvanized).
 - c. Steel Raceway and Other Systems Not Covered: Carbon Steel (Hot-dip galvanized)..
 - 2. Interior, Corrosive (Wet or Dry) Locations:
 - a. Raceways: Stainless Steel.
 - b. Conduits: Stainless Steel.
 - c. PVC-Coated Steel Conduit and Other Systems Not Covered: Stainless Steel.
 - 3. Outdoor, Noncorrosive Locations:
 - a. Raceways: Carbon Steel (Hot-dip galvanized), except where mounted on aluminum handrail, then use aluminum framing channel.
 - b. Raceway and Other Systems Not Covered: Carbon Steel (Hot-dip galvanized).
 - 4. Outdoor Corrosive Locations:
 - a. Conduits: Stainless Steel.
 - b. Raceways: Stainless Steel.
 - c. PVC-Coated Steel Conduit and Other Systems Not Covered: Stainless Steel.
- C. Paint cut ends prior to installation with the following:
 - 1. Carbon Steel Channel: Zinc-rich primer.
 - 2. Painted Channel: Rust-inhibiting epoxy or acrylic paint.
 - 3. Nonmetallic Channel: Epoxy resin sealer.
 - 4. PVC-Coated Channel: PVC patch.

END OF SECTION

SECTION 26 05 05

CONDUCTORS

PART 1 - GENERAL

1.01 SUMMARY

- A. This section includes all cables and conductors to be used for the connection of equipment covered under section 26.

1.02 ACTION SUBMITTALS

- A. Wire and cable descriptive product information.
- B. Wire and cable accessories descriptive product information.

1.03 INFORMATIONAL SUBMITTALS

- A. Factory Test Report for conductors 600 volts and below.

1.04 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. Association of Edison Illuminating Companies (AEIC): CS 8, Specification for Extruded Dielectric Shielded Power Cables Rated 5 kV through 46 kV.
 - 2. ASTM International (ASTM):
 - a. A167, Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
 - b. B3, Standard Specification for Soft or Annealed Copper Wire.
 - c. B8, Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.
 - d. B496, Standard Specification for Compact Round Concentric Lay-Stranded Copper Conductors.
 - 3. Electronic Industries Alliance (EIA), Telecommunications Industry Association (TIA): TIA-568-B, Commercial Building Telecommunications Cabling Standard.
 - 4. Insulated Cable Engineer's Association, Inc. (ICEA):
 - a. S-58-679, Standard for Control Cable Conductor Identification.
 - b. S-73-532, Standard for Control Cables.

- c. T-29-520, Conducting Vertical Cable Tray Flame Tests with Theoretical Heat Input of 210,000 Btu/hour.
- 5. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
 - a. 48, Standard Test Procedures and Requirements for High-Voltage Alternating-Current Cable Terminations 2.5 kV through 765 kV
 - b. 386, Separable Insulated Connector Systems for Power Distribution Systems Above 600V.
 - c. 404, Standard for Extruded And Laminated Dielectric Shielded Cable Joints Rated 2,500 V to 500,000 V.
- 6. National Electrical Manufacturers' Association (NEMA):
 - a. CC 1, Electric Power Connectors for Substations.
 - b. WC 57, Standard for Control, Thermocouple Extension, and Instrumentation Cables - ICEA S-73-532.
 - c. WC 70, Standard for Nonshielded Power Cables Rated 2,000 Volts or Less for the Distribution of Electrical Energy.
 - d. WC 71, Standard for Nonshielded Cables Rated 2,001-5,000 Volts for Use in the Distribution of Electric Energy.
 - e. WC 74, 5-46 kV Shielded Power Cable for Use in the Transmission and Distribution of Electric Energy.
- 7. National Fire Protection Association (NFPA):
 - a. 70, National Electrical Code (NEC).
 - b. 262, Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces.
- 8. Underwriters Laboratories Inc. (UL):
 - a. 13, Standard for Safety Power-Limited Circuit Cables.
 - b. 44, Standard for Safety Thermoset-Insulated Wires and Cables.
 - c. 62, Standard for Safety Flexible Cord and Cables.
 - d. 486A-486B, Wire Connectors.
 - e. 486C, Standard for Splicing Wire Connections.
 - f. 510, Standard for Safety Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape.
 - g. 854, Standard for Safety Service-Entrance Cables.

- h. 1072, Standard for Safety Medium-Voltage Power Cables.
- i. 1277, Standard for Safety Electrical Power and Control Tray Cables with Optional Optical-Fiber Members.
- j. 1569, Metal Clad Cables.
- k. 1581, Standard for Safety Reference Standard for Electrical Wires, Cables, and Flexible Cords.

1.05 QUALITY ASSURANCE

- A. Authority Having Jurisdiction (AHJ):
 - 1. Provide the Work in accordance with NFPA 70. Where required by the AHJ, material and equipment shall be labeled or listed by a nationally recognized testing laboratory or other organization acceptable to the AHJ in order to provide a basis for approval under NEC.
 - 2. Materials and equipment manufactured within the scope of standards published by Underwriters Laboratories Inc. shall conform to those standards and shall have an applied UL listing mark.
- B. Terminations and Splices for Conductors above 600 Volts: Work shall be done by Journeyman Lineman with splicing credentials.

PART 2 - PRODUCTS

2.01 CONDUCTORS 600V AND BELOW

- A. Conform to applicable requirements of NEMA WC 70.
- B. Conductor Type:
 - 1. 120-Volt and 277-Volt Lighting, 10 AWG and Smaller: Solid copper.
 - 2. 120-Volt Receptacle Circuits, 10 AWG and Smaller: Solid copper.
 - 3. All Other Circuits: Stranded copper
- C. Insulation: Type THHN/THWN-2, except for sizes No. 6 and larger, with XHHW-2 insulation.
- D. Flexible Cords and Cables:
 - 1. Type SOW-A/50 with ethylene propylene rubber insulation in accordance with UL 62.
 - 2. Conform to physical and minimum thickness requirements of NEMA WC 70.

2.02 600V RATED CABLE

A. Building Wire:

1. Thermoplastic Insulated Building Wire: NEMA WC-5.
2. Cross linked polyethylene- insulated.
3. Feeder and Branch Circuits: Single stranded conductor; 98% conductivity copper; 75/90°C; 600 volt PVC insulated with nylon jacket; type THWN/THHN. Minimum size #12 AWG.
4. Feeder Conductors larger than 250 KCMIL; single stranded conductor copper; 90°C; 600 volt; flame retardant moisture resistant cross linked polyethylene insulated; type XHHW-2; minimum size 300 KCMIL.
5. Control Circuits: Same as specified above for feeder and branch circuits, except minimum size #14 AWG.

B. Control Cable:

1. Conductors:
 - a. 14 AWG, seven-strand copper.
 - b. Insulation: 15-mil PVC with 4-mil nylon.
 - c. UL 1581 listed as Type THHN/THWN rated VW-1.
 - d. Single or multi conductor construction.
 - e. Color Code: In accordance with ICEA S-58-679, Method 1, Table 2.
2. Cable: Passes the ICEA T-29-520 210,000 Btu per hour Vertical Tray Flame Test.
3. Cable Sizes:

No. Of Conductors	Max Outside Diameter (in)	Jacket Thickness (Mils)
3	0.41	45
5	0.48	45
7	0.52	45
9	0.83	60
25	1.00	60
37	1.15	80

4. Manufacturers:

- a. Okonite Co.
- b. Southwire

C. Multiconductor Power Cable:

1. General:

- a. Meet or exceed UL 1581 for cable tray use.
- b. Meet or exceed UL 1277 for direct burial and sunlight-resistance.
- c. Overall jacket: PVC.

2. Conductors:

- a. Class B stranded, coated copper.
- b. Insulation: Chemically cross-linked ethylene-propylene or crosslinked polyethylene.
- c. UL rated VW-1 or listed Type XHHW-2.
- d. Color Code:
 - 1) Conductors, size 8 AWG and smaller, colored conductors, ICEA S-58-679, Method 1, Table 1.
 - 2) Conductors, size 6 AWG and larger, ICEA S-73-532, Method 4.

3. Cable shall pass ICEA T-29-520, 210,000 Btu per hour Vertical Tray Flame Test.

4. Cable Sizes:

Conductor Size	Minimum Ground Wire Size	No. Of Current Carrying Conductors	Max. Outside Diameter (in)	Nominal Jacket Thickness (Mils)
12	12	2	0.42	45
		3	0.45	45
		4	0.49	45
10	10	2	0.54	60
		3	0.58	60
		4	0.63	60
8	10	3	0.66	60
		4	0.75	60
6	8	3	0.74	60
		4	0.88	60
4	6	3	0.88	60
		4	1.04	80
2	6	3	1.01	80
		4	1.16	80
1	6	3	1.10	80
		4	1.25	80

Section 4
Scope of Work and Technical Specifications
SECTION 26 05 05-6 CONDUCTORS

1/0	6	3 4	1.22 1.35	80 80
2/0	4	3 4	1.32 1.53	80 80
3/0	4	3 4	1.40 1.60	80 80
4/0	4	3 4	1.56 1.78	80 110

5. Manufacturers:

- a. Okonite Co.
- b. Southwire

D. 16 AWG, Twisted, Shielded Pair, Instrumentation Cable: Single pair, designed for noise rejection for process control, computer, or data log applications meeting NEMA WC 57 requirements.

- 1. Outer Jacket: 45-mil nominal thickness.
- 2. Individual Pair Shield: 1.35-mil, double-faced aluminum/synthetic polymer overlapped to provide 100 percent coverage.
- 3. Dimension: 0.31-inch nominal OD.
- 4. Conductors:
 - a. Bare soft annealed copper, Class B, seven-strand concentric, meeting requirements of ASTM B8.
 - b. 20 AWG, seven-strand tinned copper drain wire.
 - c. Insulation: 15-mil nominal PVC, 600VAC rated.
 - d. Jacket: 4-mil nominal nylon.
 - e. Color Code: Pair conductors, black and red.

5. Manufacturers:

- a. Okonite Co.
- b. Alpha Wire Corp.
- c. Belden.

E. 16 AWG, Twisted, Shielded Triad Instrumentation Cable: Single triad, designed for noise rejection for process control, computer, or data log applications meeting NEMA WC 57 requirements.

- 1. Outer Jacket: 45-mil nominal.

2. Individual Pair Shield: 1.35-mil, double-faced aluminum/synthetic polymer, overlapped to provide 100 percent coverage.
 3. Dimension: 0.32-inch nominal OD.
 4. Conductors:
 - a. Bare soft annealed copper, Class B, seven-strand concentric, meeting requirements of ASTM B8.
 - b. 20 AWG, seven-strand, tinned copper drain wire.
 - c. Insulation: 15-mil nominal PVC, 600VAC rated.
 - d. Jacket: 4-mil nylon.
 - e. Color Code: Triad conductors black, red, and blue.
 5. Manufacturers:
 - a. Okonite Co.
 - b. Alpha Wire Corp.
 - c. Belden.
- F. 18 AWG, Multi-Twisted, Shielded Pairs with a Common, Overall Shield Instrumentation Cable: Designed for use as instrumentation, process control, and computer cable, meeting NEMA WC 57 requirements.
1. Conductors:
 - a. Bare soft annealed copper, Class B, seven-strand concentric, in accordance with ASTM B8.
 - b. Tinned copper drain wires.
 - c. Pair drain wire size AWG 20, group drain wire size AWG 18.
 - d. Insulation: 15-mil PVC, 600VAC rated.
 - e. Jacket: 4-mil nylon.
 - f. Color Code: Pair conductors, black and red with red conductor numerically printed for group identification.
 - g. Individual Pair Shield: 1.35-mil, double-faced aluminum/synthetic polymer.
 2. Cable Shield: 2.35-mil, double-faced aluminum/synthetic polymer, overlapped for 100 percent coverage.
 3. Cable Sizes:

Section 4
Scope of Work and Technical Specifications
SECTION 26 05 05-8 CONDUCTORS

Number of Pairs	Max. Outside Diameter (in)	Nominal Jacket Thickness (Mils)
4	0.50	45
8	0.68	60
12	0.82	60
16	0.95	80
24	1.16	80
36	1.33	80
50	1.56	80

4. Manufacturers

- a. Okonite Co.
- b. Alpha Wire Co.
- c. Belden

G. Multi-Conductor Adjustable Frequency Drive (AFD and VFD) Power Cable:

1. Conductors:

- a. Class B, stranded coated copper.
- b. Insulation: 600-volt cross-linked polyethylene, UL Type XHHW-2.
- c. Grounding Conductors: Insulated stranded copper.

2. Sheath:

- a. UL 1277 Type TC, 90 degrees C.
- b. Continuous shield, A1/polyester foil, drain wires, overall copper braid.

3. Outer Jacket: Polyvinyl chloride (PVC) per UL 1569.

4. Cable Sizes:

Conductor Size (AWG)	Minimum Ground Wire size (AWG)	No. Of Insulated Conductors	Max Outside Diameter (in)	Jacket Thickness (Mils)
12	12	4	0.610	50
10	10	4	0.670	50
8	8	4	0.910	50
6	6	4	1.010	50
4	4	4	1.150	50
2	2	4	1.310	50

5. Manufacturers and Products:

- a. Belden, Series 29500.
- b. Alpha Wire, Series V.

c. LAPP USA, OLFLEX VFD Slim.

2.03 SPECIAL CABLES

- A. Unshielded Twisted Pair (UTP) Telephone and Data Cable, 300V:
 - 1. Category 6 UTP, UL listed, and third party verified to comply with TIA/EIA 568-B.2-1 Category 6 requirements.
 - 2. Suitable for high speed network applications including gigabit ethernet and video. Cable shall be interoperable with other standards compliant products and shall be backward compatible with Category 5 and Category 5e.
 - 3. Provide four each individually twisted pair, 23 AWG conductors, with FEP insulation and blue PVC jacket.
 - 4. NFPA 70 Plenum (CMP) rated, comply with flammability plenum requirements of NFPA 70 and NFPA 262.
 - 5. Cable shall withstand a bend radius of 1-inch minimum at a temperature of minus 20 degrees C maximum without jacket or insulation cracking.
 - 6. Manufacturer and Product: Belden; 7852A.
- B. Data Highway Cable, Allen-Bradley "Blue Hose."
 - 1. Meet or exceed electrical characteristics of Allen-Bradley Catalog No. 1770-CD.
 - 2. Approved by Allen-Bradley for use with A-B programmable logic controller systems.
 - 3. Outer Jacket: Blue PVC.
 - 4. Shield: 1.35-mil, double-faced aluminum/synthetic polymer, overlapped to provide 100 percent coverage.
 - 5. Drain: 55 percent tinned copper braid and drain wire.
 - 6. Dimension: 0.243-inch nominal OD.
 - 7. Conductors:
 - a. One pair #20 AWG, seven-strand tinned copper.
 - b. Insulation: Polyethylene.
 - c. Color Code: Blue and clear.
 - 8. Manufacturers:
 - a. Allen-Bradley.

b. Belden.

C. DeviceNet Round Cable, 600V, Class 1, Two Twisted, Shielded Pairs with a Common Overall Shield:

1. Outer Jacket: PVC.
2. Overall Shield: Tinned copper braid, 18 AWG tinned copper drain wire.
3. Individual Pair Shield: Aluminum foil-polyester tape.
4. Dimension: 0.460-inch nominal OD.
5. Conductors:
 - a. 15 AWG stranded tinned copper.
 - b. Insulation: FEP.
6. Manufacturer and Product: Belden; 7897A.

D. DeviceNet Flat Cable, 600V, Class 1, Four Conductor Unshielded Network Trunk Cable:

1. Outer Jacket: Thermoplastic Elastomer (TPE).
2. Conductors: Four conductor, unshielded, flat configuration.
3. Manufacturer and Product: Allen-Bradley; 1485C-P1E.

E. Fiber Optic Cable

1. Fiber optic cable shall be optic multimode, loose tube, all-dielectric cable, Siemens, Nordx/CDT, Belden, or approved equal, and meet the following specifications:

Cladding Diameter	125.0 Microns
Core Diameter	62.5 Microns
Attenuation Range	≤0.8 dB/KM at 1300 NM ≤3.1 dB/KM at 850 NM
Bandwidth Range	≥600 Mhz-KM at 1300 NM ≥200 Mhz at 850 NM
Cable Construction	Splitable outdoor cable
Core Type	Hollow core, filled
Materials	
basic element	PVC, gray
strain relief	Kevlar fibers and impregnated glass
outer sheath/cable color	PVC black
Mechanical Characteristics	
dimensions of basic element	(3.5 □ 0.2) mm dia
cable dimensions	(6.3 X 9.8) □ 0.4 mm

cable weight	aprox. 65 kg/km
permissible tensile load	≤500 N (short time)
bending radii	≥100 mm Over flat side only
Permissible Ambient Conditions	
laying and installation temp.	-5°C to +50°C
operating temperature	-25°C to +60°C
storage temperature	-25°C to +70°C

Cable shall be compliant with EIA, ANSI Standards, graded index. All fibers must be color coded for easy identification with all-dielectric construction. All cables shall be of an insulation type rated for the purpose of installation. Where shown on Contract Drawings all fiber optic conduit run shall contain redundant 24 strand fiber optic cables as specified in this section. The exact fiber optic cable shall type and model shall be coordinated with the specified equipment.

2. Connector Type BFOC.
3. Coordinate the exact fiber cable requirement with the SCADA system integrator.

2.04 GROUNDING CONDUCTORS

- A. Equipment: Stranded copper with green, Type USE/RHH/RHW-XLPE or THHN/THWN, insulation.
- B. Direct Buried: Bare stranded copper.

2.05 ACCESSORIES FOR CONDUCTORS 600 VOLTS AND BELOW

- A. Tape:
 1. General Purpose, Flame Retardant: 7-mil, vinyl plastic, Scotch Brand 33+, rated for 90 degrees C minimum, meeting requirements of UL 510.
 2. Flame Retardant, Cold and Weather Resistant: 8.5-mil, vinyl plastic, Scotch Brand 88.
 3. Arc and Fireproofing:
 - a. 30-mil, elastomer.
 - b. Manufacturers and Products:
 - 1) 3M; Scotch Brand 77, with Scotch Brand 69 glass cloth tapebinder.
 - 2) Plymouth; 53 Plyarc, with 77 Plyglas glass cloth tapebinder.
- B. Identification Devices:

1. Sleeve:
 - a. Permanent, PVC, yellow or white, with legible machine-printed black markings.
 - b. Manufacturers and Products:
 - 1) Raychem; Type D-SCE or ZH-SCE.
 - 2) Brady, Type 3PS.
 2. Heat Bond Marker:
 - a. Transparent thermoplastic heat bonding film with acrylic pressure sensitive adhesive.
 - b. Self-laminating protective shield over text.
 - c. Machine printed black text.
 - d. Manufacturer and Product: 3M Co.; Type SCS-HB.
 3. Marker Plate: Nylon, with legible designations permanently hot stamped on plate.
 4. Tie-On Cable Marker Tags:
 - a. Chemical-resistant white tag.
 - b. Size: 1/2 inch by 2 inches.
 - c. Manufacturer and Product: Raychem; Type CM-SCE.
 5. Grounding Conductor: Permanent green heat-shrink sleeve, 2-inch minimum.
- C. Connectors and Terminations:
1. Nylon, Self-Insulated Crimp Connectors:
 - a. Manufacturers and Products:
 - 1) Thomas & Betts; Sta-Kon.
 - 2) Burndy; Insulug.
 - 3) ILSCO.
 2. Nylon, Self-Insulated, Crimp Locking-Fork, Torque-Type Terminator:
 - a. Suitable for use with 75 degrees C wire at full NFPA 70, 75 degrees C ampacity.
 - b. Seamless.

- c. Manufacturers and Products:
 - 1) Thomas & Betts; Sta-Kon.
 - 2) Burndy; Insulink.
 - 3) ILSCO; ILSCONS.
 - 3. Self-Insulated, Freespring Wire Connector (Wire Nuts):
 - a. UL 486C.
 - b. Plated steel, square wire springs.
 - c. Manufacturers and Products:
 - 1) Thomas & Betts.
 - 2) Ideal; Twister.
 - 4. Self-Insulated, Set Screw Wire Connector:
 - a. Two piece compression type with set screw in brass barrel.
 - b. Insulated by insulator cap screwed over brass barrel.
 - c. Manufacturers:
 - 1) 3M Co.
 - 2) Thomas & Betts.
 - 3) Marrette.
- D. Cable Lugs:
 - 1. In accordance with NEMA CC 1.
 - 2. Rated 600 volts of same material as conductor metal.
 - 3. Uninsulated Crimp Connectors and Terminators:
 - a. Suitable for use with 75 degrees C wire at full NFPA 70, 75 degrees C ampacity.
 - b. Manufacturers and Products:
 - 1) Thomas & Betts; Color-Keyed.
 - 2) Burndy, Hydent.
 - 3) ILSCO.
 - 4. Uninsulated, Bolted, Two-Way Connectors and Terminators:

- a. Manufacturers and Products:
 - 1) Thomas & Betts; Locktite.
 - 2) Burndy; Quiklug.
 - 3) ILSCO.
 - E. Cable Ties:
 - 1. Nylon, adjustable, self-locking, and reusable.
 - 2. Manufacturer and Product: Thomas & Betts; TY-RAP.
 - F. Heat Shrinkable Insulation:
 - 1. Thermally stabilized cross-linked polyolefin.
 - 2. Single wall for insulation and strain relief.
 - 3. Dual Wall, adhesive sealant lined, for sealing and corrosion resistance.
 - 4. Manufacturers and Products:
 - a. Thomas & Betts; SHRINK-KON.
 - b. Raychem; RNF-100 and ES-2000.
 - G. Data Cable Accessories: Terminators, connectors, and junctions necessary for a complete DeviceNet system.
- 2.06 PULLING COMPOUND
 - A. Nontoxic, noncorrosive, noncombustible, nonflammable, water-based lubricant; UL listed.
 - B. Suitable for rubber, neoprene, PVC, polyethylene, hypalon, CPE, and lead-covered wire and cable.
 - C. Approved for intended use by cable manufacturer.
 - D. Suitable for zinc-coated steel, aluminum, PVC, bituminized fiber, and fiberglass raceways.
 - E. Manufacturers:
 - 1. Ideal Co.
 - 2. Polywater, Inc.
 - 3. Cable Grip Co.

2.07 WARNING TAPE

- A. As specified in Section 26 05 33, Raceways and Boxes.

2.08 SOURCE QUALITY CONTROL

- A. Conductors 600 Volts and Below: Test in accordance with UL 44 and UL 854.
- B. Conductors Above 600 Volts: Test in accordance with NEMA WC 71 and AEIC CS 6 partial discharge level test for EPR insulated cable.

PART 3 - EXECUTION

3.01 GENERAL

- A. Conductor installation shall be in accordance with manufacturer's recommendations.
- B. Conductor and cable sizing shown is based on copper conductors, unless noted otherwise.
- C. Do not exceed cable manufacturer's recommendations for maximum pulling tensions and minimum bending radii.
- D. Terminate all conductors and cables, unless otherwise indicated.
- E. Tighten screws and terminal bolts in accordance with UL 486A-486B for copper conductors.
- F. Cable Lugs: Provide with correct number of holes, bolt size, and center-to-centerspacing as required by equipment terminals.
- G. Bundling: Where single conductors and cables in manholes, handholes, vaults, cable trays, and other indicated locations are not wrapped together by some other means, bundle conductors from each conduit throughout their exposed length with cable ties placed at intervals not exceeding 18 inches on center.
- H. Ream, remove burrs, and clear interior of installed conduit before pulling wires or cables.
- I. Concrete-Encased Raceway Installation: Prior to installation of conductors, pull through each raceway a mandrel approximately 1/4 inch smaller than raceway inside diameter.

3.02 POWER CONDUCTOR COLOR CODING

- A. Conductors 600 Volts and Below:
 - 1. 6 AWG and Larger: Apply general purpose, flame retardant tape at each end, and at accessible locations wrapped at least six full overlapping turns, covering an area 1-1/2 inches to 2 inches wide.

2. 8 AWG and Smaller: Provide colored conductors.

3. Colors:

System	Conductor	Color
All Systems	Equipment Grounding	Green
240/120v 1Ph, 3W	Grounded Neutral One Hot Leg Other Hot Leg	White Black Red
208/120v 3Ph, 4W	Grounded Neutral Phase A Phase B Phase C	White Black Red Blue
240/120v 3Ph, 4W Delta, Center Tap Ground on 1Ph	Grounded Neutral Phase A High (Wild) Leg Phase C	White Black Orange Blue
480/277v 3Ph, 4W	Grounded Neutral Phase A Phase B Phase C	White Brown Orange Yellow
NOTE: Phase A, B, C implies direction of positive Phase Rotation		

4. Tracer: Outer covering of white with an identifiable colored strip, other than green, in accordance with NFPA 70.

B. Conductors Above 600 Volts: Apply general purpose, flame retardant tape at each end, and at accessible locations wrapped at least six full overlapping turns, covering an area 1-1/2 inches to 2 inches wide.

1. Colors:

- a. Grounded Neutral: White.
- b. Phase A: Brown.
- c. Phase B: Orange.
- d. Phase C: Yellow.

3.03 CIRCUIT IDENTIFICATION

A. Identify power, instrumentation, and control conductor circuits at each termination, and in accessible locations such as manholes, handholes, panels, switchboards, motor control centers, pull boxes, and terminal boxes.

B. Circuits Not Appearing in Circuit Schedules:

- 1. Assign circuit name based on device or equipment at load end of circuit.

2. Where this would result in same name being assigned to more than one circuit, add number or letter to each otherwise identical circuit name to make it unique.

C. Method:

1. Conductors 3 AWG and Smaller: Identify with sleeves or heat bond markers.
2. Cables and Conductors 2 AWG and Larger:
 - a. Identify with marker plates or tie-on cable marker tags.
 - b. Attach with nylon tie cord.
3. Taped-on markers or tags relying on adhesives not permitted.

3.04 CONDUCTORS 600 VOLTS AND BELOW

- A. Install 10 AWG or 12 AWG conductors for branch circuit power wiring in lighting and receptacle circuits.
- B. Do not splice incoming service conductors and branch power distribution conductors 6 AWG and larger, unless specifically indicated or approved by Engineer.
- C. Connections and Terminations:
 1. Install wire nuts only on solid conductors. Wire nuts are not allowed on stranded conductors.
 2. Install nylon self-insulated crimp connectors and terminators for instrumentation and control, circuit conductors.
 3. Install self-insulated, set screw wire connectors for two-way connection of power circuit conductors 12 AWG and smaller.
 4. Install uninsulated crimp connectors and terminators for instrumentation, control, and power circuit conductors 4 AWG through 2/0 AWG.
 5. Install uninsulated, bolted, two-way connectors and terminators for power circuit conductors 3/0 AWG and larger.
 6. Install uninsulated terminators bolted together on motor circuit conductors 10 AWG and larger.
 7. Place no more than one conductor in any single-barrel pressure connection.
 8. Install crimp connectors with tools approved by connector manufacturer.
 9. Install terminals and connectors acceptable for type of material used.

10. Compression Lugs:
 - a. Attach with a tool specifically designed for purpose. Tool shall provide complete, controlled crimp and shall not release until crimp is complete.
 - b. Do not use plier type crimpers.
- D. Do not use soldered mechanical joints.
- E. Splices and Terminations:
 1. Insulate all uninsulated connections.
 2. Indoors: Use general purpose, flame retardant tape or single wall heat shrink.
 3. Outdoors, Dry Locations: Use flame retardant, cold- and weather resistant tape or single wall heat shrink.
 4. Below Grade and Wet or Damp Locations: Use dual wall heat shrink.
- F. Cap spare conductors with UL listed end caps.
- G. Cabinets, Panels, and Motor Control Centers:
 1. Remove surplus wire, bridle and secure.
 2. Where conductors pass through openings or over edges in sheet metal, remove burrs, chamfer edges, and install bushings and protective strips of insulating material to protect the conductors.
- H. Control and Instrumentation Wiring:
 1. Where terminals provided will accept such lugs, terminate control and instrumentation wiring, except solid thermocouple leads, with insulated, locking-fork compression lugs.
 2. Terminate with methods consistent with terminals provided, and in accordance with terminal manufacturer's instructions.
 3. Locate splices in readily accessible cabinets or junction boxes using terminal strips.
 4. Cable Protection:
 - a. Under Infinite Access Floors: May install without bundling.
 - b. All Other Areas: Install individual wires, pairs, or triads in flex conduit under floor or grouped into bundles at least 1/2 inch in diameter.
 - c. Maintain integrity of shielding of instrumentation cables.

d. Ensure grounds do not occur because of damage to jacket over the shield.

I. Extra Conductor Length: For conductors to be connected by others, install minimum 6 feet of extra conductor in freestanding panels and minimum 2 feet in other assemblies.

3.05 CONDUCTOR ARC AND FIREPROOFING

A. Install arc and fireproofing tape on 5 kV cables throughout their entire exposed length in manholes, handholes, vaults, cable trays, and other indicated locations.

B. Wrap conductors of same circuit entering from separate conduit together as a single cable.

C. Follow tape manufacturer's installation instructions.

D. Secure tape at intervals of 5 feet with bands of tapebinder. Each band to consist of a minimum of two wraps directly over each other.

3.06 UNDERGROUND DIRECT BURIAL CABLE

A. Warning Tape: Install approximately 12 inches above cable, aligned parallel to, and within 12 inches of centerline of the run.

END OF SECTION

SECTION 26 05 26

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes grounding and bonding systems and equipment.
- B. Section includes grounding and bonding systems and equipment, plus the following special applications:
 - 1. Underground distribution grounding.
 - 2. Ground bonding common with lightning protection system.
 - 3. Foundation steel electrodes.

1.02 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.03 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plans showing dimensioned as-built locations of grounding features specified in "Field Quality Control" Article.
- B. Qualification Data: For testing agency and testing agency's field supervisor.
- C. Field quality-control reports.

1.04 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.
 - 1. Plans showing as-built, dimensioned locations of grounding features specified in "Field Quality Control" Article, including the following:
 - a. Test wells.
 - b. Ground rods.
 - c. Ground rings.
 - d. Grounding arrangements and connections for separately derived systems.
 - 2. Instructions for periodic testing and inspection of grounding features at test wells and ground rings.

Section 4
Scope of Work and Technical Specifications
SECTION 26 05 26-2 GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

- a. Tests shall determine if ground-resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if values do not.
- b. Include recommended testing intervals.

1.05 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. Institute of Electrical and Electronics Engineers (IEEE): C2, National Electrical Safety Code (NESC)
 - 2. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).

1.06 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Certified by NETA.

PART 2 - PRODUCTS

2.01 SYSTEM DESCRIPTION

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with UL 467 for grounding and bonding materials and equipment.

2.02 CONDUCTORS

- A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare Copper Conductors:
 - 1. Solid Conductors: ASTM B 3.
 - 2. Stranded Conductors: ASTM B 8.
 - 3. Tinned Conductors: ASTM B 33.
 - 4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.
 - 5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
 - 6. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

Section 4
Scope of Work and Technical Specifications
SECTION 26 05 26-3 GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

C. Grounding Bus: Predrilled rectangular bars of annealed copper, 1/4 by 4 inches in cross section, with 9/32-inch holes spaced 1-1/8 inches apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V and shall be Lexan or PVC, impulse tested at 5000 V.

2.03 CONNECTORS

A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.

B. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

C. Bus-Bar Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

D. Bus-Bar Connectors: Compression type, copper or copper alloy, with two wire terminals.

E. Beam Clamps: Mechanical type, terminal, ground wire access from four directions, with dual, tin-plated or silicon bronze bolts.

F. Cable-to-Cable Connectors: Compression type, copper or copper alloy.

G. Cable Tray Ground Clamp: Mechanical type, zinc-plated malleable iron.

H. Conduit Hubs: Mechanical type, terminal with threaded hub.

I. Ground Rod Clamps: Mechanical type, copper or copper alloy, terminal with hex head bolt.

J. Ground Rod Clamps: Mechanical type, copper or copper alloy, terminal with hex head bolt.

K. Lay-in Lug Connector: Mechanical type, copper rated for direct burial terminal with set screw.

L. Service Post Connectors: Mechanical type, bronze alloy terminal, in short- and long-stud lengths, capable of single and double conductor connections.

M. Signal Reference Grid Clamp: Mechanical type, stamped-steel terminal with hex head screw.

N. Straps: Solid copper, copper lugs. Rated for 600 A.

O. Tower Ground Clamps: Mechanical type, copper or copper alloy, terminal one-piece clamp.

Section 4
Scope of Work and Technical Specifications
SECTION 26 05 26-4 GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

P. U-Bolt Clamps: Mechanical type, copper or copper alloy, terminal listed for direct burial.

Q. Water Pipe Clamps:

1. Mechanical type, two pieces with stainless-steel bolts.
 - a. Material: Tin-plated aluminum.
 - b. Listed for direct burial.
2. U-bolt type with malleable-iron clamp and copper ground connector rated for direct burial.

2.04 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel, sectional type; 3/4 inch by 10 feet
- B. Ground Plates: 1/4 inch thick, hot-dip galvanized.

PART 3 - EXECUTION

3.01 APPLICATIONS

- A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.
- B. Underground Grounding Conductors: Install bare tinned-copper conductor, No. 2/0 AWG minimum.
 1. Bury at least 24 inches below grade.
- C. Grounding Bus: Install in electrical equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
 1. Install bus horizontally, on insulated spacers 2 inches minimum from wall, 6 inches above finished floor unless otherwise indicated.
 2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down; connect to horizontal bus.
- D. Conductor Terminations and Connections:
 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
 2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
 3. Connections to Ground Rods at Test Wells: Bolted connectors.
 4. Connections to Structural Steel: Welded connectors.

Section 4
Scope of Work and Technical Specifications

SECTION 26 05 26-5 GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

3.02 GROUNDING AT THE SERVICE

A. Equipment grounding conductors and grounding electrode conductors shall be connected to the ground bus. Install a main bonding jumper between the neutral and ground buses.

3.03 GROUNDING SEPARATELY DERIVED SYSTEMS

A. Generator: Install grounding electrode(s) at the generator location. The electrode shall be connected to the equipment grounding conductor and to the frame of the generator.

3.04 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

A. Comply with IEEE C2 grounding requirements.

B. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches will extend above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches above to 6 inches below concrete. Seal floor opening with waterproof, nonshrink grout.

C. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, stranded, hard-drawn copper bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields according to written instructions by manufacturer of splicing and termination kits.

D. Pad-Mounted Transformers and Switches: Install two ground rods and ground ring around the pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes. Install tinned-copper conductor not less than No. 2 AWG for ground ring and for taps to equipment grounding terminals. Bury ground ring not less than 6 inches from the foundation.

3.05 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits.

B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:

Section 4
Scope of Work and Technical Specifications

SECTION 26 05 26-6 GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

1. Feeders and branch circuits.
 2. Lighting circuits.
 3. Receptacle circuits.
 4. Single-phase motor and appliance branch circuits.
 5. Three-phase motor and appliance branch circuits.
 6. Flexible raceway runs.
 7. Armored and metal-clad cable runs.
 8. Busway Supply Circuits: Install insulated equipment grounding conductor from grounding bus in the switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.
 9. X-Ray Equipment Circuits: Install insulated equipment grounding conductor in circuits supplying x-ray equipment.
- C. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.
- D. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.
- E. Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

3.06 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage. Grounding shall be connected back to the grounding grid at the pumping station.
- B. Ground Bonding Common with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.
- C. Ground Rods: Drive rods until tops are 2 inches below finished floor or final grade unless otherwise indicated.

Section 4
Scope of Work and Technical Specifications
SECTION 26 05 26-7 GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.

D. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.

1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.

E. Grounding and Bonding for Piping:

1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

3.07 FIELD QUALITY CONTROL

- A. Perform tests and inspections as required.
- B. Tests and Inspections:
 1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
 2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
 3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding

Section 4
Scope of Work and Technical Specifications
SECTION 26 05 26-8 GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

terminal, at ground test wells, and at individual ground rods. Make tests at ground rods before any conductors are connected.

- a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
 - b. Perform tests by fall-of-potential method according to IEEE 81.
4. Prepare dimensioned Drawings locating each test well, ground rod and ground-rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.
- C. Grounding system shall be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.
- E. Report measured ground resistances that exceed the following values:
 1. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 10 ohms.
 2. Power and Lighting Equipment or System with Capacity of 500 to 1000 kVA: 5 ohms.
 3. Power Distribution Units or Panelboards Serving Electronic Equipment: 3 ohm(s).
 4. Manhole Grounds: 10 ohms.
- F. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION

SECTION 26 05 29

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Steel slotted support systems.
 - 2. Conduit and cable support devices.
 - 3. Support for conductors in vertical conduit.
 - 4. Structural steel for fabricated supports and restraints.
 - 5. Mounting, anchoring, and attachment components, including powder-actuated fasteners, mechanical expansion anchors, concrete inserts, clamps, through bolts, toggle bolts, and hanger rods.
 - 6. Fabricated metal equipment support assemblies.

1.02 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For fabrication and installation details for electrical hangers and support systems.
 - 1. Hangers. Include product data for components.
 - 2. Slotted support systems.
 - 3. Equipment supports.
 - 4. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
- C. Delegated-Design Submittal: For hangers and supports for electrical systems.
 - 1. Include design calculations and details of hangers.
 - 2. Include design calculations for seismic restraints.

1.03 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, and coordinated with each other, using input from installers of the items involved.

Section 4
Scope of Work and Technical Specifications
SECTION 26 05 29-2 HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

B. Seismic Qualification Data: Certificates, for hangers and supports for electrical equipment and systems, accessories, and components, from manufacturer.

C. Welding certificates.

1.04 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M.

B. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M.
2. AWS D1.2/D1.2M.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design hanger and support system.

B. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame Rating: Class 1.
2. Self-extinguishing according to ASTM D 635.

2.02 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Preformed steel channels and angles with minimum 13/32-inch-diameter holes at a maximum of 8 inches o.c. in at least one surface.

1. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
2. Material for Channel, Fittings, and Accessories: Stainless steel, Type 304.
3. Channel Width: Selected for applicable load criteria.
4. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
5. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
6. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.

Section 4
Scope of Work and Technical Specifications
SECTION 26 05 29-3 HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

7. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Conduit and Cable Support Devices: Stainless Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- C. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for nonarmored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be made of malleable iron.
- D. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M steel plates, shapes, and bars; black and galvanized.
- E. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
 2. Mechanical-Expansion Anchors: Insert-wedge-type, stainless steel, for use in hardened portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
 3. Concrete Inserts: Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58.
 4. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.
 5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
 6. Toggle Bolts: Stainless-steel springhead type.
 7. Hanger Rods: Threaded steel.

2.03 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.
- B. Materials: Comply with requirements in Section 05 12 00 "Structural Steel Framing" for steel shapes and plates.

PART 3 - EXECUTION

3.01 APPLICATION

Section 4
Scope of Work and Technical Specifications

SECTION 26 05 29-4 HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

A. Comply with the following standards for application and installation requirements of hangers and supports, except where requirements on Drawings or in this Section are stricter:

1. NECA 1.
2. NECA 101
3. NECA 102.
4. NECA 105.
5. NECA 111.

B. Comply with all applicable Codes' requirements for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.

C. Comply with requirements for raceways and boxes specified in Section 26 05 33 "Raceways and Boxes for Electrical Systems."

D. Maximum Support Spacing and Minimum Hanger Rod Size for Raceways: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch in diameter.

E. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted or other support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.

1. Secure raceways and cables to these supports with two-bolt conduit.

F. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings, and for fastening raceways to trapeze supports.

3.02 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this article.

B. Raceway Support Methods: In addition to methods described in NECA 1, RMC may be supported by openings through structure members, according to NFPA 70.

C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:

Section 4
Scope of Work and Technical Specifications
SECTION 26 05 29-5 HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

1. To Wood: Fasten with lag screws or through bolts.
 2. To New Concrete: Bolt to concrete inserts.
 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
 4. To Existing Concrete: Expansion anchor fasteners.
 5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.
 6. To Steel: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts.
 7. To Light Steel: Sheet metal screws.
 8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate.
- E. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

3.03 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Comply with installation requirements in Section 05 12 00 "Structural Steel Framing" for site-fabricated metal supports.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- C. Field Welding: Comply with AWS D1.1/D1.1M.

END OF SECTION

SECTION 26 05 33

RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Metal conduits and fittings.
2. Nonmetallic conduits and fittings.
3. Metal wireways and auxiliary gutters.
4. Nonmetal wireways and auxiliary gutters.
5. Surface raceways.
6. Boxes, enclosures, and cabinets.
7. Handholes and boxes for exterior underground cabling.

B. Related Requirements:

1. Section 26 05 43 "Underground Ducts and Raceways for Electrical Systems" for exterior ductbanks, manholes, and underground utility construction.

1.02 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

1.03 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:

1. Structural members in paths of conduit groups with common supports.
2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.
3. Seismic Qualification Data: Certificates, for enclosures, cabinets, and conduit racks and their mounting provisions, including those for internal components, from manufacturer.

1.04 REFERENCES

Section 4
Scope of Work and Technical Specifications
SECTION 26 05 33-2 RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

- A. The following is a list of standards which may be referenced in this section:
1. American Association of State Highway and Transportation Officials (AASHTO): HB, Standard Specifications for Highway Bridges, Sixteenth Edition.
 2. ASTM International (ASTM):
 3. A123/123M, Standard Specification for Zinc (Hot-Dipped Galvanized) Coatings on Iron and Steel Products.
 4. A167, Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
 5. A240/A240M, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
 6. C857, Standard Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures.
 7. D149, Test Method for Dielectric Breakdown Voltage and Dielectric Strength of Solid Electrical Insulating Materials at Commercial Power Frequencies.
 8. Electronic Industry Alliance (EIA) and Telecommunications Industry Association (TIA): 569, Commercial Building Standard for Telecommunications Pathways and Spaces.
 9. National Electrical Contractor's Association, Inc. (NECA):
 - a. 101, Standard for Installing Steel Conduit (Rigid, IMC, EMT).
 - b. 102, Standard for Installing Aluminum Conduits.
 - c. 105, Recommended Practice for Installing Metal Cable Trays.
 - d. 111, Standard for Installing Nonmetallic Raceway (RNC, ENT, LFNC).
 10. National Electrical Manufacturers Association (NEMA):
 - a. 250, Enclosures for Electrical Equipment (1,000 Volts Maximum).
 - b. C80.1, Specification for Rigid Steel Conduit, Zinc Coated.
 - c. C80.3, Specification for Electrical Metallic Tubing, Zinc Coated.
 - d. C80.5, Specification for Rigid Aluminum Conduit.
 - e. C80.6, Intermediate Metal Conduit (IMC) – Zinc Coated.

Section 4
Scope of Work and Technical Specifications
SECTION 26 05 33-3 RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

- f. RN 1, Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
 - g. TC 2, Electrical Polyvinyl Chloride (PVC) Plastic Tubing and Conduit.
 - h. TC 3, Polyvinyl-Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing.
 - i. TC 6, PVC Plastic Utilities Duct for Underground Installation.
 - j. TC 14, Reinforced Thermosetting Resin Conduit (RTRC) and Fittings.
 - k. VE 1, Metallic Cable Tray Systems.
11. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).
12. Underwriters Laboratories Inc. (UL):
- a. 1, Standard for Flexible Metal Conduit.
 - b. 5, Standard for Surface Metal Raceways and Fittings
 - c. 6, Standard for Electrical Rigid Metal Conduit – Steel.
 - d. 6A, Standard for Electrical Rigid Metal Conduit – Aluminum, Bronze, and Stainless.
 - e. 50, Standard for Enclosures for Electrical Equipment.
 - f. 360, Standard for Liquid-Tight Flexible Steel Conduit.
 - g. 514B, Standard for Conduit, Tubing, and Cable Fittings.
 - h. 514C, Standard for Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers.
 - i. 651, Standard for Schedule 40 and 80 Rigid PVC Conduit.
 - j. 651A, Standard for Type EB and A Rigid PVC Conduit and HDPE Conduit.
 - k. 797, Standard for Electrical Metallic Tubing.
 - l. 870, Standard for Wireways, Auxiliary Gutters, and Associated Fittings.
 - m. 1242, Standard for Intermediate Metal Conduit.
 - n. 1660, Standard for Liquid-Tight Flexible Nonmetallic Conduit.

Section 4
Scope of Work and Technical Specifications
SECTION 26 05 33-4 RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

- o. 1684, Standard for Reinforced Thermosetting Resin Conduit (RTRC) and Fittings.
- p. Standard for Optical Fiber and Communication Cable Raceway.

1.05 QUALITY ASSURANCE

- A. Authority Having Jurisdiction (AHJ):
 - 1. Provide the Work in accordance with NFPA 70, National Electrical Code (NEC). Where required by the AHJ, material and equipment shall be labeled or listed by a nationally recognized testing laboratory or other organization acceptable to the AHJ in order to provide a basis for approval under NEC.
 - 2. Materials and equipment manufactured within the scope of standards published by Underwriters Laboratories, Inc. shall conform to those standards and shall have an applied UL listing mark.
 - 3. PVC-Coated, Rigid Steel Conduit Installer: Certified by conduit manufacturer as having received minimum 2 hours of training on installation procedures.

PART 2 - PRODUCTS

2.01 CONDUIT AND TUBING

- A. Rigid Galvanized Steel Conduit (RGS):
 - 1. Meet requirements of NEMA C80.1 and UL 6.
 - 2. Material: Hot-dip galvanized with chromated protective layer.
- B. Aluminum Rigid Conduit:
 - 1. Meet requirements of UL 6; ANSI C80.1.
 - 2. Material: aluminum; minimum size ¾-inch.
- C. Intermediate Metal Conduit (IMC):
 - 1. Meet requirements of NEMA C80.6 and UL 1242.
 - 2. Material: Hot-dip galvanized with chromated and lacquered protective layer.
- D. Electric Metallic Tubing (EMT):
 - 1. Meet requirements of NEMA C80.3 and UL 797.
 - 2. Material: Hot-dip galvanized with chromated and lacquered protective layer.

Section 4
Scope of Work and Technical Specifications
SECTION 26 05 33-5 RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

- E. PVC schedule 40 Conduit:
 - 1. Meet requirements of NEMA TC 2 and UL 651.
 - 2. UL listed for concrete encasement, underground direct burial, concealed or direct sunlight exposure, and 90 degrees C insulated conductors.
- F. PVC tubing (Type EB):
 - 1. Meet requirements of NEMA TC 6 and UL 651A.
 - 2. UL listed for reinforced concrete encasement, underground direct burial, concealed or direct sunlight exposure, and 90 degrees C insulated conductors.
- G. PVC-Coated Rigid Galvanized Steel Conduit:
 - 1. Meet requirements of NEMA RN 1.
 - 2. Material: Meet requirements of NEMA C80.1 and UL 6.
 - 3. Exterior Finish: PVC coating, 40-mil nominal thickness; bond to metal shall have tensile strength than PVC.
 - 4. Interior finish: Urethane coating, 2-mil nominal thickness
 - 5. Threads: Hot-dipped galvanized and factory coated with urethane.
 - 6. Bendable without damage to interior or exterior coating.
- H. Flexible Metal, Liquid-Tight Conduit:
 - 1. UL 360 listed for 105 degrees C insulated conductors.
 - 2. Material: Galvanized steel with extruded PVC jacket.
- I. Flexible Metal, Nonliquid-Tight Conduit:
 - 1. Meet requirements of UL 1.
 - 2. Material: Galvanized steel.
- J. Flexible, Nonmetallic, Liquid-Tight Conduit:
 - 1. Material: PVC core with fused flexible PVC jacket
 - 2. UL 1660 listed for:
 - a. Dry Conditions: 80 degrees C insulated conductors.
 - b. Wet Conditions: 60 degrees C insulated conductors.
 - 3. Manufacturers and Products.
 - a. Carlon; Carflex or X-Flex.

Section 4
Scope of Work and Technical Specifications
SECTION 26 05 33-6 RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

b. T & B; Xtraflex LTC or EFC.

K. Innerduct:

1. Resistant to spread of fire, per requirements of UL 2024.
2. Smooth or corrugated HDPE.
3. Textile Manufacturer Maxcell.

2.02 FITTINGS

A. Rigid Galvanized Steel and Intermediate Metal Conduit:

1. General:
 - a. Meet requirements of UL 514B
 - b. Type: Threaded, galvanized. Set screw and threadless compression fittings not permitted.
2. Bushing:
 - a. Material: Malleable iron with integral insulated throat, rated for 150 degrees C.
 - b. Manufacturers and Products:
 - 1) Appleton; Series BU-1.
 - 2) O-Z/Gedney; Type HB.
3. Grounding Bushing:
 - a. Material: Malleable iron with integral insulated throat, rated for 150 degrees C, with solderless lugs.
 - b. Manufacturers and Products:
 - 1) Appleton; Series BU-1.
 - 2) O-Z/Gedney; Type HBLG.
4. Conduit Hub:
 - a. Material: Malleable iron with integral insulated throat with bonding screw.
 - b. UL listed for use in wet locations.
 - c. Manufacturers and Products:
 - 1) Appleton; Series HUB-B.

Section 4
Scope of Work and Technical Specifications
SECTION 26 05 33-7 RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

- 2) O-Z/Gedney; Series CH
 - 3) Meyers; ST Series.
5. Conduit Bodies:
 - a. Sized as required by NFPA 70.
 - b. Manufacturers and Products (For Normal Condition):
 - 1) Appleton; Form 35 threaded unilets.
 - 2) Crouse-Hinds; Form 7 or Form 8 threaded condulets.
 - 3) Killark; Series O electrolets.
 - 4) Thomas & Betts; Form 7 or Form 8.
 - c. Manufacturers (For Hazardous Locations):
 - 1) Appleton.
 - 2) Crouse-Hinds.
 - 3) Killark.
6. Couplings: Assupplied by conduit manufacturer.
7. Unions:
 - a. Concrete tight, hot-dip galvanized malleable iron.
 - b. Manufacturers and Products:
 - 1) Appleton; Series SCC bolt-on coupling or Series EC three-piece union.
 - 2) O-Z/Gedney; Type SSp split coupling or Type 4 Series, three-piece coupling.
 - 3) Killark; Series O electrolets.
 - 4) Thomas & Betts; Form 7 or Form 8.
8. Conduit Sealing Fitting:
 - a. Manufacturers and Products:
 - 1) Appleton; Type EYF, EYM, or ESU.
 - 2) Crouse-Hinds; Type EYS or EZS.
 - 3) Killark; Type EY or Type EYS.

Section 4
Scope of Work and Technical Specifications
SECTION 26 05 33-8 RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

9. Drain Seal:
 - a. Manufacturers and Products:
 - 1) Appleton; Type EYD.
 - 2) Crouse-Hinds; Type EYD or Type EZD.
10. Drain/Breather Fitting:
 - a. Manufacturers and Products:
 - 1) Appleton; Type ECDB.
 - 2) Crouse-Hinds; Type ECD.
11. Expansion Fitting:
 - a. Manufacturers and Products:
 - 1) Deflection/Expansion Movement:
 - a) Appleton; Type DF.
 - b) Crouse-Hinds; Type XD.
 - 2) Expansion Movement Only:
 - a) Appleton; Type XJ.
 - b) Crouse-Hinds; Type XJ.
 - c) Thomas & Betts; XJG-TP.
12. Cable Sealing Fitting:
 - a. To form watertight nonslip cord or cable connection to conduit.
 - b. For Conductors with OD of 1/2 inch or less: Neoprene bushing at connector entry.
 - c. Manufacturers and Products:
 - 1) Appleton; CG-S.
 - 2) Crouse-Hinds; CGBS.
13. Electric Metallic Tubing:
 - a. Meet requirements of UL514B.
 - b. Type: Steel body and locknuts with steel or malleable iron compression nuts. Set screw and drive-on fittings not permitted.
 - c. Electro zinc-plated inside and out.

Section 4
Scope of Work and Technical Specifications
SECTION 26 05 33-9 RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

- d. Raintight.
- e. Coupling Manufacturers and Products:
 - 1) Appleton; Type 95T.
 - 2) Crouse-Hinds.
 - 3) Thomas & Betts.
- f. Connector Manufacturers and Products:
 - 1) Appleton; Type ETP.
 - 2) Crouse-Hinds.
 - 3) Thomas & Betts.
- 14. PVC Conduit and Tubing:
 - a. Meet requirements of NEMA TC 3.
 - b. Type: PVC, slip-on.
- 15. PVC-Coated Rigid Galvanized Steel Conduit:
 - a. Meet requirements of UL 514B.
 - b. Fittings: Rigid galvanized steel type, PVC coated by conduit manufacturer.
 - c. Conduit Bodies: Cast metal hot-dipped galvanized or urethane finish. Cover shall be of same material as conduit body. PVC coated by conduit manufacturer.
 - d. Finish: 40-mil PVC exterior, 2-mil urethane interior.
 - e. Overlapping pressure-sealing sleeves.
 - f. Conduit Hangers, Attachments, and Accessories: PVC-coated.
 - g. Manufacturers:
 - 1) Robroy Industries.
 - 2) Ocal
 - h. Expansion Fitting:
 - 1) Manufacturer and Product: Ocal; OCAL-BLUE XJG.
- 16. Flexible Metal, Liquid-Tight Conduit:

Section 4
Scope of Work and Technical Specifications
SECTION 26 05 33-10 RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

- a. Metal insulated throat connectors with integral nylon or plastic bushing rated for 105 degrees C.
 - b. Insulated throat and sealing O-rings.
 - c. Manufacturers and Products:
 - 1) Thomas & Betts; Series 5331.
 - 2) O-Z/Gedney; Series 4Q.
- 17. Flexible Metal, Nonliquid-Tight Conduit:
 - a. Meet requirements of UL 514B.
 - b. Body: Galvanized steel or malleable iron.
 - c. Throat: Nylon insulated.
 - d. 1-1/4-Inch Conduit and Smaller: One screw body.
 - e. 1-1/2-Inch Conduit and Larger: Two screw body
 - f. Manufacturers and Products: Appleton; Series 7400.
- 18. Flexible, Nonmetallic, Liquid-Tight Conduit:
 - a. Meet requirements of UL 514B.
 - b. Type: High strength plastic body, complete with lock nut, O-ring, threaded ferule, sealing ring, and compression nut.
 - c. Body/compression nut (gland) design to ensure high mechanical pullout strength and watertight seal.
 - d. Manufacturers and Products:
 - 1) Carlon; Type LT.
 - 2) Thomas & Betts; Series 6300.
 - 3) O-Z/Gedney; Series 4Q-P.
- 19. Flexible Coupling, Hazardous Locations:
 - a. Approved for use in atmosphere involved.
 - b. Rating: Watertight and UL listed for use in Class I, Division 1 and 2 areas.
 - c. Outer bronze braid and an insulated liner.
 - d. Conductivity equal to a similar length of rigid metal conduit.

Section 4
Scope of Work and Technical Specifications
SECTION 26 05 33-11 RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

- e. Manufacturers and Products:
 - 1) Crouse-Hinds; Type ECGJH or Type ECLK.
 - 2) Appleton; EXGJH or EXLK.

20. Watertight Entrance Seal Device:

- a. New construction:
 - 1) Material: Oversized sleeve, malleable iron body with sealing ring, pressure ring, grommet seal, and pressure clamp.
 - 2) Manufacturer and Product: O-Z/Gedney; Type FSK or Type WSK, as required.
- b. Cored-Hole Application:
 - 1) Material: Assembled dual pressure disks, neoprene sealing ring, and membrane clamp.
 - 2) Manufacturer and Product: O-Z/Gedney; Series CSM.

2.03 METAL WIREWAYS AND AUXILIARY GUTTERS

- A. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 12 unless otherwise indicated, and sized according to NFPA 70.
- B. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

2.04 NONMETALLIC WIREWAYS AND AUXILIARY GUTTERS

- A. Listing and Labeling: Nonmetallic wireways and auxiliary gutters shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Description: PVC, extruded and fabricated to required size and shape, and having snap-on cover, mechanically coupled connections, and plastic fasteners.
- C. Fittings and Accessories: Couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings shall match and mate with wireways as required for complete system.
- D. Solvents and Adhesives: As recommended by conduit manufacturer.

2.05 BOXES, ENCLOSURES, AND CABINETS

Section 4
Scope of Work and Technical Specifications
SECTION 26 05 33-12 RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

- A. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.
- B. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
- C. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, aluminum, Type FD, with gasketed cover.
- D. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.
- E. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- F. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum with gasketed cover.
- G. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
- H. Gangable boxes are prohibited.
- I. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 12 with continuous-hinge cover with flush latch unless otherwise indicated.
 - 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
 - 2. Nonmetallic Enclosures: Plastic.
 - 3. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.
- J. Cabinets:
 - 1. NEMA 250, Type 4X stainless steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
 - 2. Hinged door in front cover with flush latch and concealed hinge.
 - 3. Key latch to match panelboards.
 - 4. Metal barriers to separate wiring of different systems and voltage.
 - 5. Accessory feet where required for freestanding equipment.
 - 6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.06 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

- A. General Requirements for Handholes and Boxes:
 - 1. Boxes and handholes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.

Section 4
Scope of Work and Technical Specifications
SECTION 26 05 33-13 RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel, fiberglass, or a combination of the two.
1. Standard: Comply with SCTE 77.
 2. Configuration: Designed for flush burial with open bottom unless otherwise indicated.
 3. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
 4. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
 5. Cover Legend: Molded lettering, "ELECTRIC".
 6. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.

PART 3 - EXECUTION

3.01 RACEWAY APPLICATION

- A. Outdoors: Apply raceway products as specified below unless otherwise indicated:
1. Exposed Conduit: Galvanized Rigid Steel (non corrosive areas) and PVC Coated GRS (corrosive areas).
 2. Concealed Conduit, Aboveground: IMC (non corrosive areas).
 3. Underground Conduit: RNC, Type EPC-40-PVC, direct buried.
 4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
 5. Boxes and Enclosures, Aboveground: as indicated on the drawings.
- B. Indoors: Apply raceway products as specified below unless otherwise indicated.
1. Exposed, Not Subject to Physical Damage: Galvanized Rigid Steel (non corrosive areas) and PVC Coated GRS (corrosive areas).
 2. Exposed, Not Subject to Severe Physical Damage: Galvanized Rigid Steel (non corrosive areas) and PVC Coated GRS (corrosive areas).

Section 4
Scope of Work and Technical Specifications
SECTION 26 05 33-14 RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

3. Exposed and Subject to Severe Physical Damage: Galvanized Rigid Steel (non corrosive areas) and PVC Coated GRS (corrosive areas):
 - a. Loading dock.
 - b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
 - c. Mechanical rooms.
 4. Concealed in Ceilings and Interior Walls and Partitions: IMC (non corrosive areas).
 5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
 6. Damp or Wet Locations: Galvanized Rigid Steel (non corrosive areas) and PVC Coated GRS (corrosive areas).
 7. Boxes and Enclosures: as indicated on the drawings.
- C. Minimum Raceway Size: 3/4-inch (21-mm) trade size above grade and 1" underground.
- D. Raceway Fittings: Compatible with raceways and suitable for use and location.
- E. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
- F. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.
- G. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.
- H. Install surface raceways only where indicated on Drawings.
- I. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F (49 deg C).

3.02 INSTALLATION

- A. Comply with requirements in Section 26 05 29 "Hangers and Supports for Electrical Systems" for hangers and supports.
- B. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.

Section 4
Scope of Work and Technical Specifications
SECTION 26 05 33-15 RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

- C. Do not install raceways or electrical items on any "explosion-relief" walls or rotating equipment.
- D. Do not fasten conduits onto the bottom side of a metal deck roof.
- E. Keep raceways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- F. Comply with requirements in Section 26 05 29 "Hangers and Supports for Electrical Systems" for hangers and supports.
- G. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- H. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches (300 mm) of changes in direction.
- I. Make bends in raceway using large-radius preformed ells. Field bending shall be according to NFPA 70 minimum radii requirements. Use only equipment specifically designed for material and size involved.
- J. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- K. Support conduit within 12 inches (300 mm) of enclosures to which attached.
- L. Raceways Embedded in Slabs:
 - 1. Run conduit larger than 1-inch (27-mm) trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure raceways to reinforcement at maximum 10-foot (3-m) intervals.
 - 2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
 - 3. Arrange raceways to keep a minimum of 2 inches (50 mm) of concrete cover in all directions.
 - 4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
 - 5. Change from RNC to GRC before rising above floor.
- M. Stub-ups to Above Recessed Ceilings:
 - 1. Use EMT, IMC, or RMC for raceways.
 - 2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

Section 4

Scope of Work and Technical Specifications
SECTION 26 05 33-16 RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

- N. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- O. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.
- P. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.
- Q. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch (35-mm) trade size and insulated throat metal bushings on 1-1/2-inch (41-mm) trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.
- R. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.
- S. Surface Raceways:
1. Install surface raceway with a minimum 2-inch (50-mm) radius control at bend points.
 2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inches (1200 mm) and with no less than two supports per straight raceway section. Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.
- T. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces.
- U. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:
1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
 2. Where an underground service raceway enters a building or structure, cabinet or panel.
 3. Conduit extending from interior to exterior of building.

Section 4
Scope of Work and Technical Specifications
SECTION 26 05 33-17 RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

4. Conduit extending into pressurized duct and equipment.
5. Conduit extending into pressurized zones that are automatically controlled to maintain different pressure set points.
6. Where otherwise required by NFPA 70.

V. Expansion-Joint Fittings:

1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F (17 deg C) and that has straight-run length that exceeds 25 feet (7.6 m).
2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
3. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F (70 deg C) temperature change.
4. Outdoor Locations Exposed to Direct Sunlight: 155 deg F (86 deg C) temperature change.
5. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F (70 deg C) temperature change.
6. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per degree F (0.06 mm per meter of length of straight run per degree C) of temperature change for PVC conduits.
7. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
8. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

W. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 36 inches (915 mm) of flexible conduit for recessed and semirecessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors. Flexible conduit shall be type UA Sealtite with copper bands or engineer approved equal.

1. Use LFMC in damp or wet locations subject to severe physical damage.
2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.

Section 4
Scope of Work and Technical Specifications
SECTION 26 05 33-18 RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

X. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to bottom of box unless otherwise indicated.

Y. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between the box and cover plate or the supported equipment and box.

Z. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.

AA. Locate boxes so that cover or plate will not span different building finishes.

BB. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.

CC. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

DD. Set metal floor boxes level and flush with finished floor surface.

EE. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.03 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Section 31 23 00 "Trench Excavation and Backfill" for pipe less than 6 inches (150 mm) in nominal diameter.

2. Install backfill as specified in Section 31 23 00 "Trench Excavation and Backfill."

3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches (300 mm) of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Section 31 23 00 "Trench Excavation and Backfill."

4. Install manufactured duct elbows for stub-up at poles and equipment and at building entrances through floor unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.

Section 4

Scope of Work and Technical Specifications
SECTION 26 05 33-19 RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

5. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.
6. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches (75 mm) of concrete for a minimum of 12 inches (300 mm) on each side of the coupling.
7. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches (1500 mm) from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.
8. Underground Warning Tape: Comply with requirements in Section 26 05 53 "Identification for Electrical Systems."
9. Conduits to be encased in concrete with the top of the concrete stained red. Concrete to extend a minimum of 6-inches from outside of conduit and #4 bars at 18-inches on center shall be used for reinforcement.

3.04 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

- A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.
- B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch (12.5-mm) sieve to No. 4 (4.75-mm) sieve and compacted to same density as adjacent undisturbed earth.
- C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch (25 mm) above finished grade.
- D. Install handholes with bottom below frost line below grade.
- E. Field-cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

3.05 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies.

3.06 FIRESTOPPING

- A. Install firestopping at penetrations of fire-rated floor and wall assemblies.

Section 4
Scope of Work and Technical Specifications

SECTION 26 05 33-20 RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

3.07 PROTECTION

- A. Protect coatings, finishes, and cabinets from damage and deterioration.
- B. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
- C. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION

SECTION 26 05 43

UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Metal conduits and fittings, including GRC conduit.
 - 2. Rigid nonmetallic duct.
 - 3. Flexible nonmetallic duct.
 - 4. Duct accessories.
 - 5. Precast concrete handholes.
 - 6. Polymer concrete handholes and boxes with polymer concrete cover.
 - 7. Fiberglass handholes and boxes with polymer concrete cover.
 - 8. Fiberglass handholes and boxes.
 - 9. High density plastic boxes.

1.02 DEFINITIONS

- A. Direct Buried: Duct or a duct bank to be encased in concrete.
- B. Duct: A single duct or multiple ducts. Duct may be either installed singly or as component of a duct bank.
- C. Duct Bank:
 - 1. Two or more ducts installed in parallel, with or without additional casing materials.
 - 2. Multiple duct banks.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings:
 - 1. Factory-Fabricated Handholes and Boxes Other Than Precast Concrete:
 - a. Include dimensioned plans, sections, and elevations, and fabrication and installation details.
 - b. Include duct entry provisions, including locations and duct sizes.

Section 4

Scope of Work and Technical Specifications

SECTION 26 05 43-2 UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

- c. Include cover design.
- d. Include grounding details.
- e. Include dimensioned locations of cable rack inserts, and pulling-in and lifting irons.

1.04 INFORMATIONAL SUBMITTALS

- A. Duct and Duct-Bank Coordination Drawings: Show duct profiles and coordination with other utilities and underground structures. Drawings shall be signed and sealed by a qualified professional engineer.
- B. Qualification Data: For professional engineer and testing agency responsible for testing nonconcrete handholes and boxes.
- C. Product Certificates: For concrete and steel used in precast concrete handholes, as required by ASTM C 858.
- D. Source quality-control reports.
- E. Field quality-control reports.

1.05 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.

PART 2 - PRODUCTS

2.01 METAL CONDUIT AND FITTINGS

- A. GRC: Comply with ANSI C80.1 and UL 6.
- B. Listed and labeled as defined in NFPA 70, by a nationally recognized testing laboratory, and marked for intended location and application.

2.02 RIGID NONMETALLIC DUCT

- A. Underground Plastic Utilities Duct: Type EPC-40-PVC RNC, complying with NEMA TC 2 and UL 651, with matching fittings complying with NEMA TC 3 by same manufacturer as duct.
- B. Listed and labeled as defined in NFPA 70, by a nationally recognized testing laboratory, and marked for intended location and application.
- C. Solvents and Adhesives: As recommended by conduit manufacturer.

2.03 DUCT ACCESSORIES

Section 4

Scope of Work and Technical Specifications

SECTION 26 05 43-3 UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

- A. Duct Spacers: Factory-fabricated, rigid, PVC interlocking spacers; sized for type and size of duct with which used, and selected to provide minimum duct spacing indicated while supporting duct during concreting or backfilling.
- B. Underground-Line Warning Tape: Comply with requirements for underground-line warning tape specified in Section 26 05 53 "Identification for Electrical Systems."

2.04 MANHOLE AND HANDHOLE CONSTRUCTION MATERIALS

- A. Manholes:
 - 1. Concrete: Where applicable, conform to Division 03 - Cast-In-Place Concrete, for concrete and reinforcing.
 - a. Strength: 3000 psi (20.7 Mpa) minimum 28-day compressive strength.
 - b. Aggregate for Duct Encasement: 3/8-inch maximum size.
 - 2. Concrete Reinforcement: All underground structures, including duct banks, shall utilize concrete reinforced with rebar. Intent is for rebar details to be in accordance with the requirements of Division 03 – Concrete Reinforcement and Dowelling, and / or electrical details as shown on the Contract Drawings. In the details in Contract Drawings, structure and duct bank rebar shall be #4 steel rebar. Install rebar continuously near all the structure's or duct bank's top and bottom edges and corners, with additional #4 rebar spaced such that maximum spacing between rebars is 18-inches. Additionally, duct banks shall have #4 rebar placed across the top and bottom of the bank, every 18-inches, for the entire length of the duct bank. The top of all concrete duct banks to be stained red.
- B. Handholes:
 - 1. Non Traffic Areas:
 - a. Box: Polymer concrete from select-grade aggregates reinforced with fiberglass in combination with a polymer resin system.
 - b. Cover: Polymer concrete type with locking bolts and pull slots
 - c. Cover Marking: ELECTRICAL, TELEPHONE, or as shown.
 - d. Size: Minimum size shall be 10" x 17" and Maximum size shall be 30" x 48". When larger enclosure is required, manhole construction shall be used.
 - 2. Traffic Areas:
 - a. Box: Reinforced, cast concrete with extension and bottom slab.
 - b. Cover: Steel checked plate; H/20 loading with screw down.

Section 4
Scope of Work and Technical Specifications

SECTION 26 05 43-4 UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

- c. Cover Marking: ELECTRICAL, TELEPHONE, or as shown.

2.05 MANHOLES AND HANDHOLES ACCESSORIES

- A. Cable racks, supports, pulling-in-irons, and hardware shall be hot dipped galvanized steel.
- B. Precast concrete manholes and handholes shall be heavy duty type, designed for a Class H20 wheel load. Precast manholes and handholes shall be as manufactured by Old Castle Precast, Inc., or approved equal.
- C. Manhole frames and covers shall be cast-iron heavy-duty type for class H-20-wheel loading, and shall be as manufactured by Neenah, or equal. Manhole covers shall be marked Electrical Medium Voltage or Electric Low Voltage as applicable, in addition stamp the manhole covers with minimum 1-1/2-inch high letters and numbers for manhole identification. Provide gasketed covers with stainless steel non-standard bolt head configuration security bolts. Provide two (2) special 1/2-inch drive sockets to fit the security bolts supplied. Apply anti-siege compound to the security bolts prior to installation. The minimum manhole cover diameter shall be 26".
- D. Handhole covers and frames shall be hot dipped galvanized and designed for a Class H-20-wheel load. Handhole covers and hatches shall have Type 316 stainless steel security bolts. Handhole covers shall be marked Electric Medium Voltage or Electric Low Voltage as applicable, in addition stamp the handhole covers with minimum 1-1/2-inch high letters and numbers for handhole identification. Provide gasketed covers with stainless steel non-standard bolt head configuration security bolts. Provide two (2) special 1/2-inch drive sockets to fit the security bolts supplied. Apply anti-siege compound to the security bolts prior to installation.
- E. Conduit bell ends shall be installed in all manholes.
- F. Manholes and Handholes shall be installed to permit passive drainage of infiltration seepage as detailed on the Drawings. In the absence of such detail, provide 3-inch diameter PVC sleeve at low point of structure extending to a depth approximately 12-inches below the bottom surface of the structure. Provide a finely crushed and packed stone base below the structure to a total depth approximately 24-inches below the structure bottom to permit drainage. Provide drain cover at pipe termination in structure.

2.06 SOURCE QUALITY CONTROL

- A. Test and inspect precast concrete utility structures according to ASTM C 1037.
- B. Nonconcrete Handhole and Pull-Box Prototype Test: Test prototypes of and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.
1. Tests of materials shall be performed by an independent testing agency.

Section 4

Scope of Work and Technical Specifications

SECTION 26 05 43-5 UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

2. Strength tests of complete boxes and covers shall be by an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
3. Testing machine pressure gages shall have current calibration certification, complying with ISO 9000 and ISO 10012, and traceable to NIST standards.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Coordinate layout and installation of duct, duct bank, handholes, and boxes with final arrangement of other utilities, site grading, and surface features as determined in the field. Notify Architect if there is a conflict between areas of excavation and existing structures or archaeological sites to remain.
- B. Coordinate elevations of duct and duct-bank entrances into handholes, and boxes with final locations and profiles of duct and duct banks, as determined by coordination with other utilities, underground obstructions, and surface features. Revise locations and elevations as required to suit field conditions and to ensure that duct and duct bank will drain to handholes, and as approved by Architect.

3.02 UNDERGROUND DUCT APPLICATION

- A. Duct for Electrical Feeders 600 V and Less: RNC Type EPC-40-PVC, direct-buried unless otherwise indicated.
- B. Duct for Electrical Branch Circuits: RNC Type EPC-40-PVC, direct-buried unless otherwise indicated.
- C. Underground Ducts Crossing Paved Paths, Driveways and Roadways: RNC Type EPC-40 PVC, encased in reinforced concrete.

3.03 UNDERGROUND ENCLOSURE APPLICATION

- A. Handholes and Boxes for 600 V and Less:
 1. Units in Roadways and Other Deliberate Traffic Paths: Precast concrete. AASHTO HB 17, H-20 structural load rating.
 2. Units in Driveway, Parking Lot, and Off-Roadway Locations, Subject to Occasional, Nondeliberate Loading by Heavy Vehicles: Polymer concrete, SCTE 77, Tier 15 structural load rating.
 3. Units in Sidewalk and Similar Applications with a Safety Factor for Nondeliberate Loading by Vehicles: Polymer concrete units, SCTE 77, Tier 8 structural load rating.

Section 4
Scope of Work and Technical Specifications

SECTION 26 05 43-6 UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

4. Cover design load shall not exceed the design load of the handhole or box.

3.04 EARTHWORK

- A. Excavation and Backfill: Comply with Section 31 23 00 "Trench Excavation and Backfill," but do not use heavy-duty, hydraulic-operated, compaction equipment.
- B. Restoration: Replace area immediately after backfilling is completed or after construction vehicle traffic in immediate area is complete.
- C. Restore surface features at areas disturbed by excavation, and re-establish original grades unless otherwise indicated. Replace removed sod immediately after backfilling is completed.
- D. Restore areas disturbed by trenching, storing of dirt, cable laying, and other work. Restore vegetation and include necessary topsoiling, fertilizing, liming, seeding, sodding, sprigging, and mulching.
- E. Cut and patch existing pavement in the path of underground duct, duct bank, and underground structures.

3.05 DUCT AND DUCT-BANK INSTALLATION

- A. Where indicated on Drawings, install duct, spacers, and accessories into the duct-bank configuration shown. Duct installation requirements in this Section also apply to duct bank.
- B. Install duct according to NEMA TCB 2.
- C. Slope: Pitch duct a minimum slope of 1:300 down toward handholes and away from buildings and equipment. Slope duct from a high point between two handholes, to drain in both directions.
- D. Curves and Bends: Use 5-degree angle couplings for small changes in direction. Use manufactured long sweep bends with a minimum radius of 48 inches, both horizontally and vertically, at other locations unless otherwise indicated.
 1. Duct shall have maximum of two 90 degree bends or the total of all bends shall be no more 180 degrees between pull points.
- E. Joints: Use solvent-cemented joints in duct and fittings and make watertight according to manufacturer's written instructions. Stagger couplings so those of adjacent duct do not lie in same plane.
- F. Installation Adjacent to High-Temperature Steam Lines: Where duct is installed parallel to underground steam lines, perform calculations showing the duct will not be subject to environmental temperatures above 40 deg C. Where environmental temperatures are calculated to rise above 40 deg C, and anywhere the duct crosses

Section 4

Scope of Work and Technical Specifications

SECTION 26 05 43-7 UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

above an underground steam line, install insulation blankets listed for direct burial to isolate the duct bank from the steam line.

G. End Bell Entrances to Polymer Concrete Handholes: Use end bells, spaced approximately 10 inches o.c. for 5-inch duct, and vary proportionately for other duct sizes.

H. Terminator Entrances to Polymer Concrete Handholes: Use manufactured, cast-in-place duct terminators, with entrances into structure spaced approximately 6 inches o.c. for 4-inch duct, and vary proportionately for other duct sizes.

I. Building Wall Penetrations: Make a transition from underground duct to GRC at least 10 feet outside the building wall, without reducing duct line slope away from the building and without forming a trap in the line. Use fittings manufactured for RNC-to-GRC transition. Install GRC penetrations of building walls.

J. Sealing: Provide temporary closure at terminations of duct with pulled cables. Seal spare duct at terminations. Use sealing compound and plugs to withstand at least 15-psig hydrostatic pressure.

K. Pulling Cord: Install 200-lbf-test nylon cord in empty ducts.

L. Direct-Buried Duct and Duct Bank:

1. Excavate trench bottom to provide firm and uniform support for duct. Comply with requirements in Section 31 23 00 "Trench Excavation and Backfill" for preparation of trench bottoms for pipes less than 6 inches in nominal diameter.
2. Width: Excavate trench 12 inches wider than duct on each side.
3. Width: Excavate trench 3 inches wider than duct on each side.
4. Depth: Install top of duct at least 36 inches below finished grade unless otherwise indicated.
5. Set elevation of bottom of duct bank below frost line.
6. Support ducts on duct spacers coordinated with duct size, duct spacing, and outdoor temperature.
7. Spacer Installation: Place spacers close enough to prevent sagging and deforming of duct, with not less than four spacers per 20 feet of duct. Place spacers within 24 inches of duct ends. Stagger spacers approximately 6 inches between tiers. Secure spacers to earth and to ducts to prevent floating during concreting. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.

Section 4

Scope of Work and Technical Specifications

SECTION 26 05 43-8 UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

8. Install duct with a minimum of 3 inches between ducts for like services and 6 inches between power and communications duct.
9. Elbows: Install manufactured duct elbows for stub-ups, at building entrances, and at changes of direction in duct direction unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.
10. Install manufactured GRC elbows for stub-ups, at building entrances, and at changes of direction in duct.
11. After installing first tier of duct, backfill and compact. Start at tie-in point and work toward end of duct run, leaving ducts at end of run free to move with expansion and contraction as temperature changes during this process. Repeat procedure after placing each tier. After placing last tier, hand place backfill to 4 inches over duct and hand tamp. Firmly tamp backfill around ducts to provide maximum supporting strength. Use hand tamper only. After placing controlled backfill over final tier, make final duct connections at end of run and complete backfilling with normal compaction. Comply with requirements in Section 31 23 00 "Trench Excavation and Backfill" for installation of backfill materials.
 - a. Place minimum 3 inches of sand as a bed for duct. Place sand to a minimum of 6 inches above top level of duct.
 - b. Place minimum 6 inches of engineered fill above concrete encasement of duct.

M. Underground-Line Warning Tape: Bury magnetic underground line specified in Section 26 05 53 "Identification for Electrical Systems" no less than 12 inches above all duct banks and approximately 12 inches below grade. Align tape parallel to and within 3 inches of centerline of duct bank. Provide an additional warning tape for each 12-inch increment of ductbank width over a nominal 18 inches. Space additional tapes 12 inches apart, horizontally.

3.06 INSTALLATION OF HANDHOLES AND BOXES OTHER THAN PRECAST CONCRETE

- A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting duct, to minimize bends and deflections required for proper entrances. Use box extension if required to match depths of duct, and seal joint between box and extension as recommended by manufacturer.
- B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.
- C. Elevation: In paved areas and trafficways, set cover flush with finished grade. Set covers of other handholes 1 inch above finished grade.
- D. Install handholes and boxes with bottom below frost line.

Section 4
Scope of Work and Technical Specifications

SECTION 26 05 43-9 UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in enclosure.

F. Field cut openings for duct according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

G. For enclosures installed in asphalt paving and subject to occasional, nondeliberate, heavy-vehicle loading, form and pour a concrete ring encircling, and in contact with, enclosure and with top surface screeded to top of box cover frame. Bottom of ring shall rest on compacted earth.

1. Concrete: 3000 psi, 28-day strength, complying with Section 03 30 00 "Cast-in-Place Concrete," with a troweled finish and dyed red.
2. Dimensions: 12 inches wide by 12 inches deep.

3.07 GROUNDING

A. Ground underground ducts and utility structures according to Section 26 05 26 "Grounding and Bonding for Electrical Systems."

3.08 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Demonstrate capability and compliance with requirements on completion of installation of underground duct, duct bank, and utility structures.
2. Pull solid aluminum or wood test mandrel through duct to prove joint integrity and adequate bend radii, and test for out-of-round duct. Provide a minimum 12-inch-long mandrel equal to duct size minus 1/4 inch. If obstructions are indicated, remove obstructions and retest.
3. Test handhole grounding to ensure electrical continuity of grounding and bonding connections. Measure and report ground resistance as specified in Section 26 05 26 "Grounding and Bonding for Electrical Systems."

B. Correct deficiencies and retest as specified above to demonstrate compliance.

C. Prepare test and inspection reports.

3.09 CLEANING

A. Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of duct until duct cleaner indicates that duct is clear of dirt and debris. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts.

Section 4

Scope of Work and Technical Specifications

SECTION 26 05 43-10 UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

- B. Clean internal surfaces of handholes, including sump.
 - 1. Sweep floor, removing dirt and debris.
 - 2. Remove foreign material.

END OF SECTION

SECTION 26 05 53

IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section Includes:
 - 1. Color and legend requirements for raceways, conductors, and warning labels and signs.
 - 2. Labels.
 - 3. Bands and tubes.
 - 4. Tapes and stencils.
 - 5. Tags.
 - 6. Signs.
 - 7. Cable ties.
 - 8. Paint for identification.
 - 9. Fasteners for labels and signs.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each type of label and sign to illustrate composition, size, colors, lettering style, mounting provisions, and graphic features of identification products.
- C. Delegated-Design Submittal: For arc-flash hazard study.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Comply with ASME A13.1.
- B. Comply with NFPA 70.
- C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.
- D. Comply with ANSI Z535.4 for safety signs and labels.

Section 4
Scope of Work and Technical Specifications
SECTION 26 05 53-2 IDENTIFICATION FOR ELECTRICAL SYSTEMS

E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

F. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.02 COLOR AND LEGEND REQUIREMENTS

A. Raceways and Cables Carrying Circuits at 600 V or Less:

1. Black letters on an orange field.
2. Legend: Indicate voltage and system or service type.

B. Color-Coding for Phase- and Voltage-Level Identification, 600 V or Less: Use colors listed below for ungrounded service, feeder and branch-circuit conductors.

1. Color shall be factory applied or field applied for sizes larger than No. 8 AWG if authorities having jurisdiction permit.
2. Colors for 208/120-V Circuits:
 - a. Phase A: Black.
 - b. Phase B: Red.
 - c. Phase C: Blue.
3. Colors for 240-V Circuits:
 - a. Phase A: Black.
 - b. Phase B: Red.
4. Colors for 480/277-V Circuits:
 - a. Phase A: Brown.
 - b. Phase B: Orange.
 - c. Phase C: Yellow.
5. Color for Neutral: White.
6. Color for Equipment Grounds: Green.
7. Colors for Isolated Grounds: Green with white stripe.

C. Warning Label Colors:

1. Identify system voltage with black letters on an orange background.

Section 4
Scope of Work and Technical Specifications
SECTION 26 05 53-3 IDENTIFICATION FOR ELECTRICAL SYSTEMS

D. Warning labels and signs shall include, but are not limited to, the following legends:

1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."

E. Equipment Identification Labels:

1. Black letters on a white field.

2.03 LABELS

A. Vinyl Wraparound Labels: Preprinted, flexible labels laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing label ends.

B. Snap-around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeves, with diameters sized to suit diameter and that stay in place by gripping action.

C. Self-Adhesive Wraparound Labels: Preprinted, 3-mil-thick, polyester flexible label with acrylic pressure-sensitive adhesive.

1. Self-Lamination: Clear; UV-, weather- and chemical-resistant; self-laminating, protective shield over the legend. Labels sized such that the clear shield overlaps the entire printed legend.
2. Marker for Labels: Permanent, waterproof, black ink marker recommended by tag manufacturer.
3. Marker for Labels: Machine-printed, permanent, waterproof, black ink recommended by printer manufacturer.

D. Self-Adhesive Labels: Polyester, thermal, transfer-printed, 3-mil-thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, configured for intended use and location.

1. Minimum Nominal Size:
 - a. 1-1/2 by 6 inches for raceway and conductors.
 - b. 3-1/2 by 5 inches for equipment.
 - c. As required by authorities having jurisdiction.

2.04 BANDS AND TUBES

- A. Snap-around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeves, 2 inches long, with diameters sized to suit diameter and that stay in place by gripping action.
- B. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tubes with machine-printed identification labels, sized to suit diameters of and shrunk to fit firmly around item being identified. Full shrink recovery occurs at a maximum of 200 deg F. Comply with UL 224.

2.05 TAPES AND STENCILS

- A. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.
- B. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; not less than 3 mils thick by 1 to 2 inches wide; compounded for outdoor use.
- C. Tape and Stencil: 4-inch-wide black stripes on 10-inch centers placed diagonally over orange background and is 12 inches wide. Stop stripes at legends.
- D. Floor Marking Tape: 2-inch-wide, 5-mil pressure-sensitive vinyl tape, with black and white stripes and clear vinyl overlay.
- E. Underground-Line Warning Tape:
 - 1. Tape:
 - a. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical utility lines.
 - b. Printing on tape shall be permanent and shall not be damaged by burial operations.
 - c. Tape material and ink shall be chemically inert and not subject to degradation when exposed to acids, alkalis, and other destructive substances commonly found in soils.
 - 2. Color and Printing:
 - a. Comply with ANSI Z535.1, ANSI Z535.2, ANSI Z535.3, ANSI Z535.4, and ANSI Z535.5.
 - b. Inscriptions for Red-Colored Tapes: "ELECTRIC LINE, HIGH VOLTAGE".
 - c. Inscriptions for Orange-Colored Tapes: "TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE".
 - 3. Tag: Type I:

Section 4
Scope of Work and Technical Specifications
SECTION 26 05 53-5 IDENTIFICATION FOR ELECTRICAL SYSTEMS

- a. Pigmented polyolefin, bright colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.
- b. Width: 3 inches.
- c. Thickness: 4 mils.
- d. Weight: 18.5 lb/1000 sq. ft.
- e. Tensile according to ASTM D 882: 30 lbf and 2500 psi.

4. Tag: Type ID:

- a. Detectable three-layer laminate, consisting of a printed pigmented polyolefin film, a solid aluminum-foil core, and a clear protective film that allows inspection of the continuity of the conductive core; bright colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.
- b. Width: 3 inches.
- c. Overall Thickness: 5 mils.
- d. Foil Core Thickness: 0.35 mil.
- e. Weight: 28 lb/1000 sq. ft.
- f. Tensile according to ASTM D 882: 70 lbf and 4600 psi.

F. Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height shall be 1 inch.

2.06 TAGS

A. Write-on Tags:

- 1. Polyester Tags: 0.010-inch-thick, with corrosion-resistant grommet and cable tie for attachment.
- 2. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.
- 3. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

2.07 CABLE TIES

A. General-Purpose Cable Ties: Fungus inert, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.

- 1. Minimum Width: 3/16 inch.
- 2. Tensile Strength at 73 Deg F according to ASTM D 638: 12,000 psi.

Section 4
Scope of Work and Technical Specifications
SECTION 26 05 53-6 IDENTIFICATION FOR ELECTRICAL SYSTEMS

3. Temperature Range: Minus 40 to plus 185 deg F.
 4. Color: Black, except where used for color-coding.
- B. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.
1. Minimum Width: 3/16 inch.
 2. Tensile Strength at 73 Deg F according to ASTM D 638: 12,000 psi.
 3. Temperature Range: Minus 40 to plus 185 deg F.
 4. Color: Black.
- C. Plenum-Rated Cable Ties: Self-extinguishing, UV stabilized, one piece, and self-locking.
1. Minimum Width: 3/16 inch.
 2. Tensile Strength at 73 Deg F according to ASTM D 638: 7000 psi.
 3. UL 94 Flame Rating: 94V-0.
 4. Temperature Range: Minus 50 to plus 284 deg F.
 5. Color: Black.

2.08 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Retain paint system applicable for surface material and location (exterior or interior).
- B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.
- B. Install identifying devices before installing acoustical ceilings and similar concealment.
- C. Verify identity of each item before installing identification products.

Section 4
Scope of Work and Technical Specifications
SECTION 26 05 53-7 IDENTIFICATION FOR ELECTRICAL SYSTEMS

- D. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.
- E. Apply identification devices to surfaces that require finish after completing finish work.
- F. Install signs with approved legend to facilitate proper identification, operation, and maintenance of electrical systems and connected items.
- G. Self-Adhesive Identification Products: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.
- H. System Identification for Raceways and Cables under 600 V: Identification shall completely encircle cable or conduit. Place identification of two-color markings in contact, side by side.
1. Secure tight to surface of conductor, cable, or raceway.
- I. System Identification for Raceways and Cables over 600 V: Identification shall completely encircle cable or conduit. Place adjacent identification of two-color markings in contact, side by side.
1. Secure tight to surface of conductor, cable, or raceway.
- J. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.
- K. Elevated Components: Increase sizes of labels, signs, and letters to those appropriate for viewing from the floor.
- L. Accessible Fittings for Raceways: Identify the covers of each junction and pull box of the following systems with the wiring system legend and system voltage. System legends shall be as follows:
1. "EMERGENCY POWER."
 2. "POWER."
 3. "UPS."
- M. Vinyl Wraparound Labels:
1. Secure tight to surface at a location with high visibility and accessibility.
 2. Attach labels that are not self-adhesive type with clear vinyl tape, with adhesive appropriate to the location and substrate.
- N. Snap-around Labels: Secure tight to surface at a location with high visibility and accessibility.

Section 4
Scope of Work and Technical Specifications
SECTION 26 05 53-8 IDENTIFICATION FOR ELECTRICAL SYSTEMS

- O. Self-Adhesive Wraparound Labels: Secure tight to surface of raceway or cable at a location with high visibility and accessibility.
- P. Self-Adhesive Labels:
1. On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and operation and maintenance manual.
 2. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on 1-1/2-inch-high label; where two lines of text are required, use labels 2 inches high.
- Q. Snap-around Color-Coding Bands: Secure tight to surface at a location with high visibility and accessibility.
- R. Heat-Shrink, Preprinted Tubes: Secure tight to surface at a location with high visibility and accessibility.
- S. Marker Tapes: Secure tight to surface at a location with high visibility and accessibility.
- T. Self-Adhesive Vinyl Tape: Secure tight to surface at a location with high visibility and accessibility.
1. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding.
- U. Tape and Stencil: Comply with requirements in painting Sections for surface preparation and paint application.
- V. Floor Marking Tape: Apply stripes to finished surfaces following manufacturer's written instructions.
- W. Underground Line Warning Tape:
1. During backfilling of trenches, install continuous underground-line warning tape directly above cable or raceway at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches overall.
 2. Limit use of underground-line warning tape to direct-buried cables.
 3. Install underground-line warning tape for direct-buried cables and cables in raceways.
- X. Write-on Tags:
1. Place in a location with high visibility and accessibility.

Section 4
Scope of Work and Technical Specifications
SECTION 26 05 53-9 IDENTIFICATION FOR ELECTRICAL SYSTEMS

2. Secure using corrosion resistant cable ties.

Y. Baked-Enamel Signs:

1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
2. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on minimum 1-1/2-inch-high sign; where two lines of text are required, use signs minimum 2 inches high.

Z. Metal-Backed Butyrate Signs:

1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
2. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on minimum 1-1/2-inch-high sign; where two lines of text are required, use signs minimum 2 inches high.

AA. Laminated Acrylic or Melamine Plastic Signs:

1. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
2. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on minimum 1-1/2-inch-high sign; where two lines of text are required, use signs minimum 2 inches high.

BB. Cable Ties: General purpose, for attaching tags, except as listed below:

1. Outdoors: UV-stabilized nylon.
2. In Spaces Handling Environmental Air: Plenum rated.

3.02 IDENTIFICATION SCHEDULE

A. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.

B. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, pull points, and locations of high visibility. Identify by system and circuit designation.

C. Accessible Raceways, Control Circuit Raceways, and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits, More Than 30 A and 120 V to Ground: Identify with self-adhesive raceway labels.

Section 4
Scope of Work and Technical Specifications
SECTION 26 05 53-10 IDENTIFICATION FOR ELECTRICAL SYSTEMS

1. Locate identification at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.
- D. Accessible Fittings for Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive labels containing the wiring system legend and system voltage. System legends shall be as follows:
1. "POWER"
 2. "CONTROLS"
 3. "SIGNALS"
- E. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use vinyl wraparound labels to identify the phase.
1. Locate identification at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.
- F. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use self-adhesive wraparound labels with the conductor or cable designation, origin, and destination.
- G. Control-Circuit Conductor Termination Identification: For identification at terminations, provide heat-shrink preprinted tubes with the conductor designation.
- H. Conductors to Be Extended in the Future: Attach marker tape to conductors and list source.
- I. Locations of Underground Lines: Underground-line warning tape for power, lighting, communication, and control wiring and optical-fiber cable.
- J. Workspace Indication: Apply floor marking tape to finished surfaces. Show working clearances in the direction of access to live parts. Workspace shall comply with NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.
- K. Instructional Signs: Self-adhesive labels, including the color code for grounded and ungrounded conductors.
- L. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive equipment labels.
1. Apply to exterior of door, cover, or other access.

Section 4
Scope of Work and Technical Specifications
SECTION 26 05 53-11 IDENTIFICATION FOR ELECTRICAL SYSTEMS

2. For equipment with multiple power or control sources, apply to door or cover of equipment, including, but not limited to, the following:

- a. Power-transfer switches.
- b. Controls with external control power connections.

M. Equipment Identification Labels:

- 1. Indoor Equipment: self-adhesive label.
- 2. Outdoor Equipment: Laminated acrylic or melamine sign.

END OF SECTION

SECTION 26 05 72

OVERCURRENT PROTECTIVE DEVICE SHORT CIRCUIT STUDY

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes a computer-based, fault-current study to determine the minimum interrupting capacity of circuit protective devices. The extents of the study shall include the all the electrical equipment associated with the new power distribution system.

1.02 ACTION SUBMITTALS

- A. Product Data: For computer software program to be used for studies.
- B. Other Action Submittals: Submit the following after the approval of system protective devices submittals. Submittals shall be in digital form.
1. Short-circuit study input data, including completed computer program input data sheets.
 2. Short-circuit study and equipment evaluation report; signed, dated, and sealed by a qualified professional engineer.
 - a. Submit study report for action prior to receiving final approval of the distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that the selection of devices and associated characteristics is satisfactory.
 - b. Revised single-line diagram, reflecting field investigation results and results of short-circuit study.

1.03 INFORMATIONAL SUBMITTALS

- A. Qualification Data: the study shall be performed by the firm regularly engaged in plant power system studies and analysis with at least 5 years of relevant experience.
- B. Product Certificates: For short-circuit study software, certifying compliance with IEEE 399.

1.04 QUALITY ASSURANCE

- A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are unacceptable.

Section 4
Scope of Work and Technical Specifications
SECTION 26 05 72-2 OVERCURRENT PROTECTIVE DEVICE SHORT CIRCUIT STUDY

B. Short-Circuit Study Software Developer Qualifications: An entity that owns and markets computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.

1. The computer program shall be developed under the charge of a licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.

C. Short-Circuit Study Specialist Qualifications: Professional engineer in charge of performing the study and documenting recommendations, licensed in the state where Project is located. All elements of the study shall be performed under the direct supervision and control of this professional engineer.

D. Field Adjusting Agency Qualifications: An independent agency, with the experience and capability to adjust overcurrent devices and to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

PART 2 - PRODUCTS

2.01 COMPUTER SOFTWARE

A. Comply with IEEE 399 and IEEE 551.

B. Analytical features of fault-current-study computer software program shall have the capability to calculate mandatory features as listed in IEEE 399.

2.02 SHORT-CIRCUIT STUDY REPORT CONTENTS

A. Executive summary.

B. Study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpretation of the computer printout.

C. One-line diagram, showing the following:

1. Protective device designations and ampere ratings.
2. Cable size and lengths.
3. Transformer kilovolt ampere (kVA) and voltage ratings.
4. Motor and generator designations and kVA ratings.

5. Switchgear, switchboard, motor-control center, and panelboard designations.

D. Comments and recommendations for system improvements, where needed.

E. Protective Device Evaluation:

Section 4
Scope of Work and Technical Specifications

SECTION 26 05 72-3 OVERCURRENT PROTECTIVE DEVICE SHORT CIRCUIT STUDY

1. Evaluate equipment and protective devices and compare to short-circuit ratings.
 2. Tabulations of circuit breaker, fuse, and other protective device ratings versus calculated short-circuit duties.
 3. For 600-V overcurrent protective devices, ensure that interrupting ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
 4. For devices and equipment rated for asymmetrical fault current, apply multiplication factors listed in the standards to 1/2-cycle symmetrical fault current.
- F. Short-Circuit Study Input Data: As described in "Power System Data" Article in the Evaluations.
- G. Short-Circuit Study Output:
1. Low-Voltage Fault Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
 - a. Voltage.
 - b. Calculated fault-current magnitude and angle.
 - c. Fault-point X/R ratio.
 - d. Equivalent impedance.
 2. Momentary Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
 - a. Voltage.
 - b. Calculated symmetrical fault-current magnitude and angle.
 - c. Fault-point X/R ratio.
 - d. Calculated asymmetrical fault currents:
 - 1) Based on fault-point X/R ratio.
 - 2) Based on calculated symmetrical value multiplied by 1.6.
 - 3) Based on calculated symmetrical value multiplied by 2.7.
 3. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
 - a. Voltage.
 - b. Calculated symmetrical fault-current magnitude and angle.
 - c. Fault-point X/R ratio.

Section 4
Scope of Work and Technical Specifications
SECTION 26 05 72-4 OVERCURRENT PROTECTIVE DEVICE SHORT CIRCUIT STUDY

- d. No AC Decrement (NACD) ratio.
- e. Equivalent impedance.
- f. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a symmetrical basis.
- g. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a total basis.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Obtain all data necessary for the conduct of the study.
 - 1. Verify completeness of data supplied on the one-line diagram. Call any discrepancies to the attention of Architect.
 - 2. For equipment provided that is Work of this Project, use characteristics submitted under the provisions of action submittals and information submittals for this Project.
- B. Gather and tabulate the following input data to support the short-circuit study:
 - 1. Product Data for Project's overcurrent protective devices involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
 - 2. Obtain electrical power utility impedance at the service.
 - 3. Power sources and ties.
 - 4. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in percent, and phase shift.
 - 5. For reactors, provide manufacturer and model designation, voltage rating, and impedance.
 - 6. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip, SCCR, current rating, and breaker settings.
 - 7. Busway manufacturer and model designation, current rating, impedance, lengths, and conductor material.
 - 8. Motor horsepower and NEMA MG 1 code letter designation.

Section 4
Scope of Work and Technical Specifications

SECTION 26 05 72-5 OVERCURRENT PROTECTIVE DEVICE SHORT CIRCUIT STUDY

9. Cable sizes, lengths, number, conductor material and conduit material (magnetic or nonmagnetic).

3.02 SHORT-CIRCUIT STUDY

- A. Perform study following the general study procedures contained in IEEE 399.
- B. Calculate short-circuit currents according to IEEE 551.
- C. Base study on the device characteristics supplied by device manufacturer.
- D. The extent of the electrical power system study shall include the entire facility.
- E. Begin short-circuit current analysis at the service, extending down to the system overcurrent protective devices.
- F. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Study all cases of system-switching configurations and alternate operations that could result in maximum fault conditions.
- G. The calculations shall include the ac fault-current decay from induction motors. The calculations shall also account for the fault-current dc decrement, to address the asymmetrical requirements of the interrupting equipment.
 1. For grounded systems, provide a bolted line-to-ground fault-current study for areas as defined for the three-phase bolted fault short-circuit study.
- H. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault at each of the following:
 1. Electric utility's supply termination point.
 2. Incoming switchgear.
 3. Low-voltage switchgear.
 4. Motor-control centers.
 5. Control panels.
 6. Automatic transfer switches.
 7. Branch circuit panelboards.
 8. Disconnect switches.

3.03 ADJUSTING

- A. Make minor modifications to equipment as required to accomplish compliance with short-circuit study.

Section 4
Scope of Work and Technical Specifications

SECTION 26 05 72-6 OVERCURRENT PROTECTIVE DEVICE SHORT CIRCUIT STUDY

3.04 DEMONSTRATION

- A. Train Owner's operating and maintenance personnel in the use of study results.

END OF SECTION

SECTION 26 05 73

OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes computer-based, overcurrent protective device coordination studies to determine overcurrent protective devices and to determine overcurrent protective device settings for selective tripping. The extents of the study shall include the all the electrical equipment associated with the new power distribution system.

1.02 ACTION SUBMITTALS

- A. Product Data: For computer software program to be used for studies.
- B. Other Action Submittals: Submit the following after the approval of system protective devices submittals. Submittals shall be in digital form.
1. Coordination-study input data, including completed computer program input data sheets.
 2. Study and equipment evaluation reports.
 3. Overcurrent protective device coordination study report; signed, dated, and sealed by a qualified professional engineer.
 - a. Submit study report for action prior to receiving final approval of the distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that the selection of devices and associated characteristics is satisfactory.

1.03 INFORMATIONAL SUBMITTALS

- A. Qualification Data: the study shall be performed by firm regularly engaged in plant power system studies and analysis with at least of 5 years of relevant experience.
- B. Product Certificates: For overcurrent protective device coordination study software, certifying compliance with IEEE 399.

1.04 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For the overcurrent protective devices to include in emergency, operation, and maintenance manuals.
1. In addition to items specified in Section 01 78 23 "Operation and Maintenance Data," include the following:

Section 4
Scope of Work and Technical Specifications
SECTION 26 05 73-2 OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY

- a. The following parts from the Protective Device Coordination Study Report:
 - 1) One-line diagram.
 - 2) Protective device coordination study.
 - 3) Time-current coordination curves.
- b. Power system data.

1.05 QUALITY ASSURANCE

A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are unacceptable.

B. Coordination Study Software Developer Qualifications: An entity that owns and markets computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.

- 1. The computer program shall be developed under the charge of a licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.

C. Coordination Study Specialist Qualifications: Professional engineer in charge of performing the study and documenting recommendations, licensed in the state where Project is located. All elements of the study shall be performed under the direct supervision and control of this professional engineer.

D. Field Adjusting Agency Qualifications: An independent agency, with the experience and capability to adjust overcurrent devices and to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

PART 2 - PRODUCTS

2.01 COMPUTER SOFTWARE DEVELOPERS

- A. Comply with IEEE 242 and IEEE 399.
- B. Analytical features of device coordination study computer software program shall have the capability to calculate mandatory features as listed in IEEE 399.
- C. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output. Computer software program shall report device settings and ratings of all overcurrent protective devices and shall demonstrate selective coordination by computer-generated, time-current coordination plots.

Section 4
Scope of Work and Technical Specifications
SECTION 26 05 73-3 OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY

2.02 PROTECTIVE DEVICE COORDINATION STUDY REPORT CONTENTS

- A. Executive summary.
- B. Study descriptions, purpose, basis and scope. Include case descriptions, definition of terms and guide for interpretation of the computer printout.
- C. One-line diagram, showing the following:
 - 1. Protective device designations and ampere ratings.
 - 2. Cable size and lengths.
 - 3. Transformer kilovolt ampere (kVA) and voltage ratings.
 - 4. Motor and generator designations and kVA ratings.
 - 5. Switchgear, switchboard, motor-control center, and panelboard designations.
- D. Study Input Data: As described in "Power System Data" Article.
- E. Short-Circuit Study Output: As specified in "Short Circuit Study Output" Paragraph in "Short-Circuit Study Report Contents" Article in Section 26 05 72 "Overcurrent Protective Device Short-Circuit Study."
- F. Protective Device Coordination Study:
 - 1. Report recommended settings of protective devices, ready to be applied in the field. Use manufacturer's data sheets for recording the recommended setting of overcurrent protective devices when available.
 - a. Phase and Ground Relays:
 - 1) Device tag.
 - 2) Relay current transformer ratio and tap, time dial, and instantaneous pickup value.
 - 3) Recommendations on improved relaying systems, if applicable.
 - b. Circuit Breakers:
 - 1) Adjustable pickups and time delays (long time, short time, ground).
 - 2) Adjustable time-current characteristic.
 - 3) Adjustable instantaneous pickup.
 - 4) Recommendations on improved trip systems, if applicable.

Section 4

Scope of Work and Technical Specifications
SECTION 26 05 73-4 OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY

c. Fuses: Show current rating, voltage, and class.

G. Time-Current Coordination Curves: Determine settings of overcurrent protective devices to achieve selective coordination. Graphically illustrate that adequate time separation exists between devices installed in series, including power utility company's upstream devices. Prepare separate sets of curves for the switching schemes and for emergency periods where the power source is local generation. Show the following information:

1. Device tag and title, one-line diagram with legend identifying the portion of the system covered.
2. Terminate device characteristic curves at a point reflecting maximum symmetrical or asymmetrical fault current to which the device is exposed.
3. Identify the device associated with each curve by manufacturer type, function, and, if applicable, tap, time delay, and instantaneous settings recommended.
4. Plot the following listed characteristic curves, as applicable:
 - a. Power utility's overcurrent protective device.
 - b. Low-voltage fuses including manufacturer's minimum melt, total clearing, tolerance, and damage bands.
 - c. Low-voltage equipment circuit-breaker trip devices, including manufacturer's tolerance bands.
 - d. Transformer full-load current, magnetizing inrush current.
 - e. Ground-fault protective devices.
 - f. The largest feeder circuit breaker in each motor-control center and panelboard.
5. Provide adequate time margins between device characteristics such that selective operation is achieved.
6. Comments and recommendations for system improvements.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine Project overcurrent protective device submittals for compliance with electrical distribution system coordination requirements and other conditions affecting performance. Devices to be coordinated are indicated on Drawings.

Section 4
Scope of Work and Technical Specifications
SECTION 26 05 73-5 OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY

1. Proceed with coordination study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to coordination study may not be used in study.

3.02 PROTECTIVE DEVICE COORDINATION STUDY

- A. Comply with IEEE 242 for calculating short-circuit currents and determining coordination time intervals.
- B. Comply with IEEE 399 for general study procedures.
- C. The study shall be based on the device characteristics supplied by device manufacturer.
- D. The extent of the electrical power system study shall include the entire facility.
- E. Begin analysis at the service, extending down to the system overcurrent protective devices.
- F. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Study all cases of system-switching configurations and alternate operations that could result in maximum fault conditions.
- G. The calculations shall include the ac fault-current decay from induction motors. The calculations shall also account for the fault-current dc decrement, to address the asymmetrical requirements of the interrupting equipment.
 1. For grounded systems, provide a bolted line-to-ground fault-current study for areas as defined for the three-phase bolted fault short-circuit study.
- H. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault and single line-to-ground fault at each of the following:
 1. Electric utility's supply termination point.
 2. Switchgear.
 3. Low-voltage switchgear.
 4. Motor-control centers.
 5. Standby generators and automatic transfer switches.
 6. Branch circuit panelboards.
- I. Protective Device Evaluation:
 1. Evaluate equipment and protective devices and compare to short-circuit ratings.
 2. Adequacy of switchgear, motor-control centers, and panelboard bus bars to withstand short-circuit stresses.

3.03 POWER SYSTEM DATA

A. Obtain all data necessary for the conduct of the overcurrent protective device study.

1. Verify completeness of data supplied in the one-line diagram on Drawings. Call discrepancies to the attention of Architect.
2. Use characteristics submitted under the provisions of action submittals and information submittals for this Project.

B. Gather and tabulate the following input data to support coordination study. The list below is a guide.

1. Product Data for overcurrent protective devices specified in other Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
2. Electrical power utility impedance at the service.
3. Power sources and ties.
4. Short-circuit current at each system bus, three phase and line-to-ground.
5. Full-load current of all loads.
6. Voltage level at each bus.
7. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in percent, and phase shift.
8. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip and available range of settings, SCCR, current rating, and breaker settings.
9. Maximum demands from service meters.
10. Busway manufacturer and model designation, current rating, impedance, lengths, and conductor material.
11. Motor horsepower and NEMA MG 1 code letter designation.
12. Low-voltage cable sizes, lengths, number, conductor material, and conduit material (magnetic or nonmagnetic).
13. Data sheets to supplement electrical distribution system diagram, cross-referenced with tag numbers on diagram, showing the following:

Section 4
Scope of Work and Technical Specifications
SECTION 26 05 73-7 OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY

- a. Special load considerations, including starting inrush currents and frequent starting and stopping.
- b. Ratings, types, and settings of utility company's overcurrent protective devices.
- c. Special overcurrent protective device settings or types stipulated by utility company.
- d. Time-current-characteristic curves of devices indicated to be coordinated.
- e. Manufacturer, frame size, interrupting rating in amperes rms symmetrical, ampere or current sensor rating, long-time adjustment range, short-time adjustment range, and instantaneous adjustment range for circuit breakers.
- f. Manufacturer and type, ampere-tap adjustment range, time-delay adjustment range, instantaneous attachment adjustment range, and current transformer ratio for overcurrent relays.
- g. Panelboards, switchboards, motor-control center ampacity, and SCCR in amperes rms symmetrical.

3.04 FIELD ADJUSTING

- A. Adjust relay and protective device settings according to the recommended settings provided by the coordination study. Field adjustments shall be completed by the engineering service division of the equipment manufacturer under the Startup and Acceptance Testing contract portion.
- B. Make minor modifications to equipment as required to accomplish compliance with short-circuit and protective device coordination studies.
- C. Testing and adjusting shall be by a full-time employee of the Field Adjusting Agency, who holds NETA ETT Level III certification or NICET Electrical Power Testing Level III certification.
 - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters. Perform NETA tests and inspections for all adjustable overcurrent protective devices.

3.05 DEMONSTRATION

- A. Engage the Coordination Study Specialist to train Owner's maintenance personnel in the following:

Section 4

Scope of Work and Technical Specifications

SECTION 26 05 73-8 OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY

1. Acquaint personnel in the fundamentals of operating the power system in normal and emergency modes.
2. Hand-out and explain the objectives of the coordination study, study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpreting the time-current coordination curves.
3. Adjust, operate, and maintain overcurrent protective device settings.

END OF SECTION

SECTION 26 05 74

OVERCURRENT PROTECTIVE DEVICE ARC FLASH STUDY

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes a computer-based, arc-flash study to determine the arc-flash hazard distance and the incident energy to which personnel could be exposed during work on or near electrical equipment. The extents of the study shall include the all the electrical equipment associated with the new power distribution system.

1.02 ACTION SUBMITTALS

- A. Product Data: For computer software program to be used for studies.
- B. Study Submittals: Submit the following submittals after the approval of system protective devices submittals. Submittals shall be in digital form.
 - 1. Arc-flash study input data, including completed computer program input data sheets.
 - 2. Arc-flash study report; signed, dated, and sealed by a qualified professional engineer.
 - a. Submit study report for action prior to receiving final approval of the distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that the selection of devices and associated characteristics is satisfactory.

1.03 INFORMATIONAL SUBMITTALS

- A. Qualification Data: the study shall be performed by the firm regularly engaged in plant power system studies and analysis with at least 5 years of relevant experience.
- B. Product Certificates: For arc-flash hazard analysis software, certifying compliance with IEEE 1584 and NFPA 70E.

1.04 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data:
 - 1. Maintenance procedures according to requirements in NFPA 70E shall be provided in the equipment manuals.
 - 2. Operation and Maintenance Procedures: Provide maintenance procedures for use by Owner's personnel that comply with requirements in NFPA 70E.

1.05 QUALITY ASSURANCE

A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are unacceptable.

B. Arc-Flash Study Software Developer Qualifications: An entity that owns and markets computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.

1. The computer program shall be developed under the charge of a licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.

C. Arc-Flash Study Specialist Qualifications: Professional engineer in charge of performing the study, analyzing the arc flash, and documenting recommendations, licensed in the state where Project is located. All elements of the study shall be performed under the direct supervision and control of this professional engineer.

D. Field Adjusting Agency Qualifications: An independent agency, with the experience and capability to adjust overcurrent devices and to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

PART 2 - PRODUCTS

2.01 SOFTWARE DEVELOPERS

A. Comply with IEEE 1584 and NFPA 70E.

B. Analytical features of device coordination study computer software program shall have the capability to calculate mandatory features as listed in IEEE 399.

2.02 ARC-FLASH STUDY REPORT CONTENT

A. Executive summary.

B. Study descriptions, purpose, basis and scope.

C. One-line diagram, showing the following:

1. Protective device designations and ampere ratings.
2. Cable size and lengths.
3. Transformer kilovolt ampere (kVA) and voltage ratings.
4. Motor and generator designations and kVA ratings.

Section 4
Scope of Work and Technical Specifications
SECTION 26 05 74-3 OVERCURRENT PROTECTIVE DEVICE ARC FLASH STUDY

5. Switchgear, switchboard, motor-control center and panelboard designations.
- D. Study Input Data: As described in "Power System Data" Article.
- E. Short-Circuit Study Output: As specified in "Short-Circuit Study Output" Paragraph in "Short-Circuit Study Report Contents" Article in Section 26 05 72 "Overcurrent Protective Device Short-Circuit Study."
- F. Protective Device Coordination Study Report Contents: As specified in "Protective Device Coordination Study Report Contents" Article in Section 26 05 73 "Overcurrent Protective Device Coordination Study."
- G. Arc-Flash Study Output:
1. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
 - a. Voltage.
 - b. Calculated symmetrical fault-current magnitude and angle.
 - c. Fault-point X/R ratio.
 - d. No AC Decrement (NACD) ratio.
 - e. Equivalent impedance.
 - f. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a symmetrical basis.
 - g. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a total basis.
- H. Incident Energy and Flash Protection Boundary Calculations:
1. Arcing fault magnitude.
 2. Protective device clearing time.
 3. Duration of arc.
 4. Arc-flash boundary.
 5. Working distance.
 6. Incident energy.
 7. Hazard risk category.
 8. Recommendations for arc-flash energy reduction.

Section 4
Scope of Work and Technical Specifications
SECTION 26 05 74-4 OVERCURRENT PROTECTIVE DEVICE ARC FLASH STUDY

- I. Fault study input data, case descriptions, and fault-current calculations including a definition of terms and guide for interpretation of the computer printout.
- J. Report shall include arc flash warning labels to meet NFPA 70E requirements.
- K. Arc flash warning labels shall be installed on site.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine Project overcurrent protective device submittals. Proceed with arc-flash study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to arc-flash study may not be used in study.

3.02 ARC-FLASH HAZARD ANALYSIS

- A. Comply with NFPA 70E and its Annex D for hazard analysis study.
- B. Preparatory Studies:
 - 1. Short-Circuit Study Output: As specified in "Short-Circuit Study Output" Paragraph in "Short-Circuit Study Report Contents" Article in Section 26 05 72 "Overcurrent Protective Device Short-Circuit Study."
 - 2. Protective Device Coordination Study Report Contents: As specified in "Protective Device Coordination Study Report Contents" Article in Section 26 05 73 "Overcurrent Protective Device Coordination Study."
- C. Calculate maximum and minimum contributions of fault-current size.
 - 1. The minimum calculation shall assume that the utility contribution is at a minimum and shall assume no motor load.
 - 2. The maximum calculation shall assume a maximum contribution from the utility and shall assume motors to be operating under full-load conditions.
- D. Calculate the arc-flash protection boundary and incident energy at locations in the electrical distribution system where personnel could perform work on energized parts.
- E. Include low-voltage equipment locations, except equipment rated 240-V ac or less fed from transformers less than 125 kVA.
- F. Safe working distances shall be specified for calculated fault locations based on the calculated arc-flash boundary, considering incident energy of 1.2 cal/sq.cm.
- G. Incident energy calculations shall consider the accumulation of energy over time when performing arc-flash calculations on buses with multiple sources. Iterative calculations shall take into account the changing current contributions, as the sources

Section 4

Scope of Work and Technical Specifications
SECTION 26 05 74-5 OVERCURRENT PROTECTIVE DEVICE ARC FLASH STUDY

are interrupted or decremented with time. Fault contribution from motors shall be decremented as follows:

1. Fault contribution from induction motors should not be considered beyond three to five cycles.

H. Arc-flash computation shall include both line and load side of a circuit breaker as follows:

1. When the circuit breaker is in a separate enclosure.
2. When the line terminals of the circuit breaker are separate from the work location.

I. Base arc-flash calculations on actual overcurrent protective device clearing time. Cap maximum clearing time at two seconds based on IEEE 1584, Section B.1.2.

3.03 POWER SYSTEM DATA

A. Obtain all data necessary for the conduct of the arc-flash hazard analysis.

1. Verify completeness of data supplied on the one-line diagram on Drawings. Call discrepancies to the attention of the Engineer.
2. For new equipment, use characteristics submitted under the provisions of action submittals and information submittals for this Project.

B. Electrical Survey Data: Gather and tabulate the following input data to support study.

1. Product Data for overcurrent protective devices specified in other Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
2. Obtain electrical power utility impedance at the service.
3. Power sources and ties.
4. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip and available range of settings, SCCR, current rating, and breaker settings.
5. Busway manufacturer and model designation, current rating, impedance, lengths, and conductor material.
6. Motor horsepower and NEMA MG 1 code letter designation.
7. Low-voltage cable sizes, lengths, number, conductor material and conduit material (magnetic or nonmagnetic).

Section 4
Scope of Work and Technical Specifications

SECTION 26 05 74-6 OVERCURRENT PROTECTIVE DEVICE ARC FLASH STUDY

3.04 DEMONSTRATION

- A. Engage the Arc-Flash Study Specialist to train Owner's maintenance personnel in the potential arc-flash hazards associated with working on energized equipment and the significance of the arc-flash warning labels.

END OF SECTION

SECTION 26 08 00

COMMISSIONING OF ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

- A. Requirements specified within this section apply to the commissioning of electrical systems.
- B. Safety: Ensure work areas are restricted to any non-authorized commissioning professionals. Areas undergoing commissioning shall be taped off and indicated as restricted areas.
- C. Sequencing and scheduling:
 - 1. Perform inspection and electrical tests after equipment here in listed has been installed.
 - 2. Perform tests with apparatus de-energized whenever feasible.
 - 3. Inspection and electrical tests on energized equipment shall be:
 - a. Scheduled with Engineer and Owner prior to de-energization.
 - b. Minimized to avoid extended period of interruption to the operating plant equipment.
 - 4. Notify Engineer and Owner at least 24 hours prior to performing tests on energized electrical equipment.

1.02 INFORMATIONAL SUBMITTALS

- A. Provide the following:
 - 1. Submit 30 days prior to performing inspections or tests:
 - a. Schedule for performing inspection and tests.
 - b. List of references to be used for each test.
 - c. Sample copy of equipment and materials inspection form(s).
 - d. Sample copy of individual device test form.
 - e. Sample copy of individual system test form.
 - 2. Submit test or inspection reports and certificates for each electrical item tested within 30 days after completion of test:
 - 3. Operation and Maintenance Data:

- a. In accordance with Division 01, General Requirements.
- b. After test or inspection reports and certificates have been reviewed by Engineer and returned, insert a copy of each in Operation and Maintenance Manual.

1.03 REFERENCES

A. The following is a list of standards which may be referenced in this section:

- 1. ASTM International (ASTM):
 - a. D665, Standard Test Method for Rust-Preventing Characteristics of Inhibited Mineral Oil in the Presence of Water.
 - b. D877, Standard Test Method for Dielectric Breakdown Voltage of Insulating Liquids Using Disk Electrodes.
 - c. D923, Standard Practices for Sampling Electrical Insulating Liquids.
 - d. D924, Standard Test Method for Dissipation Factor (or Power Factor) and Relative Permittivity (Dielectric Constant) of Electrical Insulating Liquids.
 - e. D971, Standard Test Method for Interfacial Tension of Oil Against Water by the Ring Method.
 - f. D974, Standard Test Method for Acid and Base Number by Color-Indicator Titration.
 - g. D1298, Standard Test Method for Density, Relative Density (Specific Gravity), or API Gravity of Crude Petroleum and Liquid Petroleum Products by Hydrometer Method.
 - h. D1500, Standard Test Method for ASTM Color of Petroleum Products (ASTM Color Scale).
 - i. D1524, Standard Test Method for Visual Examination of Used Electrical Insulating Oils of Petroleum Origin in the Field.
 - j. D1533, Standard Test Method for Water in Insulating Liquids by Coulometric Karl Fischer Titration.
 - k. D1816, Standard Test Method for Dielectric Breakdown Voltage of Insulating Oils of Petroleum Origin Using VDE Electrodes.
 - l. D2285, Standard Test Method for Interfacial Tension of Electrical Insulating Oils of Petroleum Origin Against Water by the Drop Weight Method.

Section 4
Scope of Work and Technical Specifications
SECTION 26 08 00-3 COMMISSIONING OF ELECTRICAL SYSTEMS

2. Insulated Cable Engineers Association (ICEA):
 - a. S-93-639, Shielded Power Cables 5,000V-4,600V.
 - b. S-94-649, Concentric Neutral Cables Rated 5 through 46 kV.
 - c. S-97-682, Utility Shielded Power Cables Rated 5 through 46 kV.
3. Institute of Electrical and Electronics Engineers (IEEE):
 - a. 43, Recommended Practice for Testing Insulating Resistance of Rotating Machinery.
 - b. 48, Standard Test Procedures and Requirements for High-Voltage Alternating-Current Cable Terminators 2.5 kV through 765 kV.
 - c. 81, Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System (Part 1): Normal Measurements.
 - d. 95, Recommended Practice for Insulation Testing of AC Electric Machinery (2300V and Above) with High Direct Voltage.
 - e. 386, Separable Insulated Connector Systems for Power Distribution Systems Above 600V.
 - f. 400, Guide for Making High-Direct-Voltage Tests on Power Cable Systems in the Field.
 - g. 450, Recommended Practice for Maintenance, Testing, and Replacement of Vented Lead-Acid Batteries for Stationary Applications.
 - h. C2, National Electrical Safety Code.
 - i. C37.20.1, Standard for Metal-Enclosed Low Voltage Power Circuit Breaker Switchgear.
 - j. C37.20.2, Standard for Metal-Clad Switchgear.
 - k. C37.20.3, Standard for Metal-Enclosed Interrupter Switchgear.
 - l. C62.33, Test Specifications for Varistor Surge-Protective Devices.
4. National Electrical Testing Association (NETA): Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems (ATS).
5. National Electrical Manufacturers Association (NEMA):
 - a. AB 4, Guidelines for Inspection and Preventive Maintenance of Molded Case Circuit Breakers Used in Commercial and Industrial Applications.

Section 4
Scope of Work and Technical Specifications
SECTION 26 08 00-4 COMMISSIONING OF ELECTRICAL SYSTEMS

- b. PB 2, Deadfront Distribution Switchboards.
 - c. WC 74, 5-46 kV Shielded Power Cable for Use in the Transmission and Distribution of Electric Energy.
- 6. National Fire Protection Association (NFPA):
 - a. 70, National Electrical Code (NEC).
 - b. 70E, Standard for Electrical Safety Requirements for Employee Workplaces.
 - c. 101, Life Safety Code.
- 7. National Institute for Certification in Engineering Technologies (NICET).
- 8. Occupational Safety and Health Administration (OSHA): CFR 29, Part 1910, Occupational Safety and Health Standards.

1.04 QUALITY ASSURANCE

- A. Testing firm qualifications:
 - 1. Corporately and financially independent organization functioning as an unbiased testing authority.
 - 2. Professionally independent of manufacturers, suppliers, and installers of electrical equipment and systems being tested.
 - 3. Employer of engineers and technicians regularly engaged in testing and inspecting of electrical equipment, installations, and systems.
 - 4. Supervising engineer accredited as Certified Electrical Test Technologist by NICET or NETA and having a minimum of 5 years testing experience on similar projects.
 - 5. Technicians certified by NICET or NETA.
 - 6. Assistants and apprentices assigned to project at ratio not to exceed two certified to one noncertified assistant or apprentice.
 - 7. Registered Professional Engineer to provide comprehensive project report outlining services performed, results of such services, recommendations, actions taken, and opinions.
 - 8. In compliance with OSHA CFR 29, Part 1910.7 criteria for accreditation of testing laboratories or a full member company of NETA.
- B. Test equipment shall have an operating accuracy equal to or greater than requirements established by NETA ATS.
- C. Test instrument calibration shall be in accordance with NETA ATS.

PART 2 - PRODUCTS

PART 3 - EXECUTION

3.01 GENERAL

- A. Tests specified in this section shall be performed in accordance with requirements of Division 01, General Requirements.
- B. Tests and inspections shall establish:
 - 1. Electrical equipment is operational within industry and manufacturer's tolerances and standards.
 - 2. Installation operates properly.
 - 3. Equipment is suitable for energization.
 - 4. Installation conforms to requirements of Contract Documents and NFPA 70, NFPA 70E, NFPA 101, and IEEE C2.
- C. Perform inspection and testing in accordance with NETAATS, industry standards, and manufacturer's recommendations.
- D. Set, test, and calibrate protective relays, circuit breakers, fuses power monitoring meters, and other applicable devices in accordance with values established by the short circuit, coordination and harmonics studies as specified in Section 26 05 70, Electrical Systems Analysis.
- E. Adjust mechanisms and moving parts of equipment for free mechanical movement.
- F. Adjust and set electromechanical electronic relays and sensors to correspond to operating conditions, or as recommended by manufacturer.
- G. Verify nameplate data for conformance to Contract Documents and approved Submittals.
- H. Realign equipment not properly aligned and correct unlevelness.
- I. Properly anchor electrical equipment found to be inadequately anchored.
- J. Tighten accessible bolted connections, including wiring connections, with calibrated torque wrench/screw driver to manufacturer's recommendations, or as otherwise specified in NETAATS.
- K. Clean contaminated surfaces with cleaning solvents as recommended by manufacturer.
- L. Provide proper lubrication of applicable moving parts.

Section 4
Scope of Work and Technical Specifications
SECTION 26 08 00-6 COMMISSIONING OF ELECTRICAL SYSTEMS

- M. Inform Engineer of working clearances not in accordance with NFPA 70.
- N. Investigate and repair or replace:
 - 1. Electrical items that fail tests.
 - 2. Active components not operating in accordance with manufacturer's instructions.
 - 3. Damaged electrical equipment.
- O. Electrical Enclosures:
 - 1. Remove foreign material and moisture from enclosure interior.
 - 2. Vacuum and wipe clean enclosure interior.
 - 3. Remove corrosion found on metal surfaces.
 - 4. Repair or replace, as determined by Engineer door and panel sections having dented surfaces.
 - 5. Repair or replace, as determined by Engineer poor fitting doors and panel sections.
 - 6. Repair or replace improperly operating latching, locking, or interlocking devices.
 - 7. Replace missing or damaged hardware.
 - 8. Finish:
 - a. Provide matching paint and touch up scratches and mars.
 - b. If required due to extensive damage, as determined by Engineer, refinish entire assembly.
- P. Replace fuses and circuit breakers that do not conform to size and type required by the Contract Documents or approved Submittals.

3.02 CHECKOUT AND STARTUP

- A. Voltage Field Test:
 - 1. Check voltage at point of termination of power company supply system to project when installation is essentially complete and is in operation.
 - 2. Check voltage amplitude and balance between phases for loaded and unloaded conditions.
 - 3. Unbalance Corrections:

Section 4
Scope of Work and Technical Specifications
SECTION 26 08 00-7 COMMISSIONING OF ELECTRICAL SYSTEMS

- a. Make written request to power company to correct condition if balance (as defined by NEMA) exceeds 1 percent, or if voltage varies throughout the day and from loaded to unloaded condition more than plus or minus 4 percent of nominal.
- b. Obtain a written certification from a responsible power company official that voltage variations and unbalance are within their normal standards if corrections are not made.

B. Equipment Line Current Tests:

1. Check line current in each phase for each piece of equipment.
2. Make line current check after power company has made final adjustments to supply voltage magnitude or balance.
3. If any phase current for any piece of equipment is above rated nameplate current, prepare Equipment Line Phase Current Report that identifies cause of problem and corrective action taken.

3.03 SWITCHGEAR AND SWITCHBOARD ASSEMBLIES

A. Visual and Mechanical Inspection:

1. Insulator damage and contaminated surfaces.
2. Proper barrier and shutter installation and operation.
3. Proper operation of indicating devices.
4. Improper blockage of air-cooling passages.
5. Proper operation of drawout elements.
6. Integrity and contamination of bus insulation system.
7. Check door and device interlocking system by:
 - a. Closure attempt of device when door is in OFF or OPEN position.
 - b. Opening attempt of door when device is in ON or CLOSED position.
8. Check key interlocking systems for:
 - a. Key captivity when device is in ON or CLOSED position.
 - b. Key removal when device is in ON or CLOSED position.
 - c. Closure attempt of device when key has been removed.
 - d. Correct number of keys in relationship to number of lock cylinders.

Section 4
Scope of Work and Technical Specifications
SECTION 26 08 00-8 COMMISSIONING OF ELECTRICAL SYSTEMS

- e. Existence of other keys capable of operating lock cylinders:
 Destroy duplicate sets of keys.
- 9. Check nameplates for proper identification of:
 - a. Equipment title and tag number with latest one-line diagram.
 - b. Pushbutton.
 - c. Control switch.
 - d. Pilot light.
 - e. Control relay.
 - f. Circuit breaker.
 - g. Indicating meter.
- 10. Verify that fuse and circuit breaker ratings, sizes, and types conform to those specified.
- 11. Check bus and cable connections for high resistance by low resistance ohmmeter and calibrated torque wrench and thermographic survey applied to bolted joints.
 - a. Ohmic value to be zero.
 - b. Bolt torque level in accordance with NETAATS, Table 100.12, unless otherwise specified by manufacturer.
 - c. Thermographic survey temperature gradient of 2 degrees C, or less.
- 12. Check operation and sequencing of electrical and mechanical interlock systems by:
 - a. Closure attempt for locked open devices.
 - b. Opening attempt for locked closed devices.
 - c. Key exchange to operate devices in OFF-NORMAL positions.
- 13. Verify performance of each control device and feature.
- 14. Control Wiring:
 - a. Compare wiring to local and remote control and protective devices with elementary diagrams.
 - b. Proper conductor lacing and bundling.
 - c. Proper conductor identification.

Section 4
Scope of Work and Technical Specifications
SECTION 26 08 00-9 COMMISSIONING OF ELECTRICAL SYSTEMS

- d. Proper conductor lugs and connections.
- 15. Exercise active components.
- 16. Perform phasing check on double-ended equipment to ensure proper bus phasing from each source.
- B. Electrical Tests:
 - 1. Insulation Resistance Tests:
 - a. Applied megohmmeter dc voltage in accordance with NETA ATS, Table 100.1.
 - b. Each phase of each bus section.
 - c. Phase-to-phase and phase-to-ground for 1 minute.
 - d. With breakers open.
 - e. With breakers closed.
 - f. Control wiring except that connected to solid state components.
 - g. Insulation resistance values equal to, or greater than, ohmic values established by manufacturer.
 - 2. Overpotential Tests:
 - a. Applied ac or dc voltage and test procedure in accordance with IEEE C37.20.1 and NEMA PB 2.
 - b. Each phase of each bus section.
 - c. Phase-to-phase and phase-to-ground for 1 minute.
 - d. Test results evaluated on a pass/fail basis.
 - 3. Current Injection Tests:
 - a. For entire current circuit in each section.
 - b. Secondary injection for current flow of 1 ampere.
 - c. Test current at each device.
 - 4. Control Wiring:
 - a. Apply secondary voltage to control power and potential circuits.
 - b. Check voltage levels at each point on terminal boards and each device terminal.
 - 5. Operational Test:

- a. Initiate control devices.
- b. Check proper operation of control system in each section.

3.04 PANELBOARDS

A. Visual and Mechanical Inspection: Include the following inspections and related work:

- 1. Inspect for defects and physical damage, labeling, and nameplate compliance with requirements of up-to-date drawings and panelboard schedules.
- 2. Exercise and perform operational tests of mechanical components and other operable devices in accordance with manufacturer's instruction manual.
- 3. Check panelboard mounting, area clearances, and alignment and fit of components.
- 4. Check tightness of bolted electrical connections with calibrated torque wrench. Refer to manufacturer's instructions for proper torque values.
- 5. Perform visual and mechanical inspection for overcurrent protective devices.

B. Electrical Tests: Include the following items performed in accordance with manufacturer's instruction:

- 1. Insulation Resistance Tests:
 - a. Applied megohmmeter dc voltage in accordance with NETA ATS, Table 100.1.
 - b. Each phase of each bus section.
 - c. Phase-to-phase and phase-to-ground for 1 minute.
 - d. With breakers open.
 - e. With breakers closed.
 - f. Control wiring except that connected to solid state components.
 - g. Insulation resistance values equal to, or greater than, ohmic values
 - h. established by manufacturer.
- 2. Ground continuity test ground bus to system ground.

3.05 DRY TYPE TRANSFORMERS

A. Visual and Mechanical Inspection:

Section 4
Scope of Work and Technical Specifications
SECTION 26 08 00-11 COMMISSIONING OF ELECTRICAL SYSTEMS

1. Physical and insulator damage.
2. Proper winding connections.
3. Bolt torque level in accordance with NETA ATS, Table 100.12, unless otherwise specified by manufacturer.
4. Defective wiring.
5. Proper operation of fans, indicators, and auxiliary devices.
6. Removal of shipping brackets, fixtures, or bracing.
7. Free and properly installed resilient mounts.
8. Cleanliness and improper blockage of ventilation passages.
9. Verify that tap-changer is set at correct ratio for rated output voltage under normal operating conditions.
10. Verify proper secondary voltage phase-to-phase and phase-to-ground after energization and prior to loading.

B. Electrical Tests:

1. Insulation Resistance Tests:
 - a. Applied megohmmeter dc voltage in accordance with NETA ATS, Table 100.5 for each:
 - 1) Winding-to-winding.
 - 2) Winding-to-ground.
 - b. 10-minute test duration with resistances tabulated at 30 seconds, 1 minute, and 10 minutes.
 - c. Results temperature corrected in accordance with NETA ATS, Table 100.14.
 - d. Temperature corrected insulation resistance values equal to, or greater than, ohmic values established by manufacturer.
 - e. Insulation resistance test results to compare within 1 percent of adjacent windings.
2. Perform tests and adjustments for fans, controls, and alarm functions as suggested by manufacturer.

3.06 LOW VOLTAGE CABLES, 600V MAXIMUM

A. Visual and Mechanical Inspection:

Section 4
Scope of Work and Technical Specifications
SECTION 26 08 00-12 COMMISSIONING OF ELECTRICAL SYSTEMS

1. Inspect each individual exposed power cable for:
 - a. Physical damage.
 - b. Proper connections in accordance with single-line diagram.
 - c. Cable bends not in conformance with manufacturer's minimum allowable bending radius where applicable.
 - d. Color coding conformance with Specifications.
 - e. Proper circuit identification.
 2. Mechanical Connections For:
 - a. Proper lug type for conductor material.
 - b. Proper lug installation.
 - c. Bolt torque level in accordance with NETA ATS, Table 100.12, unless otherwise specified by manufacturer.
 3. Shielded Instrumentation Cables For:
 - a. Proper shield grounding.
 - b. Proper terminations.
 - c. Proper circuit identification.
 4. Control Cables For:
 - a. Proper termination.
 - b. Proper circuit identification.
 5. Cables Terminated Through Window Type CTs: Verify neutrals and grounds are terminated for correct operation of protective devices.
- B. Electrical Tests for Conductors No. 6 and Larger:
1. Insulation Resistance Tests:
 - a. Utilize 1,000-volt dc megohmmeter for 600-volt insulated conductors.
 - b. Test each conductor with respect to ground and to adjacent conductors for 1 minute.
 - c. Evaluate ohmic values by comparison with conductors of same length and type.
 - d. Investigate values less than 50 megohms.

2. Continuity test by ohmmeter method to ensure proper cable connections.

C. Low voltage cable tests may be performed by installer in lieu of independent testing firm.

3.07 MEDIUM VOLTAGE CABLES, 15 KV MAXIMUM

A. Visual and Mechanical Inspection:

1. Inspect each individual exposed cable for:
 - a. Physical damage plus jacket and insulation condition.
 - b. Proper connections in accordance with single-line diagram or approved Submittals.
 - c. Proper shield grounding.
 - d. Proper cable support.
 - e. Proper cable termination.
 - f. Cable bends not in conformance with manufacturer's minimum allowable bending radius.
 - g. Proper arc and fireproofing in common cable areas.
 - h. Proper circuit and phase identification.
2. Mechanical Connections:
 - a. Proper lug type for conductor material.
 - b. Proper lug installation.
 - c. Bolt torque level in accordance with NETA ATS, Table 100.12, unless otherwise specified by manufacturers.
3. Conductors Terminated Through Window Type CTs: Verify neutrals and grounds are terminated for correct operation of protective devices.
4. Cables for adjustable frequency drive need to be unterminated from their connection point to prevent static discharge.
5. All cables shall have the numbers and labels left on them when they are unterminated in the case they are to be reused.
6. Any frayed or damaged cable or terminals shall be repaired or replaced.

B. Electrical Tests:

1. Insulation Resistance Tests:

Section 4
Scope of Work and Technical Specifications
SECTION 26 08 00-14 COMMISSIONING OF ELECTRICAL SYSTEMS

- a. Utilize 2,500-volt megohmmeter for 5 kV conductors.
 - b. Test each cable individually with remaining cables and shields grounded.
 - c. Test each conductor with respect to ground and to adjacent conductors for 1 minute.
 - d. Evaluate ohmic values by comparison with conductors of same length and type.
 - e. Investigate values less than 50 megohms.
2. Shield Continuity Tests:
 - a. By ohmmeter method on each section of conductor.
 - b. Investigate values in excess of 10 ohms per 1,000 feet of conductors.
3. Acceptance Tests:
 - a. In accordance with IEEE 400, ICEA S-93-639/NEMA WC 74, ICEA S-94-649, and ICEA S-97-682 for insulated conductors.
 - b. Each conductor section tested with:
 - 1) Splices and terminations in-place but disconnected from equipment.
 - 2) Remaining conductors and shields grounded in accordance with IEEE 400.
 - c. Apply maximum test voltage per NETA ATS Table 100.6 based on method (DC, AC, PD or VLF) used.
 - d. Measure only the leakage current associated with conductor.
 - e. Utilize guard ring or field reduction sphere to suppress corona at disconnected terminations.
 - f. Maximum test voltage shall not exceed limits for terminators specified in IEEE 48, IEEE 386, or manufacturer's specifications.
 - g. Apply test voltage in a minimum of five equal increments until maximum acceptable test voltage is reached.
 - 1) Increments not to exceed ac voltage rating of conductor.
 - 2) Record dc leakage current at each step after a constant stabilization time consistent with system charging current.

Section 4
Scope of Work and Technical Specifications
SECTION 26 08 00-15 COMMISSIONING OF ELECTRICAL SYSTEMS

- h. Raise conductor to specified maximum test voltage and hold for 15 minutes or as specified by conductor manufacturer. Record leakage current at 30 seconds and 1 minute, and at 1-minute intervals, thereafter.
- i. Immediately following test, ground conductor for adequate time period to drain insulation stored charge.
- j. Test results evaluated on a pass/fail basis.
- 4. New Conductors Spliced to Existing Conductors:
 - a. Prior to performing splices, high potential dc test new conductor sections.
 - b. After splicing new conductors to existing conductors, disconnect the existing conductors and perform the following tests:
 - 1) Shield continuity test.
 - 2) Insulation resistance test.
 - 3) High potential test with test voltage not to exceed 60 percent of applied acceptance dc test voltage.

3.08 SAFETY SWITCHES, 600 VOLTS MAXIMUM

- A. Visual and Mechanical Inspection:
 - 1. Proper blade pressure and alignment.
 - 2. Proper operation of switch operating handle.
 - 3. Adequate mechanical support for each fuse.
 - 4. Proper contact-to-contact tightness between fuse clip and fuse.
 - 5. Cable connection bolt torque level in accordance with NETA ATS, Table 100.12.
 - 6. Proper phase barrier material and installation.
 - 7. Verify fuse sizes and types correspond to one-line diagram or approved Submittals.
 - 8. Perform mechanical operational test and verify electrical and mechanical interlocking system operation and sequencing.
- B. Electrical Tests:
 - 1. Insulation Resistance Tests:

Section 4
Scope of Work and Technical Specifications
SECTION 26 08 00-16 COMMISSIONING OF ELECTRICAL SYSTEMS

- a. Applied megohmmeter dc voltage in accordance with NETA ATS, Table 100.1.
 - b. Phase-to-phase and phase-to-ground for 1 minute on each pole.
 - c. Insulation resistance values equal to, or greater than, ohmic values established by manufacturer.
2. Contact Resistance Tests:
- a. Contact resistance in microhms across each switch blade and fuse holder.
 - b. Investigate deviation of 50 percent or more from adjacent poles or similar switches.

3.09 MOLDED AND INSULATED CASE CIRCUIT BREAKERS

- A. General: Inspection and testing limited to circuit breakers rated 100 amperes and larger and to motor circuit protector breakers rated 50 amperes and larger.
- B. Visual and Mechanical Inspection:
1. Proper mounting.
 2. Proper conductor size.
 3. Feeder designation according to nameplate and one-line diagram.
 4. Cracked casings.
 5. Connection bolt torque level in accordance with NETA ATS, Table 100.12.
 6. Operate breaker to verify smooth operation.
 7. Compare frame size and trip setting with circuit breaker schedules or one-line diagram.
 8. Verify that terminals are suitable for 75 degrees C rated insulated conductors.
- C. Electrical Tests:
1. Insulation Resistance Tests:
 - a. Utilize 1,000-volt dc megohmmeter for 480-volt and 600-volt circuit breakers.
 - b. Pole-to-pole and pole-to-ground with breaker contacts opened for 1 minute.
 - c. Pole-to-pole and pole-to-ground with breaker contacts closed for 1 minute.

Section 4
Scope of Work and Technical Specifications
SECTION 26 08 00-17 COMMISSIONING OF ELECTRICAL SYSTEMS

- d. Test values to comply with NETA ATS, Table 100.1.
- 2. Contact Resistance Tests:
 - a. Contact resistance in microhms across each pole.
 - b. Investigate deviation of 50 percent or more from adjacent poles and similar breakers.
- 3. Primary Current Injection Test to Verify:
 - a. Long-time minimum pickup and delay.
 - b. Short-time pickup and delay.
 - c. Ground fault pickup and delay.
 - d. Instantaneous pickup by run-up or pulse method.
 - e. Trip characteristics of adjustable trip breakers shall be within manufacturer's published time-current characteristic tolerance band, including adjustment factors.
 - f. Trip times shall be within limits established by NEMA AB 4, Table 5-3. Alternatively, use NETA ATS Table 100.7.
 - g. Instantaneous pickup value shall be within values established by NEMA AB 4, Table 5-4. Alternatively, use NETA ATS Table 100.8.

3.10 MEDIUM VOLTAGE AIR CIRCUIT BREAKERS

- A. Visual and Mechanical Inspection:
 - 1. Proper cell fit and element alignment.
 - 2. Proper operation of cubicle shutters and racking mechanism.
 - 3. Proper contact condition.
 - 4. Bolt torque level in accordance with NETA ATS, Table 100.12.
 - 5. Perform mechanical operator and contact alignment tests on breaker and it's operating mechanism in accordance with manufacturer's instructions.
 - 6. Verify primary and secondary contact wipe, gap setting, and other dimensions vital to breaker operations are correct.
 - 7. Ensure maintenance devices are available for servicing and operating breaker.
 - 8. Check for adequate lubrication on contact, moving, and sliding parts.

Section 4
Scope of Work and Technical Specifications
SECTION 26 08 00-18 COMMISSIONING OF ELECTRICAL SYSTEMS

9. Check condition of brushes and limit switches on charging and lifting motors.
10. With breaker in TEST position:
 - a. Trip and close breaker with control switch.
 - b. Trip breaker by manually operating each protective relay.
11. Perform breaker travel and velocity analysis in accordance with manufacturer's instructions; values shall be in accordance with manufacturer's acceptable limits.

B. Electrical Tests:

1. Insulation Resistance Tests:
 - a. Utilize 2,500-volt dc megohmmeter for 5-kV circuit breakers.
 - b. Pole-to-pole and pole-to-ground with breaker contacts opened for 1 minute.
 - c. Pole-to-pole and pole-to-ground with breaker contacts closed for 1 minute.
 - d. Test values to comply with NETA ATS, Table 100.1.
2. Contact Resistance Tests:
 - a. Contact resistance in microhms across each pole.
 - b. Investigate deviation of 50 percent or more from adjacent poles and similar breakers.
3. Overpotential Tests:
 - a. Maximum applied ac or dc voltage in accordance with NETA ATS, Table 100.19.
 - b. Each pole-to-ground with other poles grounded and contacts closed for 1 minute.
 - c. Test results evaluated on pass/fail basis.
4. Minimum pickup voltage tests on trip and close coils.
5. Control Wiring Tests: Insulation resistance test at 1,000 volts dc on control wiring except that connected to solid state components. Insulation resistance to be 1 megohm minimum. Analog control wiring shall be excluded from insulation resistance testing to prevent potential damage to sensitive components and to avoid introducing calibration issues.

Section 4
Scope of Work and Technical Specifications
SECTION 26 08 00-19 COMMISSIONING OF ELECTRICAL SYSTEMS

6. Power factor test on each phase with breaker in both OPEN and CLOSED positions. Compare power factor and arc chute watt loss with adjacent poles or manufacturer's published data.

7. Power factor test on each bushing utilizing conductive straps and hot collar procedures if bushings are not equipped with power factor tap. Power factor and capacitance test results within nameplate rating of bushings.

3.11 MEDIUM VOLTAGE VACUUM CIRCUIT BREAKERS

A. Visual and Mechanical Inspection:

1. Check for proper element alignment.
2. Check for proper operation of cubicle shutters and racking mechanism.
3. Bolt torque level in accordance with NETAATS, Table 100.12.
4. Perform mechanical operational tests on breaker and it's operating mechanism in accordance with manufacturer's instructions, plus check:
 - a. Pull rod adjustment.
 - b. Trip latch clearance.
 - c. Overtravel stops.
 - d. Wipe and gap setting.
5. Perform breaker travel and velocity analysis in accordance with manufacturer's instructions; values shall be in accordance with manufacturer's acceptable limits.
6. Check contact erosion indicators in accordance with manufacturer's instructions.
7. With breaker in TEST position:
 - a. Trip and close breaker with control switch.
 - b. Trip breaker by manually operating each protective relay.

B. Electrical Tests:

1. Insulation Resistance Tests:
 - a. Utilize 2,500-volt dc megohmmeter for 5-kV circuit breakers.
 - b. Pole-to-pole and pole-to-ground with breaker contacts opened for 1 minute.
 - c. Pole-to-pole and pole-to-ground with breaker contacts closed for 1 minute.

Section 4
Scope of Work and Technical Specifications
SECTION 26 08 00-20 COMMISSIONING OF ELECTRICAL SYSTEMS

- d. Test values to comply with NETA ATS, Table 100.1.
- 2. Contact Resistance Tests:
 - a. Between the line and load stab of closed contact resistance in microhms across each pole.
 - b. Investigate deviation of 50 percent or more from adjacent poles and similar breakers.
- 3. Overpotential Tests:
 - a. Maximum applied ac or dc voltage in accordance with NETA ATS, Table 100.19.
 - b. Each pole-to-ground with other poles grounded and contacts closed for 1 minute.
 - c. Test results evaluated on pass/fail basis.
- 4. Minimum pickup voltage tests on trip and close coils.
- 5. Control Wiring Tests:
 - a. Insulation resistance test at 1,000-volts dc on control wiring, except that connected to solid state components.
 - b. Insulation resistance to be 1 megohm minimum.
- 6. Vacuum bottle overpotential integrity test across each vacuum bottle with breaker in OPEN position, in accordance with manufacturer's instructions.
- 7. Power Factor Test (Each Phase):
 - a. With breaker in both OPEN and CLOSED position.
 - b. Compare power factor and arc chute watt loss with adjacent poles or manufacturer's published data.
- 8. Power Factor Test (Each Bushing):
 - a. Utilize conductive straps and hot collar procedures if bushings are not equipped with power factor tap.
 - b. Power factor and capacitance test results within nameplate rating of bushings.

3.12 PROTECTIVE RELAYS

- A. Visual and Mechanical Inspection:
 - 1. Visually check each relay for:

Section 4
Scope of Work and Technical Specifications
SECTION 26 08 00-21 COMMISSIONING OF ELECTRICAL SYSTEMS

- a. Tight cover gasket and proper seal.
 - b. Unbroken cover glass.
 - c. Condition of spiral spring and contacts.
 - d. Disc clearance.
 - e. Condition of case shorting contacts if present.
 2. Mechanically check each relay for:
 - a. Freedom of movement.
 - b. Proper travel and alignment.
 3. Verify each relay:
 - a. Complies with Contract Documents, approved Submittal, and application.
 - b. Is set in accordance with recommended settings from Coordination Study.
 4. Any changes required to relay programming shall be furnished by the equipment manufacturer. For the adjustable frequency drive, the drive manufacturer shall provide new settings as required.
- B. Electrical Tests:**
1. Insulation resistance test on each circuit to frame, except for solid state devices.
 2. Test on nominal recommended setting for:
 - a. Pickup parameters on each operating element.
 - b. Timing at three points on time-current curve.
 - c. Pickup target and seal-in units.
 - d. Special tests as required to check operation of restraint, directional, and other elements in accordance with manufacturer's instruction manual.
 3. Phase angle and magnitude contribution tests on differential and directional relays after energization to vectorially verify proper polarity and connections.
 4. Current Injection Tests:
 - a. For entire current circuit in each section.

- b. Secondary injection for current flow of 1 ampere.
- c. Test current at each device.

3.13 INSTRUMENT TRANSFORMERS

A. Visual and Mechanical Inspection:

- 1. Visually check current, potential, and control transformers for:
 - a. Cracked insulation.
 - b. Broken leads or defective wiring.
 - c. Proper connections.
 - d. Adequate clearances between primary and secondary circuit wiring.
- 2. Verify mechanically:
 - a. Grounding and shorting connections have good contact.
 - b. Withdrawal mechanism and grounding operation, when applicable, operate properly.
- 3. Verify proper primary and secondary fuse sizes for potential transformers.

B. Electrical Tests:

- 1. Current Transformer Tests:
 - a. Insulation resistance test of transformer and wiring-to-ground at 1,000 volts dc for 30 seconds.
 - b. Polarity test.
- 2. Potential Transformer Tests:
 - a. Insulation resistance test at test voltages in accordance with NETA ATS, Table 100.9 for 1 minute on:
 - 1) Winding-to-winding.
 - 2) Winding-to-ground.
 - b. Polarity test to verify polarity marks or H1-X1 relationship as applicable.
- 3. Insulation resistance measurement on instrument transformer shall not be less than that shown in NETA ATS, Table 100.5.

3.14 METERING

A. Visual and Mechanical Inspection:

1. Verify meter connections in accordance with appropriate diagrams.
2. Verify meter multipliers.
3. Verify meter types and scales conform to Contract Documents.
4. Check calibration of meters at cardinal points.
5. Check calibration of electrical transducers.

3.15 GROUNDING SYSTEMS

A. Visual and Mechanical Inspection:

1. Equipment and circuit grounds in motor control center, panelboard, switchboard, and switchgear assemblies for proper connection and tightness.
2. Ground bus connections in motor control center, panelboard, switchboard, and switchgear assemblies for proper termination and tightness.
3. Effective transformer core and equipment grounding.
4. Accessible connections to grounding electrodes for proper fit and tightness.
5. Accessible exothermic-weld grounding connections to verify that molds were fully filled and proper bonding was obtained.

B. Electrical Tests:

1. Fall-of-Potential Test:
 - a. In accordance with IEEE 81, Section 8.2.1.5 for measurement of main ground system's resistance.
 - b. Main ground electrode system resistance to ground to be no greater than 5 ohm(s).
2. Two-Point Direct Method Test:
 - a. In accordance with IEEE 81, Section 8.2.1.1 for measurement of ground resistance between main ground system, equipment frames, and system neutral and derived neutral points.
 - b. Equipment ground resistance shall not exceed main ground system resistance by 0.50 ohm.

3.16 GROUND FAULT SYSTEM

- A. Inspection and testing limited to:
 - 1. Zero sequence grounding systems.
 - 2. Residual ground fault systems.
- B. Visual and Manual Inspection:
 - 1. Neutral main bonding connection to assure:
 - a. Zero sequence sensing system is grounded ahead of neutral disconnect link.
 - b. Ground strap sensing system is grounded through sensing device.
 - c. Neutral ground conductor is solidly grounded.
 - 2. Verify control power has adequate capacity for system.
 - 3. Manually operate monitor panels for:
 - a. Trip test.
 - b. No trip test.
 - c. Nonautomatic rest.
 - 4. Zero sequence system for symmetrical alignment of core balance transformers about current carrying conductors.
 - 5. Relay check for pickup and time under simulated ground fault conditions.
 - 6. Verify nameplate identification by device operation.
- C. Electrical Tests:
 - 1. Test system neutral insulation resistance with neutral ground link removed. System neutral insulation resistance minimum 1 megohm.
 - 2. Determine relay pickup by primary current injection at the sensor. Relay pickup current within plus or minus 10 percent of device dial or fixed setting.
 - 3. Test relay timing by injecting 300 percent of pick-up current or as specified by manufacturer. Relay operating time in accordance with manufacturer's time-current characteristic curves.
 - 4. Test system operation at 55 percent rated control voltage, if applicable.
 - 5. Test zone interlock system by simultaneous sensor current injection and monitoring zone blocking functions.

3.17 AC INDUCTION MOTORS

- A. General: Inspection and testing for all 480VAC Motors.
- B. Visual and Mechanical Inspection:
 - 1. Proper electrical and grounding connections.
 - 2. Shaft alignment.
 - 3. Blockage of ventilating air passageways.
 - 4. Operate motor and check for:
 - a. Excessive mechanical and electrical noise.
 - b. Overheating.
 - c. Correct rotation.
 - d. Check vibration detectors, resistance temperature detectors, or motor inherent protectors for functionality and proper operation.
 - e. Excessive vibration, in excess of values in NETAATS Table 100.10.
 - 5. Check operation of space heaters.
 - 6. Check Ohmic value of RTDs.
- C. Electrical Tests:
 - 1. Insulation Resistance Tests:
 - a. In accordance with IEEE 43 at test voltages established by NETAATS, Table 100.1 for:
 - 1) Motors above 200 hp for 10-minute duration with resistances tabulated at 30 seconds, 1 minute, and 10 minutes.
 - 2) Motors 200 hp and less for 1-minute duration with resistances tabulated at 30 and 60 seconds.
 - b. Insulation resistance values equal to, or greater than, ohmic values established by manufacturers.
 - 2. Calculate polarization index ratios for motors above 200 hp. Investigate index ratios less than 1.5 for Class A insulation and 2.0 for Class B insulation.
 - 3. Insulation resistance test on insulated bearings in accordance with manufacturer's instructions.

Section 4
Scope of Work and Technical Specifications
SECTION 26 08 00-26 COMMISSIONING OF ELECTRICAL SYSTEMS

4. Measure running current and voltage, and evaluate relative to load conditions and nameplate full-load amperes. Measure and record RTD temperature using MPR display during running.
5. Overpotential Tests:
 - a. Applied dc voltage in accordance with IEEE 95.
 - b. Limited to 4,000-volt motors rated 1,000 hp and greater.
 - c. Test results evaluated on pass/fail basis.

3.18 MEDIUM VOLTAGE MOTOR CONTROL CENTERS

- A. Visual and Mechanical Inspection:
 1. Insulator damage and contaminated surfaces.
 2. Proper barrier and shutter installation and operation.
 3. Proper operation of indicating devices.
 4. Proper overload protection.
 5. Blockage of air-cooling passages.
 6. Proper operation of drawout elements.
 7. Integrity and contamination of bus insulation system.
 8. Check door and device interlocking system by:
 - a. Closure attempt of device when door is in OFF or OPEN position.
 - b. Opening attempt of door when device is in ON or CLOSED position.
 9. Check nameplates for proper identification of each:
 - a. Equipment title and tag number with latest one-line diagram.
 - b. Pushbutton.
 - c. Control switch.
 - d. Pilot light.
 - e. Control relay.
 - f. Circuit breaker.
 - g. Indicating meter.

Section 4
Scope of Work and Technical Specifications
SECTION 26 08 00-27 COMMISSIONING OF ELECTRICAL SYSTEMS

10. Verify fuse sizes and types conform to Contract Documents or approved Submittal.
 11. Check bus connections for high resistance by low resistance ohmmeter and calibrated torque wrench applied to bolted joints, and thermographic survey:
 - a. Ohmic value to be zero.
 - b. Bolt torque level in accordance with NETA ATS, Table 100.12, unless otherwise specified by manufacturer.
 - c. Thermographic survey temperature gradient of 2 degrees C, or less per NETA ATS Table 100.18.
 12. Check operation and sequencing of electrical and mechanical interlock systems by:
 - a. Closure attempt for locked open devices.
 - b. Opening attempt for locked closed devices.
 - c. Key exchange to operate devices in OFF-NORMAL positions.
 13. Verify performance of each control device and feature furnished as part of motor control center.
 14. Control Wiring:
 - a. Compare wiring to local and remote control, and protective devices with elementary diagrams.
 - b. Check for proper conductor lacing and bundling.
 - c. Check for proper conductor identification.
 - d. Check for proper conductor lugs and connections.
 15. Exercise active components.
 16. Inspect magnetic contactors for:
 - a. Correct mechanical operations.
 - b. Correct contact gap, wipe, alignment, and pressure.
 - c. Correct torque of connections.
 17. Perform phasing check on double-ended motor control centers to ensure proper bus phasing from each source.
- B. Electrical Tests:**
1. Insulation Resistance Tests:

Section 4
Scope of Work and Technical Specifications
SECTION 26 08 00-28 COMMISSIONING OF ELECTRICAL SYSTEMS

- a. Applied megohmmeter dc voltage in accordance with NETA ATS, Table 100.2.
 - b. Bus section phase-to-phase and phase-to-ground for 1 minute on each phase.
 - c. Contactor phase-to-ground and across open contacts for 1 minute on each phase.
 - d. Starter section phase-to-phase and phase-to-ground on each phase with starter contacts closed and protective devices open.
 - e. Test values to comply with NETA ATS, Table 100.1.
2. Overpotential Tests:
 - a. Maximum applied ac or dc voltage in accordance with NETA ATS, Table 100.9.
 - b. Phase-to-phase and phase-to-ground for 1 minute for each phase of each bus section.
 - c. Test results evaluated on pass/fail basis.
3. Bottle integrity test for vacuum contactors in accordance with manufacturer's procedure.
4. Test by Primary Current Injection:
 - a. Overload units at sensors using 300 percent of motor full-load current: Overload trip times to be in accordance with manufacturer's published data.
 - b. Check voltage levels at each point on terminal boards and each device terminal.
5. Control Wiring Tests:
 - a. Apply secondary voltage on control power and potential circuits.
 - b. Check voltage levels at each point on terminal boards and at each device terminal.
 - c. Insulation resistance test at 1,000-volts dc on control wiring, except that connected to solid state components: Insulation resistance to be 1 megohm minimum.
6. Test indicating and monitoring devices for proper operation.
7. Perform setup and testing of solid state relays and multifunction protective devices in accordance with manufacturer's instructions.

Section 4
Scope of Work and Technical Specifications
SECTION 26 08 00-29 COMMISSIONING OF ELECTRICAL SYSTEMS

8. Measure Contact and Power Fuse Resistances:
 - a. Contact resistance shall not exceed manufacturer's recommended values.
 - b. Resistance of power fuses not to deviate more than 15 percent between identical fuses.

3.19 LOW VOLTAGE MOTOR CONTROL

- A. Visual and Mechanical Inspection:
 1. Proper barrier and shutter installation and operation.
 2. Proper operation of indicating and monitoring devices.
 3. Proper overload protection for each motor.
 4. Improper blockage of air-cooling passages.
 5. Proper operation of drawout elements.
 6. Integrity and contamination of bus insulation system.
 7. Check door and device interlocking system by:
 - a. Closure attempt of device when door is in OFF or OPEN position.
 - b. Opening attempt of door when device is in ON or CLOSED position.
 8. Check key interlocking systems for:
 - a. Key captivity when device is in ON or CLOSED position.
 - b. Key removal when device is in OFF or OPEN position.
 - c. Closure attempt of device when key has been removed.
 - d. Correct number of keys in relationship to number of lock cylinders.
 - e. Existence of other keys capable of operating lock cylinders; destroy duplicate sets of keys.
 9. Check nameplates for proper identification of:
 - a. Equipment title and tag number with latest one-line diagram.
 - b. Pushbuttons.
 - c. Control switches.
 - d. Pilot lights.

Section 4
Scope of Work and Technical Specifications
SECTION 26 08 00-30 COMMISSIONING OF ELECTRICAL SYSTEMS

- e. Control relays.
 - f. Circuit breakers.
 - g. Indicating meters.
10. Verify fuse and circuit breaker sizes and types conform to Contract Documents.
11. Verify current and potential transformer ratios conform to Contract Documents.
12. Check bus connections for high resistance by low resistance ohmmeter and calibrated torque wrench applied to bolted joints:
- a. Ohmic value to be zero.
 - b. Bolt torque level in accordance with NETAATS, Table 100.12, unless otherwise specified by manufacturer.
13. Check operation and sequencing of electrical and mechanical interlock systems by:
- a. Closure attempt for locked open devices.
 - b. Opening attempt for locked closed devices.
 - c. Key exchange to operate devices in OFF-NORMAL positions.
14. Verify performance of each control device and feature furnished as part of motor control center.
15. Control Wiring:
- a. Compare wiring to local and remote control, and protective devices with elementary diagrams.
 - b. Check for proper conductor lacing and bundling.
 - c. Check for proper conductor identification.
 - d. Check for proper conductor lugs and connections.
16. Exercise active components.
17. Inspect contactors for:
- a. Correct mechanical operations.
 - b. Correct contact gap, wipe, alignment, and pressure.
 - c. Correct torque of all connections.

Section 4
Scope of Work and Technical Specifications
SECTION 26 08 00-31 COMMISSIONING OF ELECTRICAL SYSTEMS

18. Compare overload heater rating with full-load current for proper size.
19. Compare motor protector and circuit breaker with motor characteristics for proper size.
20. Perform phasing check on double-ended motor control centers to ensure proper bus phasing from each source.

B. Electrical Tests:

1. Insulation Resistance Tests:
 - a. Applied megohmmeter dc voltage in accordance with NETA ATS, Table 100.1.
 - b. Bus section phase-to-phase and phase-to-ground for 1 minute on each phase.
 - c. Contactor phase-to-ground and across open contacts for 1 minute on each phase.
 - d. Starter section phase-to-phase and phase-to-ground on each phase with starter contacts closed and protective devices open.
 - e. Test values to comply with NETA ATS, Table 100.1.
2. Current Injection through Overload Unit at 300 Percent of Motor Full Load Current and Monitor Trip Time:
 - a. Trip time in accordance with manufacturer's published data.
 - b. Investigate values in excess of 120 seconds.
3. Control Wiring Tests:
 - a. Apply secondary voltage to control power and potential circuits.
 - b. Check voltage levels at each point on terminal boards and each device terminal.
 - c. Insulation resistance test at 1,000 volts dc on control wiring except that connected to solid state components: Insulation resistance to be 1 megohm minimum.
4. Operational test by initiating control devices to affect proper operation.

3.20 BATTERY SYSTEM

- A. Visual and Mechanical Inspection:**
1. Physical damage and electrolyte leakage.
 2. Evidence of corrosion.

Section 4
Scope of Work and Technical Specifications
SECTION 26 08 00-32 COMMISSIONING OF ELECTRICAL SYSTEMS

3. Intercell bus link integrity.
4. Battery cable insulation damage and contaminated surfaces.
5. Operating conditions of ventilating equipment.
6. Visual check of electrolyte level.

B. Electrical Tests:

1. Measure:
 - a. Bank charging voltage.
 - b. Individual cell voltage.
 - c. Electrolyte specific gravity in each cell.
 - d. Measured test values to be in accordance with manufacturer's published data.
2. Verify during recharge mode:
 - a. Charging rates from charger.
 - b. Individual cell acceptance of charge.
3. Load tests for integrity and capacity; test values in accordance with IEEE 450.

3.21 LOW VOLTAGE SURGE ARRESTORS

A. Visual and Mechanical Inspection:

1. Adequate clearances between arrestors and enclosures.
2. Ground connections to ground bus or electrode.

B. Electrical Tests:

1. Varistor Type Arrestors:
 - a. Clamping voltage test.
 - b. Rated RMS voltage test.
 - c. Rated dc voltage test.
 - d. Varistor arrestor test values in accordance with IEEE C62.33, Sections 4.4 and 4.9.

3.22 MEDIUM VOLTAGE SURGE ARRESTORS AND SURGE CAPACITORS

A. Visual Inspection:

Section 4
Scope of Work and Technical Specifications
SECTION 26 08 00-33 COMMISSIONING OF ELECTRICAL SYSTEMS

1. Ground connections to ground bus.
2. Shortest practical jumper connections to line.

B. Electrical Tests:

1. Grounding electrode resistance test in accordance with IEEE 81, Section 8.2.1.5 using three-point fall-of-potential method.
2. Insulation power factor.
3. Insulation resistance.
4. RF noise test using Stodard Noise Test set with applied voltage of 1.18 times maximum continuous operating voltage.
5. Insulation power factor leakage current, watts loss, and insulation resistance tests in accordance with manufacturer's test values. RIV value not to exceed 10 microvolts above background noise.
6. Leakage current and watts loss tests.

3.23 STANDBY AND EMERGENCY GENERATOR SYSTEMS

A. Visual and Mechanical Inspection:

1. Proper grounding.
2. Blockage of ventilating passageways.
3. Proper operation of jack water heaters.
4. Integrity of engine cooling and fuel supply systems.
5. Excessive mechanical and electrical noise.
6. Overheating of engine or generator.
7. Proper installation of vibration isolators.
8. Proper cooling liquid type and level.
9. Operate engine-generator and check for:
 - a. Excessive mechanical and electrical noise.
 - b. Overheating.
 - c. Correct rotation.
 - d. Check resistance temperature detectors or generator inherent thermal protectors for functionality and proper operation.
 - e. Excessive vibration.

Section 4
Scope of Work and Technical Specifications
SECTION 26 08 00-34 COMMISSIONING OF ELECTRICAL SYSTEMS

10. Verify voltage regulator and governor operation will cause unit speed and output voltage to stabilize at proper values within reasonable length of time.
11. Proper operation of meters and instruments.
12. Compare generator nameplate rating and connection with one-line diagram or approved Submittal.
13. Verify engine-generator operation with adjustable frequency drives energized and operating under normal load conditions.

B. Electrical and Mechanical Tests:

1. Cold start test by interrupting normal power source with test load consisting of connected building load to verify:
 - a. Transfer switch operation.
 - b. Automatic starting operation.
 - c. Operating ability of engine-generator.
 - d. Overcurrent devices capability to withstand inrush currents.
2. Phase rotation tests.
3. Test engine protective shutdown features for:
 - a. Low oil pressure.
 - b. Overtemperature.
 - c. Overspeed.
4. Vibration base-line test on generator sets; levels in accordance with manufacturer's recommendations.
5. Load bank test with reactors and resistors adjusted to 80 percent power factor for each load step. Record voltage, frequency, load current, oil pressure, and engine coolant temperature at 15-minute intervals:
 - a. 25 percent applied load for 30 minutes.
 - b. 50 percent applied load for 30 minutes.
 - c. 75 percent applied load for 30 minutes.
 - d. 100 percent applied load for 3 hours.
 - e. Load test results to demonstrate ability of unit to deliver rated load for test period.
6. One-Step Rated kW Load Pickup Test:

Section 4
Scope of Work and Technical Specifications
SECTION 26 08 00-35 COMMISSIONING OF ELECTRICAL SYSTEMS

- a. Perform test immediately after performing load bank test.
- b. Apply rated load, minus largest rated hp motor, to generator.
- c. Start largest rated hp motor and record voltage drop for 20 cycles minimum with high-speed chart recorder or digital storage oscilloscope.
- d. Compare voltage drop with maximum allowable voltage dip for specified starting situation.

3.24 THERMOGRAPHIC SURVEY

A. Provide a thermographic survey per NETA ATS Table 100.18 of connections associated with incoming service conductors, bus work, and branch feeder conductors No. 2 and larger at each:

1. Medium voltage switchgear.
2. Switchboard.
3. Medium and low voltage motor control center.
4. Panelboard.

B. Provide a thermographic survey of feeder conductors terminating at:

1. Motors rated 600 hp and larger.
2. Engine-generators.

C. Remove necessary enclosure metal panels and covers prior to performing survey.

D. Perform with equipment energized during periods of maximum possible loading per NFPA 70B, Section 20.17.

E. Do not perform survey on equipment operating at less than 20 percent of rated load. If plant load is insufficient, perform test with supplemental load bank producing rated load on item being measured.

F. Utilize thermographic equipment capable of:

1. Detecting emitted radiation.
2. Converting detected radiation to visual signal.
3. Detecting 1 degree C temperature difference between subject area and reference point of 30 degrees C.

G. Temperature Gradients:

1. 3 degrees C to 7 degrees C indicates possible deficiency that warrants investigation.

Section 4
Scope of Work and Technical Specifications
SECTION 26 08 00-36 COMMISSIONING OF ELECTRICAL SYSTEMS

2. 7 degrees C to 15 degrees C indicates deficiency that is to be corrected as time permits.

3. 16 degrees C and above indicates deficiency that is to be corrected immediately.

H. Provide written report of:

1. Areas surveyed and the resultant temperature gradients.

2. Locations of areas having temperature gradients of 3 degrees C or greater.

3. Cause of heat rise and actions taken to correct the cause of heat rise.

4. Detected phase unbalance.

END OF SECTION

SECTION 26 09 23

LOW VOLTAGE SWITCHBOARD

PART 1 - GENERAL

1.01 SUMMARY

- A. Provide a low voltage switchboard as specified herein, including the following:
 - 1. 480V, 3-phase, NEMA 4X stainless steel enclosure.
 - 2. Two electrically operated main breakers: one for utility and one for emergency backup generator.
 - 3. Automatic switchover controller for seamless transition between utility and generator power.
 - 4. Surge Protection Device (SPD).
 - 5. Feeder breakers as indicated on the One-Line Diagram.

1.02 REFERENCES

- A. Comply with the latest editions of applicable codes and standards, including:
 - 1. National Electrical Code (NEC).
 - 2. UL 891 - Standard for Switchboards.
 - 3. IEEE C62.41 - Guide for Surge Voltages in Low-Voltage AC Power Circuits.

1.03 SUBMITTALS

- A. Submit the following for review and approval:
 - 1. Product data, including equipment ratings, dimensions, and features.
 - 2. Shop drawings detailing layout, components, and connections.
 - 3. Test reports and certifications.

1.04 QUALITY ASSURANCE

- A. Manufacturer shall have at least 10 years of experience in the design and production of switchboards.
- B. Equipment shall be factory-tested prior to shipment.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver equipment in factory-sealed containers with clearly labeled identification.

- B. Store in a dry, secure environment.

PART 2 - PRODUCTS

2.01 MANUFACTURER

- A. Approved manufacturers include Schneider Electric, Eaton, ABB/GE, Siemens or approved equal.

2.02 SWITCHBOARD CONSTRUCTION

- A. Enclosure:
1. NEMA 4X stainless steel, suitable for indoor and outdoor environments.
 2. Provide gaskets and seals to ensure watertight and dust-tight performance.
- B. Electrical Ratings:
1. Voltage: 480V AC.
 2. Phases: 3-phase, 4-wire.
 3. Short Circuit Current Rating (SCCR): As indicated on drawings.

2.03 COMPONENTS

- A. Main Breakers:
1. Electrically operated with remote control and manual override capability.
 2. Ratings as indicated on drawings.
- B. Automatic Switchover Controller:
1. The ATS controller shall be microprocessor-based and designed to provide seamless utility-to-generator and generator-to-utility transitions. The controller shall support typical ATS functions including a 2-wire generator start signal, programmable transfer and retransfer time delays, and adjustable engine warm-up and cool-down timers. The controller shall be capable of detecting utility failure conditions such as complete loss of utility, undervoltage, and loss of phase. It shall initiate transfer to generator power upon detection of any of these conditions and retransfer to utility power when normal utility conditions are restored and stable. LED indicators and digital display shall provide system status, event logs, and alarms.
 2. Include manual override and test functions.
- C. Surge Protection Device (SPD):

Section 4
Scope of Work and Technical Specifications
SECTION 26 09 23-3 LOW VOLTAGE SWITCHBOARD

1. Type 1 or Type 2 SPD with a minimum rating of 200kA.
 2. UL listed and compliant with IEEE C62.41.
- D. Feeder Breakers:
1. Thermal magnetic or electronic trip breakers as shown on the One-Line Diagram.
- E. Auxiliary components
1. Include indicating lights for the status of the main breakers.
 2. Include a minimum of 12" HMI screen showing the voltage, current, and frequency of each power source. A touch-screen operator interface shall provide adjustments to time delays and display the overall transfer scheme status.
 3. Include all required CTs, PTs, transformers, relays, terminal blocks, etc.
 4. All components involved in the automatic transfer scheme shall be powered by a UPS system supplied and installed within the switchboard. The UPS shall provide clean, uninterrupted power to control circuits and essential monitoring equipment. The UPS battery shall be sized to support the control circuit loads for a minimum of 30 minutes under full load conditions. The UPS system shall be fully integrated into the switchboard assembly and include status indicators and alarm capabilities.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install switchboard per manufacturer instructions and NEC requirements.
- B. Securely anchor switchboard to the concrete pad or wall-mounted as indicated.

3.02 TESTING AND COMMISSIONING

- A. Perform functional testing of main breakers, switchover controller, and SPD.
- B. Verify proper operation of all feeder breakers.
- C. Submit test results for approval.

3.03 WARRANTY AND TRAINING

- A. Provide a manufacturer's warranty of two (2) years for all components.
- B. Provide onsite training for owner's personnel on system operation and maintenance.

END OF SECTION

SECTION 26 22 13

LOW VOLTAGE DISTRIBUTION TRANSFORMERS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes distribution, dry-type transformers with a nominal primary and secondary rating of 600 V and less, with capacities up to 1500 kVA.

1.02 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings:
 - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment.
 - 3. Include diagrams for power, signal, and control wiring.

1.03 INFORMATIONAL SUBMITTALS

- A. Seismic Qualification Data: Certificates, for transformers, accessories, and components, from manufacturer.
- B. Source quality-control reports.
- C. Field quality-control reports.

1.04 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

1.05 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Accredited by NETA.
 - 1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Eaton
- B. Schneider Electric

Section 4
Scope of Work and Technical Specifications
SECTION 26 22 13-2 LOW VOLTAGE DISTRIBUTION TRANSFORMERS

- C. GE
- D. Acme
- E. Engineer's approved equal.

2.02 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Transformers shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - 1. The term "withstand" means "the transformer will remain in place without separation of any parts when subjected to the seismic forces specified.

2.03 GENERAL TRANSFORMER REQUIREMENTS

- A. Description: Factory-assembled and -tested, air-cooled units for 60-Hz service.
- B. Comply with NFPA 70.
 - 1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
- C. Transformers Rated 15 kVA and Larger:
 - 1. Comply with 10 CFR 431 (DOE 2016) efficiency levels.
 - 2. Marked as compliant with DOE 2016 efficiency levels by an NRTL.
- D. Encapsulation: Transformers smaller than 30 kVA shall have core and coils completely resin encapsulated.
- E. Cores: Electrical grade, non-aging silicon steel with high permeability and low hysteresis losses.
- F. Coils: Continuous windings except for taps.
 - 1. Coil Material: Aluminum.
 - 2. Internal Coil Connections: Brazed or pressure type.
 - 3. Terminal Connections: Welded.
- G. Shipping Restraints: Paint or otherwise color-code bolts, wedges, blocks, and other restraints that are to be removed after installation and before energizing. Use fluorescent colors that are easily identifiable inside the transformer enclosure.

2.04 DISTRIBUTION TRANSFORMERS

- A. Comply with NFPA 70, and list and label as complying with UL 1561.
- B. Cores: One leg per phase.

Section 4
Scope of Work and Technical Specifications
SECTION 26 22 13-3 LOW VOLTAGE DISTRIBUTION TRANSFORMERS

- C. Enclosure: Ventilated.
 - 1. NEMA 250, Type as shown on Electrical Drawings.
 - 2. KVA Ratings: Based on convection cooling only and not relying on auxiliary fans.
 - 3. Wiring Compartment: Sized for conduit entry and wiring installation.
- D. Taps for Transformers 3 kVA and Smaller: None.
- E. Taps for Transformers 7.5 to 24 kVA: One 5 percent tap above and one 5 percent tap below normal full capacity.
- F. Taps for Transformers 25 kVA and Larger: Two 2.5 percent taps above and two 2.5 percent taps below normal full capacity.
- G. Insulation Class, Smaller Than 30 kVA: 180 deg C, UL-component-recognized insulation system with a maximum of 115 deg C rise above 40 deg C ambient temperature.
- H. Insulation Class, 30 kVA and Larger: 220 deg C, UL-component-recognized insulation system with a maximum of 150 deg C rise above 40 deg C ambient temperature.
- I. Grounding: Provide ground-bar kit or a ground bar installed on the inside of the transformer enclosure.
- J. Wall Brackets: Manufacturer's standard brackets.

2.05 IDENTIFICATION

- A. Nameplates: Engraved, laminated-acrylic or melamine plastic signs for each distribution transformer, mounted with corrosion-resistant screws. Nameplates and label products are specified in Section 260553 "Identification for Electrical Systems."
- B. Nameplates: Self-adhesive label for each distribution transformer. Self-adhesive labels are specified in Section 260553 "Identification for Electrical Systems."

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine conditions for compliance with enclosure- and ambient-temperature requirements for each transformer.
- B. Verify that field measurements are as needed to maintain working clearances required by NFPA 70 and manufacturer's written instructions.
- C. Examine walls, floors, roofs, and concrete bases for suitable mounting conditions where transformers will be installed.

Section 4
Scope of Work and Technical Specifications
SECTION 26 22 13-4 LOW VOLTAGE DISTRIBUTION TRANSFORMERS

D. Verify that ground connections are in place and requirements in Section 26 05 26 "Grounding and Bonding for Electrical Systems" have been met. Maximum ground resistance shall be 5 ohms at location of transformer.

E. Environment: Enclosures shall be rated for the environment in which they are located. Covers for NEMA 250, Type 4X enclosures shall not cause accessibility problems.

3.02 INSTALLATION

A. Install wall-mounted transformers level and plumb with wall brackets fabricated by transformer manufacturer.

1. Coordinate installation of wall-mounted and structure-hanging supports with actual transformer provided.

B. Install transformers level and plumb on a concrete base with vibration-dampening supports. Locate transformers away from corners and not parallel to adjacent wall surface.

C. Construct concrete bases according to Section 03 30 00 "Cast-in-Place Concrete" and anchor floor-mounted transformers according to manufacturer's written instructions and requirements in Section 26 05 29 "Hangers and Supports for Electrical Systems."

1. Coordinate size and location of concrete bases with actual transformer provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

D. Secure transformer to concrete base according to manufacturer's written instructions.

E. Secure covers to enclosure and tighten all bolts to manufacturer-recommended torques to reduce noise generation.

F. Remove shipping bolts, blocking, and wedges.

3.03 CONNECTIONS

A. Ground equipment according to Section 26 05 26 "Grounding and Bonding for Electrical Systems."

B. Connect wiring according to Section 26 05 05 "Conductors."

C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.

D. Provide flexible connections at all conduit and conductor terminations and supports to eliminate sound and vibration transmission to the building structure.

3.04 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- C. Perform tests and inspections with the assistance of a factory-authorized service representative.
- D. Small (Up to 167-kVA Single-Phase or 500-kVA Three-Phase) Dry-Type Transformer Field Tests:
 - 1. Visual and Mechanical Inspection.
 - a. Inspect physical and mechanical condition.
 - b. Inspect anchorage, alignment, and grounding.
 - c. Verify that resilient mounts are free and that any shipping brackets have been removed.
 - d. Verify the unit is clean.
 - e. Perform specific inspections and mechanical tests recommended by manufacturer.
 - f. Verify that as-left tap connections are as specified.
 - g. Verify the presence of surge arresters and that their ratings are as specified.
 - 2. Electrical Tests:
 - a. Measure resistance at each winding, tap, and bolted connection.
 - b. Perform insulation-resistance tests winding-to-winding and each winding-to-ground. Apply voltage according to manufacturer's published data. In the absence of manufacturer's published data, comply with NETA ATS, Table 100.5. Calculate polarization index: the value of the index shall not be less than 1.0.
 - c. Perform turns-ratio tests at all tap positions. Test results shall not deviate by more than one-half percent from either the adjacent coils or the calculated ratio. If test fails, replace the transformer.
 - d. Verify correct secondary voltage, phase-to-phase and phase-to-neutral, after energization and prior to loading.

Section 4
Scope of Work and Technical Specifications
SECTION 26 22 13-6 LOW VOLTAGE DISTRIBUTION TRANSFORMERS

E. Remove and replace units that do not pass tests or inspections and retest as specified above.

F. Test Labeling: On completion of satisfactory testing of each unit, attach a dated and signed "Satisfactory Test" label to tested component.

3.05 CLEANING

A. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

END OF SECTION

SECTION 26 24 16

PANELBOARDS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Distribution panelboards.
 - 2. Lighting and appliance branch-circuit panelboards.

1.02 DEFINITIONS

- A. MCCB: Molded-case circuit breaker.
- B. SPD: Surge protective device.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of panelboard.
- B. Shop Drawings: For each panelboard and related equipment.
 - 1. Include dimensioned plans, elevations, sections, and details.
 - 2. Detail enclosure types including mounting and anchorage, environmental protection, knockouts, corner treatments, covers and doors, gaskets, hinges, and locks.
 - 3. Detail bus configuration, current, and voltage ratings.
 - 4. Short-circuit current rating of panelboards and overcurrent protective devices.
 - 5. Include evidence of NRTL listing for series rating of installed devices.
 - 6. Include evidence of NRTL listing for SPD as installed in panelboard.
 - 7. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
 - 8. Include wiring diagrams for power, signal, and control wiring.
 - 9. Key interlock scheme drawing and sequence of operations.
 - 10. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards.

1.04 INFORMATIONAL SUBMITTALS

- A. Panelboard schedules for installation in panelboards.

1.05 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

1.06 FIELD CONDITIONS

- A. Service Conditions: NEMA PB 1, usual service conditions, as follows:
 - 1. Ambient temperatures within limits specified.
 - 2. Altitude not exceeding 6600 feet.

1.07 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace panelboards that fail in materials or workmanship within specified warranty period.
 - 1. Panelboard Warranty Period: 18 months from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 PANELBOARDS COMMON REQUIREMENTS

- A. Fabricate and test panelboards according to IEEE 344 to withstand local seismic conditions.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with NEMA PB 1.
- D. Comply with NFPA 70.
- E. Enclosures: Surface-mounted, dead-front cabinets.
 - 1. Rated for environmental conditions at installed location.
 - a. Wet and Corrosive Areas: NEMA 250, Type 4X Stainless Steel.
 - 2. Height: 84 inches maximum.
 - 3. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box. Trims shall cover all live parts and shall have no exposed hardware.

4. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover. Trims shall cover all live parts and shall have no exposed hardware.
- F. Incoming Mains Location: Bottom.
- G. Phase, Neutral, and Ground Buses: Hard-drawn copper, 98 percent conductivity.
- H. Conductor Connectors: Suitable for use with conductor material and sizes.
 1. Material: Hard-drawn copper, 98 percent conductivity.
 2. Main and Neutral Lugs: Compression type, with a lug on the neutral bar for each pole in the panelboard.
 3. Ground Lugs and Bus-Configured Terminators: Compression type, with a lug on the bar for each pole in the panelboard.
 4. Feed-Through Lugs: Compression type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
 5. Subfeed (Double) Lugs: Compression type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
- I. NRTL Label: Panelboards shall be labeled by an NRTL acceptable to authority having jurisdiction for use as service equipment with one or more main service disconnecting and overcurrent protective devices. Panelboards shall have meter enclosures, wiring, connections, and other provisions for utility metering. Coordinate with utility company for exact requirements.
- J. Future Devices: Panelboards shall have mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
- K. Panelboard Short-Circuit Current Rating: Rated for series-connected system with integral or remote upstream overcurrent protective devices and labeled by an NRTL. Include label or manual with size and type of allowable upstream and branch devices listed and labeled by an NRTL for series-connected short-circuit rating.
- L. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals. Assembly listed by an NRTL for 100 percent interrupting capacity.

2.02 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Panelboards shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

B. Surge Suppression: Factory installed as an integral part of indicated panelboards, complying with UL 1449 SPD Type 1.

2.03 POWER PANELBOARDS

A. Manufacturers:

1. Square D
2. Eaton
3. ABB/ General Electric
4. Engineer's Approved Equal.

B. Panelboards: NEMA PB 1, distribution type.

C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.

1. For doors more than 36 inches high, provide two latches, keyed alike.

D. Mains: Circuit breaker.

E. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Plug-in circuit breakers.

F. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger than 125 A: Bolt-on circuit.

G. Branch Overcurrent Protective Devices: Fused switches.

H. Contactors in Main Bus: NEMA ICS 2, Class A, electrically held, general-purpose controller, with same short-circuit interrupting rating as panelboard.

1. External Control-Power Source: 120-V branch circuit.

2.04 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. Manufacturers:

1. Square D
2. Eaton
3. ABB/ General Electric
4. Engineer's Approved Equal.

B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.

C. Mains: Circuit breaker.

D. Branch Overcurrent Protective Devices: Plug-in circuit breakers, replaceable without disturbing adjacent units.

- E. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.
- F. Column-Type Panelboards: Single row of overcurrent devices with narrow gutter extension and overhead junction box equipped with ground and neutral terminal buses.

2.05 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Manufacturers:
 - 1. Square D
 - 2. Eaton
 - 3. ABB/ General Electric
 - 4. Engineer's Approved Equal.
- B. MCCB: Comply with UL 489, with series-connected rating to meet available fault currents.
 - 1. Thermal-Magnetic Circuit Breakers:
 - a. Inverse time-current element for low-level overloads.
 - b. Instantaneous magnetic trip element for short circuits.
 - c. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
 - 2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
 - 3. Electronic Trip Circuit Breakers:
 - a. RMS sensing.
 - b. Field-replaceable rating plug or electronic trip.
 - c. Digital display of settings, trip targets, and indicated metering displays.
 - d. Multi-button keypad to access programmable functions and monitored data.
 - e. Ten-event, trip-history log. Each trip event shall be recorded with type, phase, and magnitude of fault that caused the trip.
 - f. Integral test jack for connection to portable test set or laptop computer.
 - g. Field-Adjustable Settings:
 - 1) Instantaneous trip.

- 2) Long- and short-time pickup levels.
 - 3) Long and short time adjustments.
 - 4) Ground-fault pickup level, time delay, and I squared T response.
4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
5. GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (6-mA trip).
6. GFEP Circuit Breakers: Class B ground-fault protection (30-mA trip).
7. Arc-Fault Circuit Interrupter Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration.
8. Subfeed Circuit Breakers: Vertically mounted.
9. MCCB Features and Accessories:
- a. Standard frame sizes, trip ratings, and number of poles.
 - b. Breaker handle indicates tripped status.
 - c. UL listed for reverse connection without restrictive line or load ratings.
 - d. Lugs: Compression style, suitable for number, size, trip ratings, and conductor materials.
 - e. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and HID lighting circuits.
 - f. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
 - g. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.
 - h. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in off position.
 - i. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.
- C. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.

2.06 IDENTIFICATION

- A. Panelboard Label: Manufacturer's name and trademark, voltage, amperage, number of phases, and number of poles shall be located on the interior of the panelboard door.
- B. Breaker Labels: Faceplate shall list current rating, UL and IEC certification standards, and AIC rating.
- C. Circuit Directory: Directory card inside panelboard door, mounted in transparent card holder.

2.07 ACCESSORY COMPONENTS AND FEATURES

- A. Portable Test Set: For testing functions of solid-state trip devices without removing from panelboard. Include relay and meter test plugs suitable for testing panelboard meters and switchboard class relays.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Comply with NECA 1.
- B. Install panelboards and accessories according to NEMA PB 1.1.
- C. Comply with mounting and anchoring requirements as required to accommodate local seismic conditions.
- D. Mount top of trim 90 inches above finished floor unless otherwise indicated.
- E. Mount panelboard cabinet plumb and rigid without distortion of box.
- F. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
- G. Install overcurrent protective devices and controllers not already factory installed.
 - 1. Set field-adjustable, circuit-breaker trip ranges.
- H. Make grounding connections and bond neutral for services and separately derived systems to ground. Make connections to grounding electrodes, separate grounds for isolated ground bars, and connections to separate ground bars.
- I. Install filler plates in unused spaces.
- J. Stub four 1-inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch empty conduits into raised floor space or below slab not on grade.
- K. Arrange conductors in gutters into groups and bundle and wrap with wire ties.

3.02 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems."
- B. Create a directory to indicate installed circuit loads; incorporate Owner's final room designations. Obtain approval before installing. Handwritten directories are not acceptable. Install directory inside panelboard door.
- C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- D. Device Nameplates: Label each branch circuit device in power panelboards with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- E. Install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems" identifying source of remote circuit.

3.03 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Acceptance Testing Preparation:
 - 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- C. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection and electrical test for low-voltage air circuit breakers stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
- D. Panelboards will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results, with comparisons of the two scans. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

END OF SECTION

SECTION 26 27 26

WIRING DEVICES

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Straight-blade convenience receptacles.
2. USB charger devices.
3. GFCI receptacles.
4. SPD receptacles.
5. Toggle switches.
6. Decorator-style convenience.
7. Wall switch sensor light switches with dual technology sensors.
8. Wall switch sensor light switches with passive infrared sensors.
9. Wall switch sensor light switches with ultrasonic sensors.
10. Digital timer light switches.
11. Residential devices.
12. Wall-box dimmers.
13. Wall plates.

1.02 DEFINITIONS

A. Abbreviations of Manufacturers' Names:

1. Cooper: Copper Wiring Devices; Division of Cooper Industries, Inc.
2. Hubbell: Hubbell Incorporated: Wiring Devices-Kellems.
3. Leviton: Leviton Mfg. Company, Inc.
4. Pass & Seymour: Pass& Seymour/Legrand.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.

C. Samples: One for each type of device and wall plate specified, in each color specified.

1.04 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.05 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

PART 2 - PRODUCTS

2.01 GENERAL WIRING-DEVICE REQUIREMENTS

A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NFPA 70.

C. Devices that are manufactured for use with modular plug-in connectors may be substituted under the following conditions:

1. Connectors shall comply with UL 2459 and shall be made with stranding building wire.
2. Devices shall comply with the requirements in this Section.

D. Devices for Owner-Furnished Equipment:

1. Receptacles: Match plug configurations.

E. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

2.02 STRAIGHT-BLADE RECEPTACLES

A. Duplex Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, and FS W-C-596.

2.03 GFCI RECEPTACLES

A. General Description:

1. 125 V, 20 A, straight blade, feed-through type.
2. Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, UL 943 Class A, and FS W-C-596.
3. Include indicator light that shows when the GFCI has malfunctioned and no longer provides proper GFCI protection.

2.04 TOGGLE SWITCHES

- A. Comply with NEMA WD 1, UL 20, and FS W-S-896.
- B. Switches, 120/277 V, 20 A rated.

2.05 WALL PLATES

- A. Single and combination types shall match corresponding wiring devices.
 - 1. Plate-Securing Screws: Metal with head color to match plate finish.
 - 2. Material for Finished Spaces: 0.05-inch-thick, anodized aluminum.
 - 3. Material for Unfinished Spaces: Anodized aluminum.
 - 4. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in wet and damp locations.
- B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weather-resistant, die-cast aluminum with lockable cover.

2.06 FINISHES

- A. Device Color:
 - 1. Wiring Devices Connected to Normal Power System: unless otherwise indicated or required by NFPA 70 or device listing.
 - 2. Wiring Devices Connected to Emergency Power System: Red.
 - 3. SPD Devices: Blue.
 - 4. Isolated-Ground Receptacles: Orange.
- B. Wall Plate Color: For plastic covers, match device color.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.
- B. Coordination with Other Trades:
 - 1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of boxes.
 - 2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.

3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.

4. Install wiring devices after all wall preparation, including painting, is complete.

C. Conductors:

1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.

2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.

3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.

4. Existing Conductors:

a. Cut back and pigtail, or replace all damaged conductors.

b. Straighten conductors that remain and remove corrosion and foreign matter.

c. Pigtailing existing conductors is permitted, provided the outlet box is large enough.

D. Device Installation:

1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.

2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.

3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.

4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.

5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.

6. Use a torque screwdriver when a torque is recommended or required by manufacturer.

7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.

- 8. Tighten unused terminal screws on the device.
- 9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.
- E. Receptacle Orientation:
 - 1. Install ground pin of vertically mounted receptacles down, and on horizontally mounted receptacles to the right.
- F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.
- G. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.
- H. GFCI Receptacles: Install non-feed-through-type GFCI receptacles where protection of downstream receptacles is not required.

3.02 FIELD QUALITY CONTROL

- A. Test Instruments: Use instruments that comply with UL 1436.
- B. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.
- C. Perform the following tests and inspections as required.
 - 1. Tests for Convenience Receptacles:
 - a. Line Voltage: Acceptable range is 105 to 132 V.
 - b. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is unacceptable.
 - c. Ground Impedance: Values of up to 2 ohms are acceptable.
 - d. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
 - e. Using the test plug, verify that the device and its outlet box are securely mounted.
 - f. Tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

Section 4
Scope of Work and Technical Specifications
SECTION 26 27 26-6 WIRING DEVICES

- D. Wiring device will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

END OF SECTION

SECTION 26 29 23-1 VARIABLE FREQUENCY DRIVES (VFDs) WITH BYPASS REDUCED VOLTAGE SOFT STARTER (RVSS)

SECTION 26 29 23

**VARIABLE FREQUENCY DRIVES (VFDs) WITH BYPASS REDUCED VOLTAGE SOFT
STARTER (RVSS)**

PART 1 – GENERAL

1.01 SUMMARY

A. This section includes specifications for the supply, installation, and testing of Variable Frequency Drives (VFDs) with bypass and integrated Reduced Voltage Soft Starters (RVSS) for motor control systems.

1.02 REFERENCES

- A. Standards and guidelines referenced in this specification include:
1. UL 508C – Standard for Power Conversion Equipment.
 2. IEC 61800 – Adjustable Speed Electrical Power Drive Systems.
 3. IEEE 519 – Recommended Practices and Requirements for Harmonic Control.
 4. NEC (NFPA 70) – National Electrical Code.
 5. NEMA ICS 7 – Industrial Control and Systems Adjustable Speed Drives.

1.03 SUBMITTALS

- A. Provide the following submittals:
1. Product data sheets and catalog cut sheets.
 2. Dimensional drawings, wiring diagrams, and installation instructions.
 3. Manufacturer's certifications and compliance reports.
 4. Factory test reports and field test procedures.
 5. Operations and Maintenance (O&M) manuals.

1.04 QUALITY ASSURANCE

- A. The manufacturer shall have at least 5 years of experience producing VFDs with bypass and RVSS functionality.
- B. Equipment shall be UL-listed and labeled.
- C. Factory testing shall ensure compliance with all specifications prior to shipment.

1.05 DELIVERY, STORAGE, AND HANDLING

SECTION 26 29 23-2 VARIABLE FREQUENCY DRIVES (VFDs) WITH BYPASS REDUCED VOLTAGE SOFT STARTER (RVSS)

- A. Deliver equipment in factory-sealed packaging.
- B. Store equipment in a clean, dry, and protected location.
- C. Handle equipment in accordance with manufacturer's recommendations.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Subject to compliance with specifications, acceptable manufacturers include:
 - 1. Amtech.
 - 2. Siemens.
 - 3. Schneider Electric.
 - 4. Rockwell Automation (Allen-Bradley).
 - 5. Yaskawa.

2.02 EQUIPMENT DESCRIPTION

- A. VFD General Requirements:
 - 1. Voltage Rating: 480 VAC, 3-phase, 60 Hz.
 - 2. Power Rating: 125 HP.
 - 3. Enclosure: NEMA 4X with Air Conditioner.
 - 4. Environmental Ratings: Ambient temperature of 0°C to 40°C, relative humidity up to 95% non-condensing.
- B. Control Features:
 - 1. Integrated keypad with graphical display.
 - 2. Programmable acceleration and deceleration ramps.
 - 3. Multiple preset speeds (minimum 4).
 - 4. Modbus RTU or Ethernet communication.
 - 5. Fault diagnostics and event logging.
- C. Bypass RVSS Starter:
 - 1. Manual and automatic bypass modes.
 - 2. RVSS for reduced voltage starting during bypass operation.
 - 3. Overload protection and phase loss detection.

SECTION 26 29 23-3 VARIABLE FREQUENCY DRIVES (VFDs) WITH BYPASS REDUCED VOLTAGE SOFT STARTER (RVSS)

- 4. Indication of operating status via LED or HMI display.
- D. Harmonic Mitigation:
 - 1. Input line reactors or filters to comply with IEEE 519.
 - 2. Include DC link choke if applicable.
- E. Protection Features:
 - 1. Overcurrent, overvoltage, undervoltage, and ground fault protection.
 - 2. Surge protection per ANSI/IEEE C62.41.
 - 3. Thermal overload protection for the motor.

2.03 ACCESSORIES

- A. Provide the following accessories:
 - 1. Line reactors or harmonic filters.
 - 2. Remote control panels.
 - 3. Air Conditioner.
 - 4. Ethernet communication modules.
 - 5. See Electrical Drawings for more details.

PART 3 – EXECUTION

3.01 INSTALLATION

- A. Install VFDs in accordance with manufacturer's instructions.
- B. Ensure proper grounding and bonding per NEC requirements.
- C. Route power and control wiring in separate conduits.
- D. Verify cooling and ventilation clearances.

3.02 FIELD QUALITY CONTROL

- A. Pre-energization Tests:
 - 1. Verify correct wiring and connections.
 - 2. Check for mechanical damage or loose components.
- B. Startup and Commissioning:
 - 1. Conduct startup per manufacturer's procedures.
 - 2. Perform functional tests for VFD and bypass RVSS modes.

SECTION 26 29 23-4 VARIABLE FREQUENCY DRIVES (VFDs) WITH BYPASS REDUCED VOLTAGE SOFT STARTER (RVSS)

3. Verify harmonic levels comply with IEEE 519.

3.03 TRAINING

- A. Provide onsite training for the Owner's personnel covering:
 1. Operation of the VFD and bypass system.
 2. Troubleshooting and maintenance procedures.

3.04 WARRANTY

- A. Provide a manufacturer's warranty of two (2) years for all components.

END OF SECTION

SECTION 26 32 13

ENGINE DRIVEN GENERATOR SETS

PART 1 - GENERAL

1.01 REFERENCES

A. The equipment covered by these specifications shall be designed, tested, rated, assembled and installed in strict accordance with all applicable standards of ANSI, NEC, ISO, U.L., IEEE and NEMA.

1.02 WORK INCLUDED

A. The work includes supplying a complete integrated emergency generator system. The system consists of a diesel generator set with related component accessories as specified herein.

B. The Contractor shall provide a full tank of diesel fuel for the completion of all testing.

C. A complete system load test shall be performed after all equipment is installed.

D. The equipment supplied and installed shall meet the requirements of the NEC and all applicable local codes and regulations. All equipment shall be of new and current production by a Manufacturer who has 25 years of experience building this type of equipment. Manufacturer shall be ISO9001 certified.

1.03 MANUFACTURERS

A. There shall be one source responsibility for warranty, parts and service through a local representative with factory trained service personnel.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Generator Set

a. Cummins

b. Caterpillar

c. Kohler.

2. Automatic Transfer Switch (incorporated into main Switchboard gear)

1.04 SUBMITTALS

A. Engine-generator submittals shall include the following information

1. Factory published specification sheet indicating standard and optional accessories, ratings, etc.

Section 4
Scope of Work and Technical Specifications
SECTION 26 32 13-2 ENGINE DRIVEN GENERATOR SETS

2. Manufacturer's catalog cut sheets of all auxiliary components such as Automatic Transfer Switches, battery charger, control panel, enclosure, main circuit breaker, etc.
3. Dimensional elevation and layout drawings of the generator set, enclosure and transfer switchgear and related accessories.
4. Weights of all equipment.
5. Concrete pad recommendation, layout and stub-up locations of electrical and fuel systems.
6. Interconnect wiring diagram of complete emergency system, including generator, switchgear, day tank, remote pumps, battery charger, jacket water heater, remote alarm indications.
7. Engine mechanical data including heat rejection, exhaust gas flows, combustion air and ventilation air flows, noise data, fuel consumption, etc.
8. Generator electrical data including temperature and insulation data, cooling requirements, excitation ratings, voltage regulation, voltage regulator, efficiencies, waveform distortion and telephone influence factor.
9. Generator resistances, reactances, and time constants.
10. Generator motor starting capability.
11. Control panel schematics.
13. Oil sampling analysis, laboratory location, and information.
14. Manufacturer's and dealer's written warranty.
15. Letter of guarantee that the proposed generator will be capable of starting and running the loads specified on the drawings.

1.05 WARRANTY

- A. The manufacturer's standard warranty shall in no event be for a period of less than two (2) years from date of substantial completion and shall include repair parts, labor, reasonable travel expense necessary for repairs at the job site, and expendables (lubricating oil, filters, antifreeze, and other service items made unusable by the defect) used during the course of repair. Submittals received without written warranties as specified will be rejected in their entirety.
- B. Manufacturer shall provide all maintenance services for the first two years.

1.06 PARTS AND SERVICE QUALIFICATIONS

- A. The engine-generator supplier shall have service facilities within 75 miles of the project site and maintain 24-hour parts and service capability. The distributor shall stock parts as needed to support the generator set package for this specific project.
- B. The dealer shall maintain qualified, factory trained service personnel that can respond to an emergency call within 4 hours of notification, 24 hours per day.

PART 2 - PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. The generator set shall be Standby and have a kW rating as shown on the one line diagram. The additional ratings shall be 1800 RPM, 0.8 power factor, 480Y/277 VAC, 3 phase, 4 wire, 60 hertz, including radiator fan and all parasitic loads.
- B. All materials and parts comprising the unit shall be new and unused.

2.02 DIESEL ENGINE

- A. The engine shall be water-cooled inline or vee-type, four cycle compression ignition diesel. It shall meet specifications when operating on number 2 domestic burner oil. Two cycle engines will not be considered. The engine shall be equipped with fuel, lube oil, and intake air filters, lube oil cooler, fuel transfer pump, fuel priming pump, service meter, gear-driven water pump.
- B. The complete engine block shall be machined from one casting. Designs incorporating multiple blocks bolted together are not acceptable.
- C. The engine shall utilize a gear-type, positive displacement, full pressure lubricating oil pump and water-cooled lube oil cooler. Pistons shall be spray-cooled. Provide oil filters, oil pressure gauge, dipstick and oil drain.
- D. Fuel filter and serviceable fuel system components shall be located to prevent fuel from spilling onto generator set batteries.
- E. The engine shall be equipped with an isochronous electronic governor to maintain 0% droop from no load to full load and +/- 0.25% steady state frequency variation. The governor shall be equipped with speed adjustment.

2.03 GENERATOR

- A. The synchronous generator shall be a single bearing, self-ventilated, drip-proof design in accordance with NEMA MG 1 and directly connected to the engine flywheel housing with a flex coupling.
- B. The insulation material shall meet NEMA standards for Class H insulation and be vacuum impregnated with epoxy varnish to be fungus resistant. Temperature rise of the

rotor and stator shall not exceed NEMA class F (130° C rise by resistance over 40° C ambient). The excitation system shall be of brushless construction.

C. The brushless exciter shall be independent of main stator windings (either permanent magnet or auxiliary windings) and shall consist of a three-phase armature and a three-phase full wave bridge rectifier mounted on the rotor shaft. Surge suppressors shall be included to protect the diodes from voltage spikes. Generator shall have the ability to sustain short circuit current of 300% of rated current to allow protective devices to operate.

D. The automatic voltage regulator (AVR) shall maintain generator output voltage within +/- 0.5% for any constant load between no load and full load. The regulator shall be a totally solid state design which includes electronic voltage buildup, volts per Hertz regulation, three phase sensing, over-excitation protection, loss of sensing protection, temperature compensation, shall limit voltage overshoot on startup, and shall be environmentally sealed.

2.04 CIRCUIT BREAKER

A. Provide a generator mounted circuit breaker, molded case or insulated case construction. Breaker shall be sized as shown on the drawings. Breaker shall be Merlin Gerin or equal and utilize a thermal magnetic trip unit and 24 VDC shunt trip. The breaker shall be UL listed with shunt trip device connected to engine/generator safety shutdowns. Breaker shall be housed in an extension terminal box mounted on the side of the generator. Mechanical type lugs, sized for the circuit breaker feeders shown on drawing, shall be supplied on the load side of breaker. Breaker shall include long term, short term instantaneous, and ground fault protection.

2.05 CONTROLS

A. Generator Mounted Control Panel:

1. Provide a MODBUS connection.
2. Provide a generator mounted control panel for complete control and monitoring of the engine and generator set functions. Panel shall include automatic start/stop operation, adjustable cycle cranking, digital LCD AC metering (0.5% true rms accuracy) with phase selector switch, digital engine monitoring, shutdown sensors and alarms with horn and reset, adjustable cooldown timer and emergency stop push-button. Panel shall incorporate self-diagnostics capabilities and fault logging. Critical components shall be environmentally sealed to protect against failure from moisture and dirt. Components shall be housed in a NEMA 1/IP22 enclosure with hinged lid.
3. Provide the following digital readouts on the Generator Mounted Control Panel:
 - a. Engine oil pressure

Section 4
Scope of Work and Technical Specifications
SECTION 26 32 13-5 ENGINE DRIVEN GENERATOR SETS

- b. Coolant temperature
- c. Engine RPM
- d. System DC Volts
- e. Engine running hours
- f. Generator AC volts
- g. Generator AC amps
- h. Generator frequency

4. Control Panel Annunciation - Provide the following indications for protection and diagnostics according to NFPA 110 level 1:

- a. Low oil pressure
- b. High water temperature
- c. Low coolant level
- d. Overspeed
- e. Overcrank
- f. Emergency stop depressed
- g. Approaching high coolant temperature
- h. Approaching low oil pressure
- i. Low coolant temperature
- j. Low voltage in battery
- k. Control switch not in auto. position
- l. Low fuel main tank
- m. Battery charger ac failure
- n. High battery voltage
- o. Generator supplying load
- p. Spare.

5. Generator "Running", "Common Fault" and "Low Fuel Level" relays with dry, 120VAC, 5 Amp rated contacts.

B. COOLING SYSTEM

1. The generator set shall be equipped with a rail-mounted, engine-driven radiator with blower fan and all accessories. The cooling system shall be sized to operate at full load conditions and 110° F ambient air entering the room or enclosure (If an enclosure is specified) without derating the unit and 50/50 anti-freeze mixture. The generator set supplier is responsible for providing a properly sized cooling system based on the enclosure static pressure restriction.

C. FUEL SYSTEM

1. Filter/Separator - In addition to the standard fuel filters provided by the engine manufacturer, there shall also be installed a primary fuel filter/water separator in the fuel inlet line to the engine.
2. All fuel piping shall be black iron or flexible fuel hose rated for this service. No galvanized piping will be permitted.
3. Flexible fuel lines shall be rated for 300 degrees F and 100 PSI.
4. Fuel Tank shall be double wall with Leak Detection.

D. EXHAUST SYSTEM

1. A critical type silencer, companion flanges, and flexible stainless steel exhaust fitting properly sized shall be furnished and installed according to the manufacturer's recommendation.
2. Mounting shall be provided by the contractor as shown on the drawings. The silencer shall be mounted so that its weight is not supported by the engine.
3. Exhaust pipe size shall be sufficient to ensure that exhaust back pressure does not exceed the maximum limitations specified by the engine manufacturer.

E. STARTING SYSTEM

1. A DC electric starting system with positive engagement shall be furnished. The motor voltage shall be as recommended by the engine manufacturer.
2. Jacket Water Heater: A unit mounted thermal circulation type water heater. The heater watt rating shall be sized by the manufacturer to maintain jacket water temperature at 90 degrees F, and shall be a 120 volt, single phase, 60 hertz.
3. Batteries: A lead-acid storage battery set of the heavy duty diesel starting type shall be provided. Battery voltage shall be compatible with the starting system. The battery set shall be rated no less than 140 ampere hours and 1000 CCA. Necessary cables and clamps shall be provided.

4. A battery tray shall be provided for the batteries and shall conform to NEC 480-7(b). It shall be treated to be resistant to deterioration by battery electrolyte. Further, construction shall be such that any spillage or boil-over battery electrolyte shall be contained within the tray to prevent a direct path to ground.

5. Battery Charger: A current limiting battery charger shall be furnished to automatically recharge batteries. Charger shall float at 2.17 volts per cell and equalize at 2.33 volts per cell. It shall include overload protection, silicon diode full wave rectifiers, voltage surge suppressor, DC ammeter, DC voltmeter, and fused AC input. AC input voltage shall be 120 volts, single phase. Charger shall have LED annunciation for low DC volts, rectifier failure, loss of AC power, high DC volts. Amperage output shall be as required. Charger shall be wall mounting type in NEMA 1 enclosure, installed in the generator set enclosure.

F. GENERATOR SET ENCLOSURE – SOUND ATTENUATED AND WEATHER PROTECTIVE

1. The complete diesel engine generator set, including generator control panel, engine starting batteries and fuel oil tank, shall be enclosed in a factory assembled, weather protective enclosure mounted on the fuel tank base.

2. The enclosure shall be constructed of corrosion resistant steel with electrostatically applied powder coated baked polyester paint. It shall consist of a roof, side walls, and end walls. Fasteners shall be either zinc plated or stainless steel. Enclosure shall have a minimum wind speed rating of 150 MPH.

3. A dual wall fuel tank base of 72 hour capacity at 100% load shall be provided as an integral part of the enclosure. It shall be contained in a rupture basin with 110% capacity. The tank shall be pressure tested for leaks prior to shipment and have all necessary venting per UL142 standards. A locking fill cap, a mechanical reading fuel level gauge, low fuel level alarm contact, and fuel tank rupture alarm contact shall be provided.

4. The enclosure shall reduce the ambient noise level at full load to a maximum of 75 dB at 23 feet, and no greater than 40dB at the property line.

5. Number of doors on enclosure shall be as required so that all normal maintenance operations, such as lube oil change, filter change, belt adjustment and replacements, hose replacements, access to the control panels, etc., may be accomplished without disassembly of any enclosure components. Access doors shall be fabricated of the same material as the enclosure walls and shall be reinforced for rigidity.

6. Handles shall be key lockable, all doors keyed alike, and hinges shall be zinc die cast or stainless steel. Fasteners shall be zinc plated or stainless steel. Doors shall be of a lift off design allowing one person to remove door if necessary.

7. Air handling will be sized and designed by the manufacturer for 0.5" static pressure drop through enclosure. Intake openings shall be screened to prevent the entrance of rodents.

8. Lube oil and coolant drains shall be extended to the exterior of the enclosure and terminated with drain valves. Radiator access shall be through a hinged, lockable cover on enclosure. Cooling fan and charging alternator shall be fully guarded to prevent injury.

9. Lifting points shall be provided on base frame suitable for lifting combined weight of base tank, generator set and enclosure.

G. AUTOMATIC TRANSFER SWITCH (INCORPORATED INTO MAIN SWITCHBOARD GEAR)

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install equipment in accordance with manufacturer's recommendations, the project drawings and specifications, and all applicable codes. Installation of the system includes but is not limited to pouring a concrete pad for the generator set and automatic transfer switch, receiving and offloading the equipment, providing all labor, permits and material to install the total system.

B. Start-Up and Testing

1. Coordinate all start-up and testing activities with the Engineer and Owner.

2. After installation is complete and normal power is available, the manufacturer's local dealer shall perform the following:

3. Verify that the equipment is installed properly.

4. Check all auxiliary devices for proper operation, including battery charger, jacket water heater(s), generator space heater, remote annunciator, etc.

5. Test all alarms and safety shutdown devices for proper operation and annunciation.

6. Check all fluid levels.

7. Start engine and check for exhaust, oil, fuel leaks, vibrations, etc.

8. Verify proper voltage and phase rotation at the transfer switch before connecting to the load.

9. Connect the generator to building load and verify that the generator will start and run all designated loads in the plant.

Section 4
Scope of Work and Technical Specifications
SECTION 26 32 13-9 ENGINE DRIVEN GENERATOR SETS

10. Perform a 4 hour load bank test at full nameplate load using a load bank and cables supplied by the local generator dealer. Observe and record the following data at 15 minute intervals:

- a. Service meter hours
- b. Volts AC - All phases
- c. Amps AC - All phases
- d. Frequency
- e. Power factor or Vars
- f. Jacket water temperature
- g. Oil Pressure
- h. Fuel pressure
- i. Ambient temperature

11. Operation and Maintenance Manuals

- a. Provide three (3) sets of operation and maintenance manuals covering the generator, switchgear, and auxiliary components. Include parts manuals, final as-built wiring interconnect diagrams and recommended preventative maintenance schedules.

3.02 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain packaged engine generators.

- 1. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining equipment.
- 2. Review data in maintenance manuals.
- 3. Schedule training with Owner, with at least seven days' advance notice.
- 4. Minimum Instruction Period: Four hours.

END OF SECTION

SECTION 31 10 00

SITE PREPARATION

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Specification Sections, apply to this Section.

1.02 DEFINITIONS

- A. Subsoil:
 - 1. All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.
- B. Surface Soil:
 - 1. Soil that is present at the top layer of the existing soil profile at the Project site.
 - a. In undisturbed areas, the surface soil is typically topsoil.
 - b. In disturbed areas such as urban environments, the surface soil can be subsoil.
- C. Topsoil:
 - 1. Top layer of the soil profile consisting of existing native surface topsoil or existing in-place surface soil and is the zone where plant roots grow.
 - 2. Its appearance is generally friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects more than 2 inches (50 mm) in diameter; and free of subsoil and weeds, roots, toxic materials, or other nonsoil materials.
- D. Plant-Protection Zone:
 - 1. Area surrounding individual trees, groups of trees, shrubs, or other vegetation to be protected during construction, and indicated on Drawings.
- E. Tree-Protection Zone:
 - 1. Area surrounding individual trees or groups of trees to be protected during construction, and defined by a circle concentric with each tree with a radius 1.5 times the diameter of the drip line unless otherwise indicated.
- F. Vegetation:
 - 1. Trees, shrubs, groundcovers, grass, and other plants.

1.03 MATERIAL OWNERSHIP

- A. Except for stripped topsoil and other materials indicated to be stockpiled or otherwise remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

1.04 SUBMITTALS

- A. Existing Conditions:
 - 1. Documentation of existing trees and plantings, adjoining construction, and site improvements that establish preconstruction conditions that might be misconstrued as damage caused by site clearing.
 - a. Use sufficiently detailed photographs and/or videotape.
 - b. Include plans and notations to indicate specific wounds and damage conditions of each tree or other plants designated to remain.
- B. Record Drawings:
 - 1. Identifying and accurately showing locations of capped utilities and other structural, electrical, and mechanical conditions.

1.05 QUALITY ASSURANCE

- A. Pre-installation Conference:
 - 1. Conduct conference at Project site.

1.06 PROJECT CONDITIONS

- A. Traffic:
 - 1. Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.
 - a. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from the Owner and authorities having jurisdiction.
 - b. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.
- B. Salvable Improvements:
 - 1. Carefully remove items indicated to be salvaged and store on Owner's premises where indicated.
- C. Utility Locator Service:

1. Utilize a utility locator service for area where Project is located before site clearing.
2. Do not commence site clearing operations until temporary erosion and sedimentation control and plant-protection measures are in place.

D. Protection Zones

1. The following practices are prohibited within protection zones:
 - a. Storage of construction materials, debris, or excavated material.
 - b. Parking vehicles or equipment.
 - c. Foot traffic.
 - d. Erection of sheds or structures.
 - e. Impoundment of water.
 - f. Excavation or other digging unless otherwise indicated.
 - g. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.
2. Do not direct vehicle or equipment exhaust towards protection zones.
3. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones.

E Soil Stripping, Handling, And Stockpiling:

1. Perform only when the topsoil is dry or slightly moist.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Satisfactory Soil Material:

1. Requirements for satisfactory soil material are specified in Section 31 23 00 – Trench Excavation and Fill.
2. Obtain approved borrow soil material off-site when satisfactory soil material is not available on-site.

B. Antirust Coating:

1. Fast-curing, lead- and chromate-free, self-curing, universal modified-alkyd primer complying with MPI #79, Alkyd Anticorrosive Metal Primer or SSPC-Paint 20 or SSPC-Paint 29 zinc-rich coating.

PART 3 – EXECUTION

3.01 PREPARATION

- A. Protect and maintain benchmarks and survey control points from disturbance during construction.
- B. Locate and clearly identify trees, shrubs, and other vegetation to remain.
- C. Protect existing site improvements to remain from damage during construction.
 - 1. Restore damaged improvements to their original condition, as acceptable to the Owner.

3.02 TEMPORARY EROSION AND SEDIMENTATION CONTROL

- A. Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to erosion and sedimentation control Drawings and requirements of authorities having jurisdiction.
- B. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.
- C. Inspect, maintain, and repair erosion and sedimentation control measures during construction until permanent vegetation has been established.
- D. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.03 TREE AND PLANT PROTECTION

- A. General:
 - 1. Repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by construction operations, in a manner approved by the Owner.

3.04 EXISTING UTILITIES

- A. Owner will arrange for disconnecting and sealing indicated utilities that serve existing structures before site clearing, when requested by Contractor.
 - 1. Verify that utilities have been disconnected and capped before proceeding with site clearing.
- B. Locate, identify, disconnect, and seal or cap utilities indicated to be removed.
 - 1. Arrange with utility companies to shut off indicated utilities.

2. Owner will arrange to shut off indicated utilities when requested by Contractor.
- C. Locate, identify, and disconnect utilities indicated to be abandoned in place.
- D. Interrupting Existing Utilities:
1. Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
 - a. Notify Owner and Owner not less than two days in advance of proposed utility interruptions.
 - b. Do not proceed with utility interruptions without Owner or Owner's written permission.
 2. Excavate for and remove underground utilities indicated to be removed.
 3. Removal of underground utilities as included on the Drawings.

3.05 CLEARING AND GRUBBING

- A. The sites of all excavation and grading shall be first cleared of all paving, trees, stumps, roots, brush, organic matter, crops, paving, structures, fences, sidewalks, rubbish, debris, etc., which shall be removed or disposed of in a satisfactory manner in a legally permitted location.
- B. Refer to Section 31 11 10 for detailed Clearing and Grubbing requirements.

3.06 TIMBER

- A. Salvage all timber within cleared area having a marketable value.
- B. The timber within the cleared area shall become the property of the Contractor and the Contractor shall be responsible for selling and/or disposing the timber.

3.07 DISPOSAL OF CLEARED AND GRUBBED MATERIALS

- A. Dispose of the cleared and grubbed materials by burning or chipping. Burning shall be permitted during approved burning seasons only. During non-burning season periods, use chipping for debris disposal. Remove chipped material from the site or disposed of in areas approved by Owner.
- B. If burning is allowed, do not allow a fire to be unattended. The Contractor is responsible for damage caused by such fires. Do not bury burned and nonflammable materials.
1. All Contractors should be aware that the Georgia Environmental Protection Division has issued a burning ban for thirteen (13) Metro Atlanta

Counties. The ban went into effect in 1996 and shall continue each year from May 1 through September 30. This ban should be considered when bidding projects that require clearing and debris removal. It is the Contractor's responsibility to remove all construction debris from the jobsite. Any costs incurred as a result of the burning ban are the sole responsibility of the Contractor.

C. Disposal of materials in streams will not be permitted. Do not pile materials in stream channels or along the banks where it might be washed away by flood.

D. Remove all fence material within the areas to be cleared from the job site. Fence materials become the property of the Contractor.

3.08 DISCING

A. After grubbing is complete, discing of the entire area is required. Perform discing in two directions at approximate right angles. Generally, perform the second discing along the contour.

B. The construction area is to be left free-draining with a finished agricultural appearance.

3.09 TOPSOIL STRIPPING

A. Remove sod and grass before stripping topsoil.

B. Strip topsoil to a depth of 7 inches in a manner to prevent intermingling with underlying subsoil or other waste materials.

1. Remove subsoil and nonsoil materials from topsoil, including clay lumps, gravel, other objects more than 2 inches in diameter, trash, debris, weeds, roots, and other waste materials.

C. Stockpile topsoil away from edge of excavations without intermixing with subsoil. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust and erosion by water.

1. Limit height of topsoil stockpiles to 72 inches.

2. Do not stockpile topsoil within protection zones.

3. Dispose of surplus topsoil. Surplus topsoil is that which exceeds quantity indicated to be stockpiled or reused.

4. Stockpile surplus topsoil to allow for re-spreading deeper topsoil.

3.10 SITE IMPROVEMENTS

A. Remove existing above- and below-grade improvements as indicated and as necessary to facilitate new construction.

B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.

1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut along line of existing pavement to remain before removing adjacent existing pavement. Saw-cut faces vertically.

2. Paint cut ends of steel reinforcement in concrete to remain with two coats of antirust coating, following coating manufacturer's written instructions. Keep paint off surfaces that will remain exposed.

3.11 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property and/or Project site.

B. Separate recyclable materials produced during site clearing from other non-recyclable materials. Store or stockpile without intermixing with other materials and transport them to recycling facilities. Do not interfere with other Project work.

END OF SECTION

SECTION 31 11 10

CLEARING AND GRUBBING

PART 1 – GENERAL

1.01 SCOPE

- A. Clearing and grubbing includes, but is not limited to, removing from the Project site, trees, stumps, roots, brush, structures, abandoned utilities, trash, debris and all other materials found on or near the surface of the ground in the construction area and understood by generally accepted engineering practice not to be suitable for construction of the type contemplated.
- B. Precautionary measures that prevent damage to existing features including trees, to remain are part of the Work.
- C. The sites of all excavation and grading shall first be cleared of all paving, trees, walls, fences, sidewalks, stumps, brush, rubbish, and crops, which shall be removed and disposed of in a satisfactory manner.
- D. On all lawns and other improved grass areas, the sod shall be carefully removed, kept alive when possible, and replaced after the backfilling is completed.
- E. The Contractor shall also remove all spoil from such areas as quickly as possible after the excavation is backfilled, and shall leave the premises in as good a condition as before undertaking the work.
- F. Fences which have been removed, damaged, or broken down shall be replaced at or before completion of the work to pre-construction quality or better.
- G. Clearing and grubbing operations shall be coordinated with temporary and permanent erosion and sedimentation control procedures.

1.02 QUALITY ASSURANCE

- A. The Contractor shall comply with applicable codes, ordinances, rules, regulations and laws of local, municipal, State or Federal authorities having jurisdiction over the Project. All required permits of a temporary nature shall be obtained for construction operations by the Contractor.
- B. Open burning, if allowed, shall first be permitted by the local authority having jurisdiction. The Contractor shall notify the local fire department and abide by fire department restrictions.
- C. All Contractors should be aware that the Georgia Environmental Protection Division has issued a burning ban for thirteen (13) Metro Atlanta Counties. The ban went into effect in 1996 and shall continue each year from May 1 through September 30. This ban should be considered when bidding projects that require clearing and debris

removal. It is the Contractor's responsibility to remove all construction debris from the jobsite. Any costs incurred as a result of the burning ban are the sole responsibility of the Contractor.

1.03 JOB CONDITIONS

A. Location of the Work: The area to be cleared and grubbed is shown schematically on the Drawings or specified below. It includes all areas designated for pipeline construction.

PART 2 – PRODUCTS

2.01 EQUIPMENT

A. The Contractor shall furnish equipment of the type normally used in clearing and grubbing operations including, but not limited to, tractors, trucks, loaders and root rakes.

PART 3 – EXECUTION

3.01 SCHEDULING OF CLEARING

A. The Contractor shall clear at each construction site only that length of the right of way, permanent or construction easement which would be the equivalent of two week's pipe laying. This length shall be determined from the Contractor's Progress Schedule.

B. The Owner may permit clearing for additional lengths of the pipe line provided that temporary erosion and sedimentation controls are in place and a satisfactory stand of temporary grass is established. Should a satisfactory stand of grass not be possible, no additional clearing shall be permitted beyond that specified above.

C. A satisfactory stand of grass shall have no bare spots larger than one square yard. Bare spots shall be scattered and the bare area shall not comprise more than one percent of any given area.

3.02 CLEARING AND GRUBBING

A. Clear and grub no more than 3 feet on each side of the pipeline before excavating. Remove all trees, growth, debris, stumps and other objectionable matter. Clear the construction easement or road right of way only if necessary.

B. Materials to be cleared, grubbed and removed from the Project site include, but are not limited to, all trees, stumps, roots, brush, trash, organic matter, paving, miscellaneous structures, houses, debris and abandoned utilities.

C. Grub, stockpile, and/or place in embankments surface rocks and boulders from the soil in accordance with the Specifications.

D. Remove obstructions, trees, shrubs, and other vegetation to permit installation of new construction.

E. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.

1. When it is necessary to cut tree roots on the surface of the ground, the ends shall be cut off smooth, without splitting or shattering and scars greater than one inch in diameter shall be sealed with an approved asphalt sealant tree paint.
2. The trunks of the trees shall be carefully protected from damage, and if unavoidable damage occurs, the injured portions shall be neatly trimmed and covered with an application of an approved asphalt sealant tree paint.
3. Excavating machinery, cranes, etc., shall be handled with care to prevent damage to trees, particularly to overhanging branches, and branches shall not be cut off except by permission of Owner.

F. Grubbing shall consist of completely removing roots, stumps, trash and other debris from all graded areas so that topsoil is free of roots and debris. Topsoil is to be left sufficiently clean so that further picking and raking will not be required.

G. All stumps, roots, foundations and planking embedded in the ground shall be removed and disposed of. Piling and butts of utility poles shall be removed to a minimum depth of two feet below the limits of excavation for structures, trenches and roadways or two feet below finish grade, whichever is lower.

H. Grind down stumps and remove roots, obstructions, and debris to a depth of 24 inches below exposed subgrade.

I. Use only hand methods for grubbing within protection zones.

J. Chip removed tree branches and stockpile in approved areas or dispose of offsite, as directed by Owner.

K. Landscaping features shall include, but are not necessarily limited to, fences, cultivated trees, cultivated shrubbery, property corners, man made improvements, subdivision and other signs within the right of way and easement. The Contractor shall take extreme care in moving landscape features and promptly re establishing these features.

L. Surface rocks and boulders shall be grubbed from the soil and removed from the site if not suitable as rip rap.

M. Where the tree limbs interfere with utility wires, or where the trees to be felled are in close proximity to utility wires, the tree shall be taken down in sections to eliminate the possibility of damage to the utility.

N. Any work pertaining to utility poles shall coordinate and comply with the requirements of the appropriate utility.

Section 4
Scope of Work and Technical Specifications
SECTION 31 11 10-4 CLEARING AND GRUBBING

O. All fences adjoining any excavation or embankment that, in the Contractor's opinion, may be damaged or buried, shall be carefully removed, stored and replaced. Any fencing that, in the Owner's opinion, is significantly damaged shall be replaced with new fence material.

P. The Contractor shall exercise special precautions for the protection and preservation of trees, cultivated shrubs, sod, fences, etc. situated within the limits of the construction area but not directly within excavation and/or fill limits. The Contractor shall be held liable for any damage the Contractor's operations have inflicted on such property.

Q. The Contractor shall be responsible for repairs and/or replacement of all damage to existing improvements resulting from Contractor's operations.

R. Fill depressions caused by clearing and grubbing operations with proper backfill soil material, unless further excavation or earthwork is indicated by the Drawings or directed by Owner.

1. Place fill material in horizontal layers or lifts, not exceeding a loose depth of eight (8) inches, and compact each layer to 85% of maximum dry density – Standard Proctor (ASTM D698).

3.03 DISPOSAL OF DEBRIS

A. The debris resulting from the clearing and grubbing operation shall be hauled to a disposal site secured by the Contractor and shall be disposed of in accordance with all requirements of Federal, State, County and municipal regulations.

B. No debris of any kind shall be deposited in any stream or body of water, or in any street or alley.

C. No debris shall be deposited upon any private property except with written consent of the property owner. In no case shall any material or debris be left on the Project, shoved onto abutting private properties or buried on the Project.

END OF SECTION

SECTION 31 20 00

EARTHWORK

PART 1 – GENERAL

1.01 WORK INCLUDED

A. The work covered by this Section includes furnishing all labor, equipment, and materials required to accomplish all clearing, grubbing, excavation, dewatering, sheeting, backfilling, grading, and any other similar earthwork operation which may be necessary to properly complete the work. All work shall be done in conformity with the Specifications and the directions of the Engineer.

B. This Section includes the following:

1. Preparing and grading subgrades for slabs, walks, pavements, and landscaping.
2. Excavating and backfilling for buildings and structures.
3. Drainage and moisture-control fill course for slabs-on-grade.
4. Subbase course for walks and pavements.
5. Subsurface drainage backfills for walls and trenches.
6. Excavating and backfilling trenches within building lines.
7. Excavating and backfilling for underground mechanical and electrical utilities and appurtenances.

1.02 RELATED DOCUMENTS

- A. Division 1: General Requirements.
- B. Division 31: Site Work.

1.03 DEFINITIONS

- A. **Excavation:** Consists of the removal of material encountered to subgrade elevations and the reuse or disposal of materials removed.
- B. **Subgrade:** The uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, or topsoil materials.
- C. **Borrow:** Soil material obtained off-site when sufficient approved soil material is not available from excavations.
- D. **Subbase Course:** The layer placed between the subgrade and base course in a paving system, or the layer placed between the subgrade and surface of a pavement or walk.

E. Base Course: The layer placed between the subbase and surface pavement in a paving system.

F. Drainage Fill: Course of washed granular material supporting slab-on- grade placed to cut off upward capillary flow of pore water.

G. Unauthorized Excavation: Consists of removing materials beyond indicated subgrade elevations or dimensions without direction by the Engineer. Unauthorized excavation, as well as remedial work directed by the Engineer, shall be at the Contractor's expense.

H. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below ground surface.

I. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within building lines.

1.04 SUBMITTALS

A. General: Submit the following according Section 01300 of the Specifications.

B. Product data for the following:

1. Each type of plastic warning tape.
2. Filter fabric.
3. Ground stabilization fabric.

C. Samples of the following:

1. 20-lb samples sealed in airtight containers, of each proposed fill and backfill soil material from on-site or borrow sources.
2. 12-by-12-inch sample of filter fabric.
3. 12-by-12-inch sample of ground stabilization fabric.

D. Test Reports: In addition to test reports required under field quality control, submit the following:

1. Laboratory analysis of each soil material proposed for fill and backfill from on-site and borrow sources.
2. One optimum moisture-maximum density curve for each soil material.
3. Report of field density test of each stratum tested.

1.05 SUMMARY

- A. The elevations shown on the Drawings as existing are taken from the best existing data and are intended to give reasonable, accurate information about the existing elevations. They may not be exact, and the Contractor must satisfy himself as to the exact quantities of excavation and fill required.
- B. Earthwork operations shall be performed in a safe and proper manner with appropriate precautions being taken against all hazards.
- C. All excavated and filled areas for structures, trenches, fills, topsoil areas, embankments and channels shall be maintained by the Contractor in good condition at all times until final acceptance by the Owner. All damage caused by erosion or other construction operations shall be repaired by the Contractor using material of the same type as the damaged material.
- D. Earthwork within the public rights-of-way shall be done in accordance with requirements and provisions of the permits issued by applicable agencies for the construction within their respective rights-of-way. Such requirements and provisions, where applicable, shall take precedence and supersede the provisions of these Specifications.
- E. The Contractor shall control grading in a manner to prevent water running into excavations. Obstruction of surface drainage shall be avoided, and means shall be provided whereby storm water can be uninterrupted in existing gutters, other surface drains, or temporary drains. Free access must be provided to all fire hydrants, valves, and meters.
- F. No classification of excavated materials will be made. Excavation work shall include the removal and subsequent handling of all materials excavated or otherwise removed in performance of the contract work, regardless of the type, character, composition, or condition thereof.
- G. Tests for compaction and density shall be conducted by the Engineer or by an independent testing laboratory selected by him. Costs of compaction tests performed by an independent testing laboratory shall be paid for by the Contractor. The Contractor shall make all necessary excavations and shall supply any samples of materials necessary for conducting compaction and density tests. The cost of all retests made necessary by the failure of materials to conform to the requirements of these Contract Documents shall be paid by the Contractor.
- H. All earthwork operations shall comply with the requirements of OSHA Construction Standards, Part 1926, Subpart P, Excavations, Trenching, and Shoring, and Subpart O, Motor Vehicles, Mechanized Equipment, and Marine Operations, and shall be conducted in a manner acceptable to the Owner and the Engineer.

I. It is understood and agreed that the Contractor has made a thorough investigation of the surface and subsurface conditions of the site and any special construction problems which might arise as a result of nearby watercourses and floodplains, particularly in areas where construction activities may encounter water-bearing sands and gravels or limestone solution channels. The Contractor shall be responsible for providing all services, labor, equipment, and materials necessary or convenient to him for completing the work within the time specified in these Contract Documents.

1.06 QUALITY ASSURANCE

A. The Contractor shall perform earthwork in compliance with the requirements of all authorities having jurisdiction over the construction.

B. Testing and Inspection Service: The Engineer or a qualified independent geotechnical engineering testing agency, designated by the Engineer, will be employed to classify proposed on-site and borrow soils to verify that soils comply with specified requirements and to perform required field and laboratory testing.

C. Pre-installation Conference: The Contractor will conduct a conference at Project site to comply with requirements of Division 1, Section 01200, Project Meetings.

1. Before commencing earthwork, the Contractor will meet with representatives of the governing authorities, Owner, Engineer, consultants, Geotechnical Engineer, independent testing agency and other concerned entities. The Contractor will review earthwork procedures and responsibilities including testing and inspection procedures and requirements. The Contractor shall notify participants at least 3 working days prior to convening conference. The Contractor shall record discussions and agreements and furnish a copy to each participant.

1.07 PROJECT CONDITIONS

A. Existing Utilities: The Contractor shall not interrupt existing utilities serving facilities occupied by the Owner or others except when permitted in writing by the Engineer and then only after acceptable temporary utility services have been provided.

1. The Contractor shall provide a minimum 48-hours written notice to the Engineer and receive written notice to proceed before interrupting any utility.

B. The Contractor shall demolish and completely remove from site existing underground utilities indicated on the plans to be removed. The Contractor shall coordinate with utility companies to shutoff services if lines are active.

PART 2 – PRODUCTS

2.01 SOIL MATERIALS

- A. The Contractor shall provide approved borrow soil materials from off-site when sufficient approved soil materials are not available from excavations.
- B. Satisfactory Soil Materials are defined as ASTM D 2487 soil classification groups GW, GP, GM, SW, SP, SM, ML and CL; free of rock or gravel larger than 2 inches in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.
- C. Unsatisfactory Soil Materials are defined as ASTM D 2487 soil classification groups GC, SC, MH, CH, OL, OH and PT.
- D. Backfill and Fill Materials shall be satisfactory soil materials.
- E. Engineered fill is defined as subbase or base materials.

2.02 ACCESSORIES

A. Detectable Warning Tape shall be acid and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, 6 inches wide and 4 mils thick minimum, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 2'-6" deep.

- 1. Tape Colors: Provide tape colors to utilities as follows:
 - a. Red: Electric.
 - b. Yellow: Gas, oil, steam, and dangerous materials.
 - c. Orange: Telephone and other communications.
 - d. Blue: Water systems.
 - e. Green: Sewer systems.

B. The Contractor shall install a continuous run of plastic metallic tape above the top of the pipe at 18 to 24 inches below finished grade. Tape shall be suitable for detection with metal pipe location equipment, labeled to identify contents of pipe, and brightly colored to contrast with the

soil. In addition to the tape, the contractor shall install a continuous run of tracer wire attached to pipe runs greater than 500'. This tracer wire shall be attached to a 2" galvanized pipe with a 180-degree bend at top extending 36" above grade for connection to locator equipment.

C. Fabric:

- 1. Filter Fabric (for underdrains and other drainage use) shall be a non-woven pervious geotextile fabric that meets the following requirements:
 - a. Weight (ASTM D-3776): 4.5 ounces per square yard.

- b. Thickness (ASTM D-1777): 60 mils.
- c. Grab Tensile Strength (ASTM D-1682): 120 pounds.
- d. Grab Elongation (ASTM D-1682): 55%.
- e. Flow Rate (CFMC-GET-2): 285 gallons per minute per square foot.

PART 3 – EXECUTION

3.01 PREPARATION

- A. The Contractor shall protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.
- B. The Contractor shall protect subgrades and foundation soils against freezing temperatures or frost and provide protective insulating materials as necessary.
- C. The Contractor shall provide erosion control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

3.02 DRAINAGE

- A. The Contractor shall provide positive drainage on site at all times and prevent surface water and subsurface or ground water from entering excavations, from ponding on prepared subgrades and from flooding Project site and surrounding area.
- B. The Contractor shall protect subgrades and foundation soils from softening and damage by rain or water accumulation.

3.03 EXCAVATION

- A. The Contractor shall perform all excavation of every description, and of whatever substances encountered, to the dimensions and levels shown on the Drawings and/or specified.
- B. Over excavation of the organic sand layer (i.e. small to large roots) shall be performed. The preliminary soils investigation report shall be made available at the contractors. The over excavation operations shall be monitored by a licensed geotechnical engineer to evaluate the horizontal and vertical extent of the organic zone. The geotechnical engineer shall certify that (1) all organics are removed; and (2) excavation of acceptable soils has been minimized. The over excavation shall be performed within and to a distance of at least five feet beyond each individual structure footprint.

After the organics are removed, compacted of the resulting subgrade should not be attempted. Dry structural fill, as approved by the engineer, shall be placed over the

subgrade with relatively light tracked equipment. No rubber-tired equipment should be allowed to traverse the areas until at least two and a half feet of compacted structural fill is in place. The structural fill, after placement and compaction, should have densities equivalent to 95 percent of the Modified Proctor maximum dry density (ASTM D 1557) design grade elevations.

C. Unclassified Excavation: Excavation is unclassified and includes excavation to required subgrade elevations regardless of the character of materials and obstructions encountered.

1. Rock excavating equipment for footings, trenches and pits shall be equivalent to Caterpillar Model No. 215D LC track-mounted hydraulic excavator, equipped with a 42-inch-wide short-tip radius rock bucket, rated at not less than 120-hp flywheel power with bucket-curling force of not less than 25,000 lbs. and stick-crowd force of not less than 18,700 lbs., measured according to SAE Standard J1179.

2. Rock-excavating equipment for open excavations shall be equivalent to Caterpillar Model No. 973, heavy-duty, track-mounted loader, rated at not less than 210-hp flywheel power and developing minimum of 45,000-lb breakout force, measured according to SAE Standard J732c-69. Excavations more than 10 feet in width and pits more than 30 feet in either length or width are defined as open excavations.

D. Rock will not be classified as such for additional payment. The Progressive Design-Build Contractor shall satisfy himself as to rock and other materials which may be encountered in excavation and make proper allowances for all contingencies in his lump sum or unit price bid. Neither the Owner nor the Engineer will be responsible for subsurface conditions found.

E. Excavation for pipelines shall be made in open cut unless shown otherwise on the Drawings. Trenches shall be cut true to the lines and grades shown on the Drawings or established by the Engineer on the ground. The banks of trenches shall be cut in vertical parallel planes equidistant from the pipe centerline. From an elevation 12 inches above the top of the pipe to the bottom of the trench, the horizontal distance between vertical planes for different sizes of pipe

F. shall not exceed those specified and/or shown on the Drawings. When sheeting is used, the width of the trench shall be considered as the distance between the inside faces of the sheeting. The bottom of the trench shall be cut carefully to the required grade of the pipe except where bedding materials or cradles are required, in which case the excavation shall extend to the bottom of the bedding or cradles as shown on the Drawings. Minimum pipe cover shall be as specified or shown on the Drawings.

1. Bell holes for bell and spigot pipe and mechanical joint pipe shall be excavated at proper intervals so the barrel of the pipe will rest for its entire length upon the bottom of the trench. Bell holes shall be large enough to permit proper installation of all joints in the pipe. Bell holes shall not be excavated more than 10 joints ahead of pipe laying. No part of any bell or coupling shall be in contact with the trench bottom, trench walls, or granular embedment when the pipe is jointed.

2. Pipe trenches shall not be excavated more than 100 feet in advance of pipe laying and all work shall be performed to cause the least possible inconvenience to the public. Adequate temporary bridges or crossings shall be constructed and maintained where required to permit uninterrupted vehicular and pedestrian traffic.

3. Unless otherwise specified herein or shown on the Drawings, wherever pipe trenches are excavated below the elevation shown on the Drawings, the Contractor, at his own expense, shall fill the void thus made to the proper grade with Class "C" concrete or with compacted layers of crushed rock or gravel conforming to the requirements for bedding materials.

4. Rock, boulders, and large stones encountered in trenches shall be removed to provide a clearance of not less than 6 inches in every direction from all parts of pipe, fittings, and other appurtenances.

5. In all cases where materials are deposited along open trenches, they shall be placed so that no damage will result to the work or adjacent property in case of rain or other surface wash.

C. If additional material, other than that to be obtained from excavation, is required for backfilling and grading, the Contractor shall obtain that additional material from borrow as directed by the Engineer.

D. All excess excavated earth, and all excavated rock, shall be hauled off to a designated spoil area. Surfaces and slopes of spoil areas shall be left smooth and free to drain.

E. All ditches are to be closed at the end of each workday.

3.04 STABILITY OF EXCAVATIONS

A. Contractor must comply with all local codes, ordinances and requirements of authorities having jurisdiction to maintain stable excavations.

B. The sides of all excavations shall be sufficiently sheeted, shored, and braced whenever necessary to prevent slides, cave-ins, settlement, or movement of the banks and to maintain the excavation clear of all obstructions. Wood or steel sheeting of approved design and type shall be used in wet, saturated, or flowing ground. All sheeting, shoring, and bracing shall have sufficient strength and rigidity to withstand the pressures exerted.

C. The responsibility for correctly assessing the need for sheeting and analyzing the stresses induced shall be the total responsibility of the Contractor. Since the Engineer does not dictate or determine the Contractor's sequence or limits of excavation, the Engineer assumes no responsibility for sheeting and shoring. The Contractor must employ or otherwise provide for adequate professional structural and geotechnical engineering supervision to assess the need for sheeting and shoring and design same. Results of sheeting and shoring analysis and design shall be submitted to the Engineer upon request.

D. Excavations adjacent to existing or proposed buildings and structures, or in paved streets or alleys shall be sheeted, shored, and braced adequately to prevent undermining beneath or subsequent settlement of such structures or pavements. Underpinning of adjacent structures shall be done when necessary to maintain structures in safe condition. Any damage to structures or pavements occurring through settlements, water or earth pressures, slides, caves, or other causes; due to failure or lack of sheeting or bracing, or due to improper bracing; or occurring through negligence or fault of the Contractor in any other manner shall be repaired by the Contractor at his own expense.

E. Sheeting, shoring, or bracing materials shall not be left in place unless otherwise specified or shown on the Drawings or ordered by the Engineer in writing. Such materials shall be removed in such manner that no danger or damage will occur to new or existing structures or property, public or private, and so that cave-ins or slides will not take place. Steel sheeting may be removed without cutting, provided the rate of removal is in pace with tamping and backfilling operations to assure complete filling of the void created by the withdrawal of the sheeting. Complete withdrawal of the sheeting in advance of tamping and backfilling will not be permitted.

F. All holes and voids left in the work by the removal of sheeting, shoring, or bracing shall be filled and thoroughly compacted.

3.05 UNAUTHORIZED EXCAVATION

A. The Contractor shall not commence or continue any excavation until authorized by the Engineer.

B. The Contractor shall fill any unauthorized excavation as directed by the Engineer.

3.06 STORAGE OF SOIL MATERIALS

A. The Contractor shall stockpile excavated materials acceptable for backfill and fill soil materials, including acceptable borrow materials.

B. The Contractor shall stockpile soil materials without intermixing.

C. The Contractor shall place, grade and shape stockpiles to drain surface water.

D. The Contractor shall cover to prevent wind-blown dust.

- E. The Contractor shall stockpile soil materials away from edge of excavations.
- F. The Contractor shall not store soil materials within drip line of remaining trees.

3.07 BACKFILLING

A. The backfilling of sewer and pipeline trenches shall be started immediately after the construction of same has been inspected by the Engineer. Selected backfill material shall consist of finely divided earth, stone, dust, sand, crushed stone, or other approved material free from all wood, vegetable matter, debris, and other objectionable material and having scattered clods, stone, or broken concrete less than 2 inches in maximum dimension.

1. Material that is too dry to be adequately compacted shall receive a prior admix of sufficient water to obtain optimum moisture content. Material having excessive water content shall not be placed at any time.
2. Selected backfill material shall be carefully placed in the trench on each side of the pipe in 6-inch layers for the full width of the trench and thoroughly and uniformly compacted by tamping or ramming. Sufficient select backfill material shall be placed around the pipe and compacted to provide not less than 12 inches cover over the top of the pipe.
3. Backfilling shall be carried on simultaneously on both sides of the pipe and in a manner, which will prevent injurious side pressures.

If suitable select materials are not available from the trench excavation, the Contractor will be required to obtain the select materials elsewhere.

B. Across sidewalks and driveways and at any other places subject to vehicular traffic or other superimposed loads, trench backfill shall be compacted in 6-inch layers to the density of the original adjacent material for the full depth of the trench. The top 6 inches of backfill shall consist of uniformly graded crushed stone.

C. Roadway subgrade shall be accomplished in layers not exceeding 6 inches in depth and each layer shall be thoroughly compacted to minimum 98 percent of the Modified Proctor maximum dry density as determined by ASTM D-698. This operation shall include any reshaping and wetting required to obtain proper compaction. All soft or otherwise unsuitable material shall be removed and replaced with suitable material.

D. In all other areas not affected by superimposed loads, trench backfill may be placed from the level 12 inches above the top of pipe upward without compaction. At these places backfill shall be neatly rounded over the trench to sufficient height to allow for settlement to grade after consolidation.

E. Wherever the subgrade is by nature too soft or mucky, in the opinion of the Engineer, for the proper installation of the pipe, he may order the Contractor to undercut the trench and backfill with stone or gravel bedding material. The stone shall be brought

to the subgrade required by the class of bedding for the particular location and compacted.

F. Where slabs are to be constructed on earth fill, the fill shall be of select material. Selected backfill material shall consist of finely divided earth, stone, dust, sand, crushed stone, or other approved material free from all wood, vegetable matter, debris, and other objectionable material and having scattered clods, stone, or broken concrete less than 2 inches in maximum dimension. The fill shall be placed in layers of not more than six inches compacted thickness and compacted by the use of heavy rolling or power tamping equipment to secure at least 95% of the Modified Proctor Dry Density.

G. Backfills around structures shall be properly placed and compacted. The fills shall be brought up in layers. The layers shall be thoroughly compacted to at least 95% of the Modified Proctor Dry Density, each layer to be not deeper than six inches compacted thickness. Compaction around structures shall be by use of heavy power tamping equipment.

3.08 STORM DRAIN TRENCH BACKFILL

A. The Contractor shall shape bedding course to provide continuous support for bells, joints, and barrels of storm drainpipe.

B. After the trench bottom has been exposed and before placement of any backfill, the trench bottom shall be inspected by the Engineer.

C. A minimum 12-inch depth course of No. 57 stone wrapped in filter fabric shall be placed in the bottom of the trench. None of the aggregate in this 12-inch course shall be in contact with soil. The filter fabric shall be lapped a minimum of two (2) feet at the joints.

D. Aggregate backfill shall be placed in 8-inch layers on top of the filter fabric wrapped 12-inch course. The first 8-inch layer shall be consolidated to a uniform density. Each subsequent 8-inch layer of aggregate backfill shall be placed and consolidated to a uniform density. Care shall be exercised in the placement of each layer to see that each section is continuously supported throughout its length. Aggregate shall be so placed up to one-half ($\frac{1}{2}$) the outside diameter of the pipes.

E. The trench above one-half ($\frac{1}{2}$) the outside diameter of the pipes shall be backfilled with material meeting the requirements of Section 207 of the above-cited standard specification for normal backfill. The material shall be placed in 6-inch layers and compacted to 95 percent of the laboratory dry density except that the 12 inches immediately underneath the stone base shall be compacted to 100 percent of the laboratory dry density.

F. Compaction tests shall be performed on each 6-inch layer of normal backfill between and alongside each 60-inch pipe at intervals not exceeding 200 feet. The next

layer shall not be placed until the specified compaction has been achieved in each underlying layer.

3.09 MOISTURE CONTROL

A. The site shall be kept free of surface water at all times. The Contractor shall install drainage ditches and dikes and shall perform all pumping and other work necessary to divert or remove rainfall and other accumulations of surface water from the excavations. The diversion and removal of surface water shall be performed in a manner that will prevent the accumulation of water within the construction area where it may be detrimental.

B. Where groundwater is encountered, the Contractor shall make the effort necessary to secure a dry excavation. In sandy and in other suitable type soils, dewatering shall be done by well pointing. If, in the opinion of the Engineer, the Contractor has failed to obtain an absolutely dry excavation by insufficient use of all known methods of dewatering, the Engineer may order the Contractor to excavate below grade and place not less than 6 inches of graded crushed stone fill material over the bottom to form french drains to suitably located sumps and to remove the water by bailing or pumping. The graded crushed stone fill material shall be placed at the Contractor's own expense and shall be of such depth that there shall be no water in the excavation at the time of pouring concrete. All costs of equipment, labor, and materials required for dewatering shall be included in the bid price.

3.10 FIELD QUALITY CONTROL

A. The Contractor shall inspect and test each subgrade and each fill or backfill layer. Do not proceed until test results for previously completed work verify compliance with requirements.

1. Perform field in-place density tests according to ASTM D 1556 (sand cone method), ASTM D 2167 (rubber balloon method), or ASTM D 2937 (drive cylinder method), as applicable.

a. Field in-place density tests may also be performed by the nuclear method according to ASTM D 2922, provided that calibration curves are periodically checked and adjusted to correlate to tests performed using ASTM D 1556. With each density calibration check, check the calibration curves furnished with the moisture gages according to ASTM D 3017.

b. When field in-place density tests are performed using nuclear methods, make calibration checks of both density and moisture gages at beginning of work, on each different type of material encountered and at intervals as directed by the Engineer.

2. Paved and Building Slab Areas: At subgrade and at each compacted fill and backfill layer, perform at least one field in-place density test for every 2,000

sq. ft. or less of paved area or building slab, but in no case fewer than three tests.

3. Foundation Wall Backfill: In each compacted backfill layer, perform at least one field in-place density test for each 100 feet or less of wall length, but no fewer than two tests along a wall face.

4. Trench Backfill: In each compacted initial and final backfill layer, perform at least one field in-place density test for each 150 feet or less of trench, but no fewer than two tests.

B. When the tests indicate that subgrades, fills or backfills are below specified density, the Contractor shall scarify and moisten or aerate, or remove and replace soil to the depth required, re-compact and retest until required density is obtained.

3.11 PROTECTION AND MAINTENANCE

A. The Contractor shall protect newly graded areas from traffic, freezing, erosion, trash, and debris.

B. The Contractor shall repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or lose compaction due to subsequent construction operations or weather conditions. The Contractor shall scarify or remove and replace material to depth directed by the Engineer. The Contractor shall reshape and re-compact at optimum moisture content to the required density.

C. Where settling occurs during the Project correction period, the Contractor shall remove finished surfacing, backfill with additional approved material, compact, and reconstruct surfacing.

D. The Contractor shall restore appearance, quality, and condition of finished surfacing to match adjacent work and eliminate evidence of restoration to the greatest extent possible.

3.12 DISPOSAL OF WASTE AND UNSUITABLE MATERIALS

A. All materials removed by excavation, which are suitable for the purpose, shall be used to the extent possible for backfilling pipe trenches, foundations, and footings and for making embankment fills or for such other purposes as may be shown on the Drawings. All materials not used for such purposes shall be considered as waste materials and the disposal thereof shall be made by the Contractor in a manner and at locations approved by the Engineer.

B. Waste materials shall be spread in uniform layers and neatly leveled and shaped. Spoil banks shall be provided with sufficient and adequate openings to permit surface drainage of adjacent lands.

C. Unsuitable materials, consisting of wood, vegetable matter, debris, soft or spongy clay, peat, and other objectionable material so designated by the Engineer shall be removed from the work site and disposed of by the Contractor in a manner and at a location approved by the Engineer.

D. No unsuitable or waste material shall be dumped on private property unless written permission is furnished by the owner of the property and unless a dumping permit is issued from the local jurisdiction.

3.13 FINAL GRADING

A. After other earthwork operations have been completed, the sites of all structures, roads, and embankments shall be graded within the limits and to the elevations shown on the Drawings. Grading operations shall be so conducted that materials shall not be removed or loosened beyond the required limits. The finished surfaces shall be left in smooth and uniform planes such as are normally obtainable from the use of hand tools. If the Contractor is able to obtain the required degree of evenness by means of mechanical equipment, he will not be required to use hand labor methods. Slopes and ditches shall be neatly trimmed and finished to slopes shown on the Drawings unless otherwise approved by the Engineer.

B. Unless otherwise specified or shown on the Drawings, all finished ground surfaces shall be graded and dressed to present a surface varying not more than plus or minus 0.10 foot as regards local humps or depressions and shall be acceptable to the Engineer.

3.14 TOPSOIL

A. All areas to be sprigged or planted with trees, shrubs, or grass as shown on the plans shall be prepared by grading to a smooth, even surface to a level 4 inches below the elevation of the finished grade shown on the Drawings. It shall then be brought to a neat and finished grade by the addition of 4 inches of approved topsoil.

B. Topsoil removed from the construction area may be stockpiled and reused or topsoil may be obtained from approved borrow areas. If obtained from borrow areas, the Contractor shall make suitable arrangements with the property owner and shall pay all costs incident to the borrowed material including royalties.

3.15 SETTLEMENT

A. Tanks shall be filled to their maximum level and allowed to sit for 7 days prior to the final piping connections are made.

B. The Contractor shall be responsible for all settlement of backfill, fills, and embankments which may occur within one (1) year after final acceptance of the work by the Owner.

Section 4
Scope of Work and Technical Specifications
SECTION 31 20 00-15 EARTHWORK

C. The Contractor shall make, or cause to be made, all repairs or replacements made necessary by settlement within 30 days after receipt of written notice from the Engineer or Owner.

END OF SECTION

SECTION 31 23 00

TRENCH EXCAVATION AND BACKFILL

PART 1 – GENERAL

1.01 SUMMARY

A. Scope

1. The work under this Section consists of furnishing all labor, equipment and materials and performing all operations in connection with the trench excavation and backfill required to install the pipelines as shown on the Drawings and as specified.

B. All excavation shall be by open cut unless otherwise indicated on the Drawings or directed by the Owner.

1. In general, topsoil may be removed by machine method.
2. Excavation below topsoil may also be performed by machine, but shall be supplemented by such hand dressing or leveling as may be required to conform to lines and grades as directed by the Owner.
3. Material so removed shall be used in backfill, making embankments, filling low areas, or as otherwise directed.
4. Hand tool excavation shall be used where necessary to protect existing utilities and structures.

C. Excavation shall include the removal of any trees, stumps, brush, debris or other obstacles which remain after the clearing and grubbing operations, which may obstruct the work, and the excavation, removal, and disposal of all earth, rock or other materials including the existing pipe if any to the extent necessary to install the new pipelines and appurtenances in conformance with the lines and grades shown on the Drawings and as specified.

D. Backfill shall include the refilling and compaction of the fill in the trenches and excavations up to the surrounding ground surface or road grade at crossing. The trench is divided into five specific areas:

1. Foundation: The area beneath the bedding, sometimes also referenced to as trench stabilization.
2. Bedding: The area above the trench bottom (or foundation) and below the bottom of the barrel of the pipe.
3. Haunching: The area above the bottom of the barrel of the pipe up to a specified height above the bottom of the barrel of the pipe.

Section 4
Scope of Work and Technical Specifications
SECTION 31 23 00-2 TRENCH EXCAVATION AND BACKFILL

4. Initial Backfill: The area above the haunching material and below a plane 18 inches above the top of the barrel of the pipe.
5. Final Backfill: The area above a plane 18-inches above the top of the barrel of the pipe.

E. The choice of method, means, techniques and equipment rests with the Contractor.

1. The Contractor shall select the method and equipment for trench excavation and backfill depending upon the type of material to be excavated and backfilled, the depth of excavation, the amount of space available for operation of equipment, storage of excavated material, proximity of man made improvements to be protected, available easement or right of way and the prevailing practice in the area.

1.02 QUALITY ASSURANCE

A. Density:

1. All references to "maximum dry density" shall mean the maximum dry density defined by the "Maximum Density Optimum Moisture Test", ASTM D698,
2. Except that for non cohesive materials "maximum dry density" shall mean the maximum index density as determined by the "Maximum Index Density of Soils Using a Vibratory Table", ASTM D4253.

B. Determination of the density of foundation, bedding, haunching, or backfill materials in place shall meet with the requirements of:

1. ASTM D1556, "Density of Soil In Place by the Sand Cone Method".
2. ASTM D2937, "Density of Soil In Place by the Drive Cylinder Method".
3. ASTM D2922, "Density of Soil and Soil Aggregate In Place by Nuclear Methods (Shallow Depth)".

C. Sources and Evaluation Testing: Testing of materials to certify conformance with the Specifications shall be performed by an independent testing laboratory in accordance with Section 01 45 29 of these Specifications. All imported fill materials shall meet the requirements of on site fill materials.

1.03. SAFETY

- A. Perform all trench excavation and backfilling activities in accordance with the Occupational Safety and Health Act of 1970 (PL 91 596), as amended.
- B. The Contractor shall pay particular attention to the Safety and Health Regulations Part 1926, Subpart P "Excavation, Trenching & Shoring" as described in OSHA publication 2226.

PART 2 – PRODUCTS

2.01. TRENCH FOUNDATION MATERIALS

A. Crushed stone shall be utilized for trench foundation (trench stabilization) and shall meet the requirements of the Georgia Department of Transportation Specification 800.2.01, Group I (limestone, marble or dolomite) or Group II (quartzite, granite or gneiss). Stone size shall be between No. 57 and No. 4, inclusive.

2.02. BEDDING AND HAUNCHING MATERIALS

A. Bedding requirements specified herein shall apply to sanitary sewer lines only. These requirements are to be considered minimum bedding requirements and as such, do not relieve the Contractor of the responsibility to provide any additional bedding necessary for proper support of the sewer and construction.

B. Unless specified otherwise, bedding and haunching materials shall be crushed stone as specified below.

C. Crushed stone utilized for bedding and haunching shall meet the requirements of the Georgia Department of Transportation Specification 800.2.01, Group I (limestone, marble or dolomite) or Group II (quartzite, granite or gneiss). Stone size shall be between No. 57 and No. 4, inclusive.

D. Earth materials utilized for bedding and haunching shall be suitable materials selected from materials excavated from the trench.

1. Suitable materials shall be clean and free of rock larger than 2 inches at its largest dimension, organics, cinders, stumps, limbs, frozen earth or mud, man made wastes and other unsuitable materials.

2. Should the material excavated from the trench be saturated, the saturated material may be used as earth material, provided it is allowed to dry properly and it is capable of meeting the specified compaction requirements.

3. When necessary, earth bedding and haunching materials shall be moistened to facilitate compaction by tamping.

4. If materials excavated from the trench are not suitable for use as bedding or haunching material, provide select material conforming to the requirements of this Section at no additional cost to the Owner.

E. Filter Fabric Woven Type

1. Filter fabric associated with bedding shall be a polypropylene woven fabric.

2. The fabric shall be a high modulus type with good separation capabilities.

Section 4
Scope of Work and Technical Specifications
SECTION 31 23 00-4 TRENCH EXCAVATION AND BACKFILL

3. The fabric shall be inert to biological degradation and naturally occurring chemicals, alkalies and acids.
4. The fabric shall have an equivalent opening size EOS of 20 to 45.
5. The fabric shall also conform to the minimum property values listed in the following table:

Fabric Property	Unit	Test Method	Minimum Value
Grab Tensile Strength	lbs.	ASTM D 4632	200
Grab Tensile Elongation	%	ASTM D 4632	15
CBR Puncture Strength	lbs.	ASTM D 6241	700
Trapezoid Tear Strength	lbs.	ASTM D 4533	75
Permittivity	Sec-1	ASTM D 4491	0.05
Water Flow rate	gpm/ft2	ASTM D 4491	5
UV Resistance @ 500 Hours	%	ASTM D 4355	70

6. If ordered by the Owner, the filter fabric manufacturer shall furnish the services of a competent factory representative to supervise and/or inspect the installation of pipe.
7. This service will be furnished for a minimum of 10 days during initial pipe installation.
8. Filter fabric shall be Mirafi 500X, Amoco 2002 or Exxon GTF 200.

2.03. BACKFILLING – GENERAL

- A. Materials used for backfilling shall be free from all perishable and objectionable materials; no stones larger than two (2) inches in the longest dimension shall be placed directly above the pipe. All larger stones must be placed to the sides of the ditch such that the pipe can be excavated for repair without digging through them.
- B. Select compactable material shall be used in pipe trenches under roadways and other paved areas. When required on the plans or required by the Owner, graded aggregate base shall be used in pipe trenches under roadways.

2.04. BACKFILLING – INITIAL BACKFILL

- A. Initial backfill material shall be crushed stone or earth materials as specified for bedding and haunching materials.
- B. When necessary, initial backfill materials shall be moistened to facilitate compaction by tamping. If materials excavated from the trench are not suitable for use as initial backfill material, provide select material conforming to the requirements of this Section at no additional cost to the owner.

2.05. BACKFILLING – FINAL BACKFILL

Section 4
Scope of Work and Technical Specifications
SECTION 31 23 00-5 TRENCH EXCAVATION AND BACKFILL

A. Final backfill material shall be general excavated earth materials, shall not contain rock larger than 2 inches at its greatest dimension, cinders, stumps, limbs, man made wastes and other unsuitable materials.

B. If materials excavated from the trench are not suitable for use as final backfill material, provide select material conforming to the requirements of this Section.

2.06. SELECT BACKFILL

A. Select backfill shall be materials which meet the requirements as specified for bedding, haunching or initial backfill materials, including compaction requirements.

2.07. CONCRETE

A. Concrete for bedding, haunching, initial backfill or encasement shall have a compressive strength of not less than 3,000 psi, with not less than 5.5 bags of cement per cubic yard and a slump between 3 and 5 inches.

B. Ready mixed concrete shall be mixed and transported in accordance with ASTM C94.

C. Reinforcing steel shall conform to the requirements of ASTM A615, Grade 60.

2.08. FLOWABLE FILL

A. Low strength flowable fill concrete shall meet the requirements of Section 600 of the Georgia Department of Transportation specifications.

2.09. GRANULAR MATERIAL

A. Granular material, where required for trench backfill, shall be sand, river sand, crushed stone or aggregate, pond screenings, crusher run, recycled concrete, or other angular material.

B. Granular material shall meet gradation requirements for Size No. 57 or finer.

PART 3 – EXECUTION

3.01. TRENCH EXCAVATION

A. Topsoil and grass shall be stripped a minimum of 6 inches over the trench excavation site and stockpiled separately for replacement over the finished grading areas.

B. Topsoil shall be removed to its entire depth from all areas to be excavated or graded.

1. The topsoil shall be piled in designated or approved locations where it will not interfere with construction operations.

Section 4
Scope of Work and Technical Specifications
SECTION 31 23 00-6 TRENCH EXCAVATION AND BACKFILL

2. Topsoil as stored shall be reasonably free of subsoil, debris, and stones larger than two (2) inches in diameter.
 3. The stored topsoil shall be left in piles to be used for finished grading.
- C. Trenches shall be excavated to the lines and grades shown on the Drawings with the centerlines of the trenches on the centerlines of the pipes and to the dimensions which provide the proper support and protection of the pipe and other structures and accessories.
- D. All excavations shall be adequately shored to ensure worker safety. All pipe laying operations shall comply with OSHA requirements for trench safety.
- E. Trench Width for Pipelines
1. The sides of all trenches shall be vertical to a minimum of one foot above the top of the pipe.
 2. Unless otherwise indicated on the Drawings, the maximum trench width shall be equal to the sum of the outside diameter of the pipe plus two feet.
 3. In order to limit loads on the pipe, the maximum width of the trench shall not be more than 36 inches wider than the outside diameter of the pipe. This trench width restriction applies to that portion of the trench 4 inches below the bottom of the pipe to 12 inches above the top of the pipe.
 4. The minimum trench width shall be that which allows the proper consolidation of the haunching and initial backfill material.
 5. Excavation of pipe trenches with sides sloping to the trench bottom will not be permitted.
 6. Excavate the top portion of the trench to any width within the construction easement or right of way which will not cause unnecessary damage to adjoining structures, roadways, pavement, utilities, trees or private property. Where necessary to accomplish this, provide sheeting and shoring.
 7. Where rock is encountered in trenches, excavate to remove boulders and stones to provide a minimum of 9 inches clearance between the rock and any part of the pipe barrel.
 8. Wherever the prescribed maximum trench width is exceeded, the Contractor shall use the next higher Class or Type of bedding and haunching as shown on the Drawings for the full trench width as actually cut.
 9. The excessive trench width may be due to unstable trench walls, inadequate or improperly placed bracing and sheeting which caused sloughing, accidental overexcavation, intentional overexcavation necessitated by the size of the Contractor's tamping and compaction equipment, intentional overexcavation

Section 4
Scope of Work and Technical Specifications
SECTION 31 23 00-7 TRENCH EXCAVATION AND BACKFILL

due to the size of the Contractor's excavation equipment, or other reasons beyond the control of the Owner or Owner.

F. Depth

1. The trenches shall be excavated to the required depth or elevation which allow for the placement of the pipe and bedding to the dimensions shown on the Drawings.
2. Where rock is encountered in trenches for pipelines, excavate to the minimum depth which will provide clearance below the pipe barrel of 8 inches for pipe 21 inches in diameter and smaller and 12 inches for larger pipe and valves.

G. Length of Trench to Be Opened

1. The length of trench to be opened, or the areas of the surface to be disturbed or unrestored at any one time, shall be limited with regard both to expeditious construction, and to the convenience, safety, and comfort of citizens directly or indirectly affected by the Work.
2. New trenches will not be permitted to be excavated if there are previously excavated trenches that require backfilling, or surface areas that require restoration.
3. In any event, no additional work of any kind will be permitted if there are existing streets or roadways that require attention to return them to a safe and proper condition.
4. IN GENERAL, NO TRENCH SHALL BE OPEN MORE THAN 500 FEET AHEAD OF PIPE LAYING AND BACKFILLING.

H. Excavated Materials

1. Excavated materials shall be placed adjacent to the work to be used for backfilling as required.
2. Top soil shall be carefully separated and lastly placed in its original location.
3. Excavated material shall be placed sufficiently back from the edge of the excavation to prevent caving of the trench wall, to permit safe access along the trench and not cause any drainage problems.
4. Excavated material shall be placed so as not to damage existing landscape features or man made improvements.

I. Storage of Materials:

Section 4
Scope of Work and Technical Specifications
SECTION 31 23 00-8 TRENCH EXCAVATION AND BACKFILL

1. All salvageable materials which may be removed from the site, together with all materials taken from the trenches, shall be stored in an approved, suitable place, or as directed by the Owner.
2. The Contractor shall be responsible for any loss of, or damage to, salvageable materials through careless removal or neglectful or wasteful storage of such materials.
3. In the storing of excavated material, which is to be used as backfill, the Contractor shall exercise care so as to avoid inconveniencing the public.
 - a. If, in the opinion of the Owner, it is necessary to remove this excavated material from the streets or lots, the Contractor shall be required to do so.

3.02. SHEETING, BRACING AND SHORING

- A. The Contractor shall be responsible for supporting and maintaining required excavations including sheeting and shoring the sides and ends of excavations with timber or other supports.
 1. The requirement of sheeting or shoring, or the addition of supports, shall not relieve the Contractor of his responsibility of their sufficiency.
- B. The need and adequacy of sheeting, shoring, bracing, or other provisions to protect workmen and equipment in a trench or other excavation, and to meet local and OSHA safety requirements, shall be the sole and exclusive responsibility of the Contractor.
- C. Sheeting, bracing and shoring shall be installed in the following instances:
 1. Where sloping of the trench walls do not adequately protect persons within the trench from slides or cave ins.
 2. In caving ground.
 3. In wet, saturated, flowing or otherwise unstable materials.
 4. Where necessary to prevent damage to adjoining buildings, structures, roadways, pavement, utilities, trees or private properties which are required to remain.
 5. Where necessary to maintain the top of the trench within the available construction easement or right of way.
- D. In all cases, excavation protection shall strictly conform to the requirements of the Occupational Safety and Health Act of 1970, as amended.

- E. Timber: Timber for shoring, sheeting, or bracing shall be sound and free of large or loose knots and in good, serviceable condition. Size and spacing shall be in accordance with OSHA regulations.
- F. Steel Sheeting and Sheet Piling
1. Steel sheet piling shall be the continuous interlock type.
 2. The weight, depth and section modulus of the sheet piling shall be sufficient to restrain the loads of earth pressure and surcharge from existing foundations and live loads.
 3. Procedure for installation and bracing shall be so scheduled and coordinated with the removal of the earth that the ground under existing structures shall be protected against lateral movement at all times.
 4. The Contractor shall provide closure and sealing between sheet piling and existing facilities.
- G. Trench Shield
1. A trench shield or box may be used to support the trench walls. The use of a trench shield does not necessarily preclude the additional use of bracing and sheeting.
 2. When trench shields are used, care must be taken to avoid disturbing the alignment and grade of the pipe or disrupting the haunching of the pipe as the shield is moved.
 3. When the bottom of the trench shield extends below the top of the pipe, the trench shield will be raised in 6 inch increments with specified backfilling occurring simultaneously.
 4. At no time shall the trench shield be "dragged" with the bottom of the shield extending below the top of the pipe or utility.
- H. Remove bracing and sheeting in units when backfill reaches the point necessary to protect the pipe and adjacent property.
1. Leave sheeting in place when, in the opinion of the Owner, it cannot be safely removed or is within three feet of an existing structure, utility, or pipeline.
 2. Cut off any sheeting left in place at least two feet below the surface.
- I. Sheet piling within three feet of an existing structure or pipeline shall remain in place, unless otherwise directed by the Owner.

3.03. ROCK EXCAVATION

Section 4
Scope of Work and Technical Specifications
SECTION 31 23 00-10 TRENCH EXCAVATION AND BACKFILL

A. Definition of Rock: Solid mineral material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material that exceed 3/4 cubic yard for footing, trench, and pit excavation that cannot be removed by rock excavating equipment equivalent to the following in size and performance ratings, without systematic drilling, ram hammering, ripping, or blasting, when permitted:

1. Late-model, track-mounted hydraulic excavator equipped with a 42-inch wide, maximum, short-tip-radius rock bucket.

a. Rated at not less than 138-hp flywheel power with bucket-curling force of not less than 28,700 lbf and stick-crowd force of not less than 18,400 lbf.

b. With extra-long reach boom measured according to SAE J-1179.

B. Unless otherwise directed by the Owner, rock shall be fully taken out at least twenty-five (25) feet in advance of pipe laying, at least 6 inches below the invert of the pipe, and to a trench width for the size of the pipe to be laid, as specified in Fulton County Standard Details.

C. All pipe installed within rock excavation shall be laid upon a minimum of six (6) inches of # 57 stone coarse aggregate.

D. Blasting may be allowed for removing rock for excavation when properly permitted.

1. Blasting will only be allowed with pre-approval from Fulton County.

2. Typically, blasting will not be approved.

3. When blasting, the Contractor must use all possible precautions against accidents or damages due to use or storage of explosives, and assumes all responsibility/liability associated with blasting activities.

4. ONLY LICENSED EMPLOYEES OR SUBCONTRACTORS WILL BE ALLOWED TO CONDUCT BLASTING ACTIVITIES – PROOF OF SUCH LICENSING MUST BE PROVIDED TO THE OWNER PRIOR TO ENGAGING IN ANY BLASTING ACTIVITIES.

5. Explosives shall be used, handled and stored as prescribed by the laws and regulations of the State of Georgia, and all applicable local laws and regulations pertaining to such.

6. All explosives shall be stored in a safe place at a sufficient distance from the work so that no damage will occur to any portion of the work should an accident occur relating to the stored explosives.

7. Conduct blasting operations in accordance with all existing ordinances and regulations. Protect all buildings and structures from the effects of the blast.

Section 4
Scope of Work and Technical Specifications
SECTION 31 23 00-11 TRENCH EXCAVATION AND BACKFILL

Repair any resulting damage. If the Contractor repeatedly uses excessive blasting charges or blasts in an unsafe or improper manner, the Owner may direct the Contractor to employ an independent blasting consultant to supervise the preparation for each blast and approve the quantity of each charge.

8. Removal of Rock: Dispose of rock off site that is surplus or not suitable for use as rip rap or backfill.

9. The Contractor shall notify the Owner prior to any blasting. Additionally, the Contractor shall notify the Owner and local fire department before any charge is set

10. Furnish all labor, equipment and materials required to drill, blast, loosen, excavate, and dispose material to complete the work shown on the Drawings and specified herein.

11. The work includes, but is not be limited to:

a. Blast round design.

b. Planning and execution of appropriate site-specific safety measures to be employed during all blasting operations, and the safe handling and storage of high explosives and blasting agents.

c. Drilling blast holes, loading blast holes with explosives, and wiring and safe detonation of blast rounds.

d. Removal from the site of all excess excavated soil, debris, and rock as indicated in the Contract Documents, or as directed, and disposal of excess materials at a permitted disposal site.

e. Dewatering and maintenance of groundwater and surface water in all excavations.

f. Performance of all surveys necessary to establish and verify the lines and grades and to determine the amount of material removed.

g. Implementation of monitoring program to monitor condition of existing structures and utilities in vicinity of proposed blasting operations to insure existing features remain undamaged by blasting procedures.

12. Make all excavations in conformance with the lines, grades and cross sections on the Drawings or established by the Owner. Where blasting is required, blasting should ensure removal of six inches (6") of rock below proposed grade line.

13. All over-blast shall be removed and the resulting over-excavation backfilled and compacted with #57 gradation stone coarse aggregate.

14. Conduct all blasting operations, including transporting and storing of explosives in compliance with the Georgia State Fire Commissioner's Rules and Regulations for Explosives and Blasting Agents, latest edition and all applicable local codes.

15. Blasting Submittals

a. Submit the following in accordance with the procedures and requirements set forth in Section 01 33 00 Submittal Procedures, at least thirty (30) working days prior to beginning any blasting operations:

1) Names, addresses, telephone numbers, and qualifications of the blasting subcontractor(s) and explosives supplier(s) that will be used, including the designated Blaster-In-Charge.

2) Copies of Training Certificates for the designated Blaster-In-Charge, blasting foreman and any other key personnel that will be responsible for the work, showing that they have received specialized training in the proper handling of explosives.

3) A Blasting Plan, indicating the methods, materials and equipment to be used. The Blasting Plan should indicate the types of explosives to be used, drilling patterns, and a general layout and schedule for executing the work in accordance with state regulations.

4) A ground vibration and air blast monitoring plan, indicating structures that will be monitored, monitoring equipment that will be used, and personnel that will perform the monitoring.

16. At least 24 hours before each blast round, submit a detailed blast round design plan to the Owner. The blasting plan submitted is for quality control and record keeping purposes. Review by the Owner does not relieve the Contractor of his responsibilities as provided herein. Include the following in the blast round design submittals:

a. Location (state, grid coordinates) and limits of the shot.

b. Number, diameter, and depth of blast holes to be detonated in the round, and a plan showing the drill hole pattern, spacing and distance to the free face.

c. Depth of overburden.

d. Total weight of explosives in the round and the types of explosives to be used.

Section 4
Scope of Work and Technical Specifications
SECTION 31 23 00-13 TRENCH EXCAVATION AND BACKFILL

- e. Loading diagram showing the location of explosives, primers, and initiators; and location, depth, and type of stemming to be used in each hole.
- f. Initiation sequence, including delay timer and delay system, total weight of explosive to be detonated on each delay, and a list of the timing of the delays.
- g. Manufacturer's data sheet for all explosives, primers, and initiators to be used.
- h. Planned seismic monitoring positions, distances from the blast round, and seismograph types to be used to monitor vibrations and air blast overpressures.
- i. Type and amount of blasting mats and/or depth of soil cover to be used over the top surface of the shot.
- j. Any other information required by applicable state and federal regulations.

17. Within 24 hours after each blast round, submit a blasting report to the Owner. Include the following in the blasting report:

- a. Date and time of shot.
- b. Foreman's name.
- c. Number and depth of holes detonated.
- d. Weather conditions at the time of detonation.
- e. Type of explosives and detonators used.
- f. Peak particle velocity of ground motion and primary frequency for all ground vibration monitoring stations.
- g. Peak air blast overpressure measured.
- h. Distance from the blast round to each monitoring station for vibrations and air blast.
- i. Amount of explosive used in each hole, and maximum weight of explosive detonated on any single delay in the blast round.

E. Pre-Blast Survey

- 1. Contractor shall have an approved vibration consultant conduct the pre-blast survey on the residences and facilities adjacent to the proposed rock blasting in accordance with the submitted survey and monitoring plan.

Section 4
Scope of Work and Technical Specifications
SECTION 31 23 00-14 TRENCH EXCAVATION AND BACKFILL

2. The survey shall include, but not be limited to the following:
 - a. A site plan or drawing of the structure to be examined showing the structure in relationship to the proposed rock blasting area and a full description of the structure including type of materials and construction.
 - b. Examination of the structure (interior and exterior surfaces) by experienced and qualified personnel, noting any visible structural and aesthetic flaws in or on the structure. Note existing cracks and flaws, with significant cracks measured, and all cracks and flaws photographed.
 - c. Upon completion of the examination, ask the structure's owner to review the report, note any corrections or omissions, and sign a statement that to the best of his knowledge, the examination report reflects the conditions of the structure prior to any rock blasting. If the structure's owner refuses to sign said report, it should be noted in the report by the examiner.
 - d. Nothing contained herein shall relieve the Contractor of responsibility for claims arising from his construction operations. Failure to inspect any structure, whether or not required by these Contract Documents, or inadequacy of the inspections shall not relieve the Contractor of his responsibility. The Contractor shall indemnify the Owner from such claim.
 - e. In the event that any property owner denies access for the survey of structures and facilities, notify such property owner, by certified mail, stating that this is final notification. Submit to the Owner, copies of all correspondence between the Contractor and the property owner(s). The Owner, upon review of the submitted correspondence may waive requirements set forth above. However, the Contractor is fully responsible for claims and damage arising from his construction operations regardless of property location.
 - f. Submit two (2) sets of copies of the examination reports to the Owner and Engineer for their records.

F. Use of Explosives

1. When the use of explosives is necessary for the prosecution of the Work, exercise the utmost care not to endanger life or property. Be responsible for any and all damage or injury to persons or property resulting from the use of explosives.
2. Store all explosives in a secure manner, in compliance with all laws, and clearly mark all such storage places "DANGEROUS EXPLOSIVES".

Section 4
Scope of Work and Technical Specifications
SECTION 31 23 00-15 TRENCH EXCAVATION AND BACKFILL

3. Notify any public utility company having facilities in close proximity to the site of the Work of the intention to use explosives.

a. Provide this notice sufficiently in advance to enable the utility companies to take whatever steps they may consider necessary to protect their property from injury.

b. Also give the Owner, all occupants of adjacent property, and all other Contractors working in or near the Project, notice of the intention to use explosives.

4. Only non-electric type initiators may be used.

G. Blasting Operations

1. Provide explosives of such quantity and power and use in such locations as will neither open seams nor otherwise disturb the material outside the prescribed limits of excavation.

2. As the excavation approaches its final limits, reduce the depth of holes for blasting and the amount of explosives used for each hole so that the underlying or adjacent rock will not be disturbed or shattered.

3. Do not perform blasting within 100 feet of newly placed concrete that has cured less than 7 days.

4. Do not perform blasting within 50 feet of any existing structure or any new structure in progress.

H. Blast Monitoring

1. Following review by the Owner regarding the proximity of permanent buildings and structures to the blasting site, Owner may direct the Contractor to employ an independent, qualified specialty subcontractor, approved by the Owner to:

a. Monitor the blasting by use of seismograph,

b. Identify the areas where light charges must be used,

c. Conduct pre blast and post blast inspections of structures, including photographs or videos, and maintain a detailed written log.

2. The Contractor shall exercise the utmost care not to damage property on-site and off-site.

a. Notify each adjoining property owner within 5,000 feet of the site of the anticipated ground vibrations and noise which will occur due to the blasting operations.

Section 4
Scope of Work and Technical Specifications
SECTION 31 23 00-16 TRENCH EXCAVATION AND BACKFILL

- b. Provide this notice 30 days in advance to enable the adjacent property owners to take whatever precautions they may consider necessary.
 - c. Limit operations to minimize any disturbance to the adjacent property owners.
 - d. Notify motorists on adjacent roadways in accordance with state regulations.
 - e. Take responsibility for any damage to any structure or utility line, pipes, etc., on-site and off-site as a result of his operations.
- 3. For each blast round, monitor and record noise and air blast overpressures at the site perimeter nearest the blast location and at the on-site or off-site structure located nearest to the round.
 - a. Peak air blast overpressure shall not exceed 0.018 psi, measured at the site perimeter.
- 4. Sufficiently cover the site of every blast round with blasting mats or other devices to prevent any flying debris.
 - a. The Contractor will be fully responsible for any damage caused by flying debris, both to on-site and off-site properties.
- 5. Whenever blasting is to be performed within 2,500 feet of any structure, measure the peak particle velocities of ground vibration resulting from each blast at the structure.
- 6. Monitor vibrations utilizing a seismograph capable of providing a record of particle velocity and frequency along three mutually perpendicular axes utilizing internal calibration.
- 7. Measured peak particle velocity of ground motion at the monitored structure shall not exceed the values shown in the following graph:
- I. Blasting Notification
 - 1. Give twenty-four (24) hour notice to Owner and adjacent residences and/or businesses prior to each blast.
- J. Complaints
 - 1. Submit notice of blasting complaints to Owner in writing within twenty-four (24) hours of receipt thereof.
 - a. Identify the origin of complaint in the notice and provide a brief description of alleged damage or other circumstances upon which the complaint is predicated.

Section 4
Scope of Work and Technical Specifications
SECTION 31 23 00-17 TRENCH EXCAVATION AND BACKFILL

- b. Assign a number to each complaint consecutively in the order of receipt.
- c. Assign each complaint a separate number and show in each letter complaint all previous complaint numbers registered by the same complainant.
- d. In addition, make a summary report each month to Owner. Indicate date, time and name of person investigating the complaint and amount of damages (or an estimate thereof), if any, in the summary report.

K. Post Blast Survey

- 1. Contractor shall have the same vibration consultant who performed the pre-blast survey conduct the post-blast survey.
- 2. The consultant shall examine all structures from which a complaint has originated after the blast. The survey shall include, but not be limited to the following:
 - a. A full description of the alleged damage caused by the blast.
 - 1) Where appropriate, provide a sketch to more fully describe the location and type of damage.
 - 2) Measure cracks and compare to any original measurements which may have been taken in the Pre-Blast Survey.
 - b. Take colored photographs of any alleged damage.
 - c. Submit two (2) copies of the Post Blast Survey report to the Owner. The report shall include the consultant's assessment of the alleged damage and an opinion as to its likely cause.

3.04. DEWATERING EXCAVATIONS

- A. Dewater excavation continuously to maintain a water level two feet below the bottom of the trench.
- B. The Contractor shall pump out, or otherwise remove and properly dispose of any water (including storm water), which may be found or may accumulate, as fast as it may collect in the excavation. The removal is required regardless of the source.
- C. All necessary precautions shall be taken to prevent disturbance of, and to properly drain, any areas upon which concrete is to be poured or pipe is to be laid.
- D. There shall be located at the work site at all times during construction, proper and approved equipment with such sufficient capacity for the removal of any water that

Section 4
Scope of Work and Technical Specifications
SECTION 31 23 00-18 TRENCH EXCAVATION AND BACKFILL

accumulates in excavations and in such manner as not to withdraw sand or cement from any concrete.

1. Where the utility crosses natural drainage channels, the work shall be conducted in such a manner that unnecessary damage or delays in the prosecution of the work will be prevented.
2. Provision shall be made for the satisfactory disposal of surface water to prevent damage to public or private property.

E. Contractor is also to ensure that removal of any liquids will not interfere with the proper laying of masonry or pipe, or execution of any required work for the complete construction of the project.

F. The flow in storm drains, gutters, or water courses encountered during the construction shall be adequately provided for by the Contractor to ensure these flows do not interfere with the execution of the work, and are maintained in such a manner as to ensure continuity of flow at all times in accordance with the Fulton County Erosion and Sediment Control Ordinance.

G. Unless otherwise permitted, ground water encountered within the limits of excavation shall be depressed to an elevation not less than twelve (12) inches below the bottom of such excavation.

1. This depression is to be performed before pipe laying or concrete work is started and shall be so maintained until concrete and joint materials have attained initial set.

H. Control drainage in the vicinity of excavation so the ground surface is properly pitched to prevent water running into the excavation.

I. In all cases, accumulated water in the trench shall be removed before placing bedding or haunching, laying pipe, placing concrete or backfilling.

J. Where dewatering is performed by pumping the water from a sump, crushed stone shall be used as the medium for conducting the water to the sump.

1. Sump depth shall be at least two feet below the bottom of the trench.
2. Pumping equipment shall be of sufficient quantity and/or capacity to maintain the water level in the sump two feet below the bottom of the trench.
3. Pumps shall be a type such that intermittent flows can be discharged.
4. A standby pump shall be required in the event the operating pump or pumps clog or otherwise stop operation.

K. Dewater by use of a well point system when pumping from sumps does not lower the water level two feet below the trench bottom.

Section 4
Scope of Work and Technical Specifications
SECTION 31 23 00-19 TRENCH EXCAVATION AND BACKFILL

1. Where soil conditions dictate, the Contractor shall construct well points cased in sand wicks.
 2. The casing, 6 to 10 inches in diameter, shall be jetted into the ground, followed by the installation of the well point, filling casing with sand and withdrawing the casing.
- L. Should sewage or any other odorous liquids be encountered during the work in the excavation, the Owner shall be immediately notified.
1. The Owner will then determine if actions by the Contractor have caused the source of the odorous liquids to leak and will promptly notify the appropriate regulatory agencies, if necessary.
 2. In addition, the Owner will instruct the Contractor as to what actions, if any, the Contractor can and cannot perform prior to any directives which may be issued by the regulatory agencies.
 3. Any sewage shall be pumped and hauled to a manhole, pump station, or water reclamation facility, as directed
 4. Any other liquids will be properly disposed of as directed by the Owner and/or any regulatory agencies having jurisdiction.

3.05. TRENCH FOUNDATION AND STABILIZATION

- A. The bottom of the trench shall provide a foundation to support the pipe and its specified bedding. The trench bottom shall be graded to support the pipe and bedding uniformly throughout its length and width.
- B. Where foundation conditions are such that proper bedding cannot be provided, the Contractor may be directed by the Owner to provide foundation cushion, concrete cradles, or other special provisions as may be required for the proper support of the pipe.
- C. If, after dewatering as specified above, the trench bottom is spongy, or if the trench bottom does not provide firm, stable footing and the material at the bottom of the trench will still not adequately support the pipe, the trench will be determined to be unsuitable and the Owner shall then authorize payment for trench stabilization.
- D. Should the undisturbed material encountered at the trench bottom constitute, in the opinion of the Owner, an unstable foundation for the pipe, the Contractor shall be required to remove such unstable material and fill the trench to the proper subgrade with crushed stone as directed by the Owner.
- E. Where the replacement of unsuitable material with crushed stone does not provide an adequate trench foundation, the trench bottom shall be excavated to a depth of at least two feet below the specified trench bottom.

1. Place filter fabric in the bottom of the trench and support the fabric along the trench walls until the trench stabilization, bedding, haunching and pipe have been placed at the proper grade.

2. The ends of the filter fabric shall be overlapped by one foot above the pipe.

F. Where trench stabilization is provided, the trench stabilization material shall be compacted to at least 90 percent of the maximum dry density, unless shown or specified otherwise.

3.06. BEDDING AND HAUNCHING

A. Prior to placement of bedding material, the trench bottom shall be free of any water, loose rocks, boulders or large dirt clods.

1. Bottoms of trenches in earth must be shaped or molded and compacted to the contour of the outside of the pipe, using bedding materials, as directed, or where indicated on the Drawings, to give full support to the lower segment of the pipe and so that the pipe is firmly supported in the excavation throughout its entire length.

2. This shall be performed in such a manner as to prevent any subsequent settlement of the pipe.

3. Boulders or loose rock which might bear against the pipe will not be permitted in the trench bottom, or in the initial backfill within twelve (12) inches above the top of the pipe.

4. Bottoms of excavations which are of loose granular soils shall be compacted by vibratory compactor prior to laying of pipe.

B. Bedding material shall be placed to provide uniform support along the bottom of the pipe and to place and maintain the pipe at the proper elevation.

1. The initial layer of bedding placed to receive the pipe shall be brought to the grade and dimensions indicated on the Drawings.

2. Bedding shall be carefully placed along the full width of the trench so that the pipe is true to line and grade of the pipe barrel.

- a. As used herein "carefully placed" means material that has been spaded or shovel-sliced so that the material fills and supports the haunch area and encases pipe to the limits specified herein.

- b. Bedding material shall be carried up the sides of the pipe to the heights shown for the various classes of bedding.

Section 4
Scope of Work and Technical Specifications
SECTION 31 23 00-21 TRENCH EXCAVATION AND BACKFILL

3. The pipe shall be placed and brought to grade by tamping the bedding material or by removal of the excess amount of the bedding material under the pipe.
 4. Adjustment to grade line shall be made by scraping away or filling with bedding material.
 - a. Wedging or blocking up of pipe will not be permitted.
 - b. Applying pressure to the top of the pipe, such as with a backhoe bucket, to lower the pipe to the proper elevation or grade will not be permitted.
 5. Each pipe section shall have a uniform bearing on the bedding for the length of the pipe, except immediately at the joint.
- C. At each joint, bell holes shall be provided in all classes of bedding.
1. Excavate bell holes of ample depth and width to permit the joint to be assembled properly but small enough to ensure that support is provided throughout the length of pipe barrel to relieve the pipe bell of any load.
- D. After the pipe section is properly placed, add the haunching material to the specified depth.
1. The haunching material shall be shoveled, sliced, tamped, vigorously chinked or otherwise consolidated to provide uniform support for the pipe barrel and to fill completely the voids under the pipe, including the bell hole.
 2. Prior to placement of the haunching material, the bedding shall be clean and free of any water, loose rocks, boulders or dirt clods.
- E. Bedding
1. Class "A" (Bedding Factor 2.8): Excavate the bottom of the trench flat at a minimum depth as shown on the Drawings, below the bottom of the pipe barrel. Lay pipe to line and grade on concrete block. Place concrete to the full width of the trench and to a height of one fourth of the outside diameter of the pipe above the invert.
 2. Class "B" (Bedding Factor 1.9): Class 'B' Bedding shall be installed by first undercutting the trench an adequate amount to provide bedding underneath the pipe bell as indicated. The trench shall then be brought to grade with compacted #57 Stone Coarse Aggregate placed the full width of the trench, as excavated. Haunching material shall then be carefully placed by hand and compacted to provide full support under the pipe barrel up to Centerline. At a minimum, Class 'B' Bedding shall be used for PVC and HDPE pipes.

Section 4
Scope of Work and Technical Specifications
SECTION 31 23 00-22 TRENCH EXCAVATION AND BACKFILL

3. Class "C" (Bedding Factor 1.5): Class 'C' Bedding shall be installed by first undercutting the trench an adequate amount to provide bedding underneath the pipe bell as indicated. The trench shall then be brought to grade with compacted #57 Stone Coarse Aggregate placed the full width of the trench, as excavated. Haunching material shall then be carefully placed by hand and compacted to provide full support under and up to a height of one fourth the outside diameter of the pipe above the bottom of the pipe barrel. At a minimum, Class 'C' Bedding shall be used for DIP.

4. Type 5: Type 5 Bedding shall be installed by first undercutting the trench an adequate amount to provide bedding underneath the pipe bell as indicated. The trench shall then be brought to grade with compacted #57 Stone Coarse Aggregate placed the full width of the trench, as excavated before installing pipe. Haunching material shall then be carefully placed by hand and compacted to provide full support under and up to the top of the pipe barrel.

5. Groundwater Flow Dams may be required under certain conditions.

a. If there is a large volume of groundwater which might follow the crushed stone bedding downhill and due to the elevations involved, might build adequate pressure to create problems, flow dams will be required.

b. Flow dams consist of red clay bedding typically about three feet long and spaced about 100 feet along pipeline.

F. Excessive Width and Depth

1. If the trench is excavated to excess width, provide the bedding class with the next higher bedding factor.

2. Crushed stone haunching and initial backfill may be used in lieu of Class "A" bedding, where Class "A" bedding is necessitated by excessive trench width.

3. If the trench is excavated to excessive depth, provide crushed stone to place the bedding at the proper elevation or grade.

G. Compaction: Bedding and haunching materials under pipe and accessories shall be compacted to a minimum of 90 percent of the maximum dry density, unless shown or specified otherwise.

3.07. BACKFILLING – GENERAL

A. Backfilling shall include initial and final backfilling, re-grading of grounds, restoration of surface and sub-surface materials and structures, including resurfacing of paved areas damaged by the Contractor.

B. Backfilling shall not be performed in freezing weather (below 32oF) except by permission of the Owner and shall not be performed with frozen material or upon frozen materials.

C. All backfilling shall be left with smooth, even surfaces, free of rock on the surface, properly graded and shall be maintained in this condition until final completion and acceptance of the Work.

D. Where directed by the Owner, the backfill shall be mounded slightly above the adjacent ground to allow for settlement.

E. Except as otherwise specified or directed, all forms, bracing, and lumber shall be removed before backfilling.

3.08. BACKFILLING – INITIAL BACKFILL

A. Initial backfill shall be placed to anchor the pipe, protect the pipe from damage by subsequent backfill and ensure the uniform distribution of the loads over the top of the pipe.

B. Initial backfilling must be performed properly and before any filling is deposited in large quantities from a machine bucket or other vehicle.

C. Initial backfill material over PVC and HDPE pipes shall be free of rocks larger than two (2) inches in the largest dimension. Initial backfill material over DIP pipe shall be free of rocks larger than four (4) inches in the largest dimension.

D. During initial backfill, dumping from a bucket will not be allowed to fall from a height of more than one foot upon a pipe, and in all cases the bucket must be lowered so that the shock of the falling earth will not injure the pipe or structure.

E. Place initial backfill material carefully around the pipe in uniform layers to a depth of at least 18 inches above the pipe barrel.

1. Layer depths shall be a maximum of 6 inches for pipe 18 inches in diameter and smaller and a maximum of 12 inches for pipe larger than 18 inches in diameter.

F. Carefully and thoroughly consolidate initial backfill in trenches where pipe has been laid, by tamping simultaneously on both sides of the pipe to prevent side pressures.

1. Compact each layer thoroughly with suitable hand tools or tamping equipment.

2. This backfilling and compacting must be performed before any backfill material is deposited directly from a machine bucket, loaders, trucks, or other mechanical equipment.

3. When utilizing a machine bucket for backfilling, the bucket must be lowered into the trench to deposit the material in such a manner as to avoid the shock of falling earth which could injure or damage the pipe or structure.
 4. Under no circumstances should the material be allowed to fall from the machine or loader bucket directly onto the pipe in the trench.
- G. Initial backfill shall be compacted to a minimum 90 percent of the maximum dry density, unless shown or specified otherwise.
- H. Only after the initial backfill has been placed to a point 18 inches above the top of the pipe, may work proceed in placing the final backfill, which must be carefully placed and compacted by tamping.

3.09. BACKFILLING – FINAL BACKFILL

- A. After initial backfill material has been placed and compacted, backfill with final backfill material. Place backfill material in uniform layers, compacting each layer thoroughly as follows:
1. In 6 inch layers, if using light power tamping equipment, such as a “jumping jack”.
 2. In 12 inch layers, if using heavy tamping equipment, such as hammer with tamping feet.
 3. In 24 inch layers, if using a hydra hammer.
- B. Backfill carefully to restore the ground surface to its original condition.
- C. All precautions must be taken to avoid having any unincorporated material which may result in future settlement in these areas. Compaction shall be accomplished by approved mechanical tampers
- D. The top 6 inches shall be topsoil obtained as specified in “Trench Excavation” of this Section.
- E. Excavated material which is unsuitable for backfilling, and excess material, shall be disposed of, at no additional cost to the Owner, in a manner approved by the Owner.
1. Surplus soil may be neatly distributed and spread over the site, if approved by the Owner.
 2. If such spreading is allowed, the site shall be left in a clean and sightly condition and shall not affect pre construction drainage patterns.
 3. Surplus rock from the trenching operations shall be removed from the site.

F. If materials excavated from the trench are not suitable for use as backfill materials, provide select backfill material conforming to the requirements of this Section.

G. Settlement: If trench settles, re fill and grade the surface to conform to the adjacent surfaces.

H. Final backfill shall be compacted to a minimum 90 percent of the maximum dry density, unless specified otherwise.

I. All backfilling shall be left with smooth, even surfaces, properly graded, and shall be maintained in such condition until final completion and acceptance of the work, notwithstanding applicable warranty periods.

J. Where directed by Owner, the Contractor shall mound the backfill slightly above the adjacent ground to allow for settlement.

3.10. CONCRETE ENCASEMENT FOR PIPELINES

A. Where concrete encasement is shown on the Drawings for pipelines, excavate the trench to provide a minimum of 6 inches clearance from the bell of the pipe.

B. Lay the pipe to line and grade on concrete blocks.

C. In lieu of bedding, haunching and initial backfill, place concrete to the full width of the trench and to a height of not less than 12 inches above the pipe bell. Do not backfill the trench for a period of at least 24 hours after concrete is placed.

3.11. ADDITIONAL MATERIAL

A. Where final grades above the pre construction grades are required to maintain minimum cover, additional fill material will be as shown on the Drawings.

1. Utilize excess material excavated from the trench, if the material is suitable.

2. If excess excavated materials are not suitable, or if the quantity available is not sufficient, provide additional suitable fill material at no cost to the Owner.

B. When acceptable excess material is not available from other parts of the Project for backfill, required fills, embankments, etc., the Contractor shall obtain the necessary "borrow" material at locations off the site of the work.

C. If the Owner determines the original excavated material is unsuitable for use as backfill, such as perishable matter, refuse, building materials, wire, brush, stumps, ashes, large stones, mulch, or other soft materials, the Contractor shall properly dispose of the objectionable materials, and shall furnish, haul, and place borrow material suitable for proper backfill.

D. Locating such acceptable "borrow" sites shall be the sole responsibility of the Contractor. All materials to be used as borrow shall be approved by the Owner.

3.12. BACKFILL UNDER ROADS

- A. Final backfill material under roadways and other paved areas shall be compacted to a density of not less than 95 percent of maximum dry density as determined by ASTM D698 – Standard Proctor. The top 12 inches shall be compacted to a minimum of 98 percent of the maximum dry density.
- B. Final backfill material under non-paved areas within the road right-of-way shall be compacted to not less than 90 percent of maximum dry density as determined by ASTM D698.
- C. Final backfill material in non-paved areas outside of road right-of-way shall be compacted to not less than 85 percent of maximum dry density as determined by ASTM D698 or as directed by the Owner.

3.13. BACKFILL WITHIN GEORGIA DOT RIGHT OF WAY

- A. Backfill within the Georgia DOT right of way shall meet the requirements stipulated in the “Utility Accommodation Policy and Standards”, published by the Georgia Department of Transportation.

3.14. BACKFILL ALONG RESTRAINED JOINT PIPE

- A. Backfill along restrained joint pipe shall be compacted to a minimum 90 percent of the maximum dry density.

3.15. BACKFILLING STRUCTURES

- A. Backfilling of structures shall proceed as various structures or parts of structures are completed.
 - 1. The Contractor shall refill the space outside and around the wall with material excavated from the site and stored for this purpose.
 - 2. Immediately adjacent to the structure, the backfill material shall be placed in eight inch layers and compacted to avoid future settlement.
 - 3. This filling shall be carried to such height as will bring the finished grade to the required elevations.

3.16. FLOWABLE FILL

- A. Where flowable fill is required, excavate the trench to provide a minimum of 6 inches clearance on either side of the pipe barrel.
- B. Lay the pipe to line and grade on solid concrete blocks or bricks.
- C. In lieu of bedding, haunching and initial backfill, place flowable fill to the full width and depth of the trench.

D. Flowable fill shall be protected from freezing for a period of 36 hours after placement.

1. Minimum temperature of flowable fill at point of delivery shall be 50 degrees F.

E. The Contractor shall provide steel plates over flowable fill in road locations.

3.17. COMPACTED GRANULAR MATERIAL

A. Where compacted granular material is required as initial and final backfill material, it shall be placed after bedding and haunching material specified elsewhere has been placed.

B. Compacted granular material shall be compacted to a minimum 95 percent of the maximum dry density.

3.18. TRENCH SURFACE FINISH

A. Trenches cut in pavement on public roads or in areas that will become under pavement in proposed public roads (such as typical subdivision developments) shall be compacted in accordance with Fulton County Standard Details as applicable.

1. Such compaction shall be verified by an independent soils laboratory. The number, depth and location of such compaction test shall be as required by the Owner.

a. Compaction tests will generally be required at approximately 400 foot intervals in existing roads and 800 foot intervals in proposed roads.

b. Compaction tests shall be performed at the Contractors' expense.

2. Trenches located perpendicular within existing public roads shall require an 8 inch thick concrete base course poured over the compacted backfill.

a. The concrete base course shall extend the full width of the trench cut plus a minimum of 12 inches on either side of the trench.

b. The existing pavement shall be neatly sawed along both sides of the trench.

c. The concrete used shall be a minimum 3,000 PSI high early strength concrete.

d. Once the concrete base course has properly set, the concrete surface shall be cleaned and a minimum 1-½ inch thick bituminous concrete pavement (to match existing pavement), shall be laid matching the level of the adjacent pavement.

Section 4
Scope of Work and Technical Specifications
SECTION 31 23 00-28 TRENCH EXCAVATION AND BACKFILL

B. Trenches cut in driveways or private parking areas shall require a minimum 6 inch thick, fully compacted, graded aggregate base.

1. The existing pavement shall be neatly sawed along both sides of the ditch.
2. Material of the same type and thickness shall be laid matching the level of the adjacent drive surface.
3. In restoring concrete drives, the base course shall be wetted prior to pouring new concrete.
4. Concrete used shall be 3,000 PSI high early strength.

C. Trenches cut through curbs and sidewalks shall be restored in such a manner as to conform in size, line, grade and materials with that adjoining.

1. In restoring curbs and sidewalks, entire slabs or squares shall be removed and replaced.
2. The subsoil and foundation material shall be well compacted.
3. The sub-base shall be thoroughly rolled or tamped and shall be wet just before the concrete is placed, but shall show no pools of water.

D. Should settlements, cracks, or other indications of failure appear in adjoining pavements, drives, curbs, or sidewalks, the adjoining surfaces shall be removed to the extent necessary to secure firm, undisturbed bearing and shall be re-laid in a satisfactory manner.

E. Trenches cut in non-paved areas shall be thoroughly compacted to a level 4 inches below ground surface.

1. All easements shall be adequately re-grassed to prevent soil erosion.
2. Natural topsoil at least 4 inches thick and of a good condition and tillable structure shall be placed atop the compacted trench backfill.
 - a. Topsoil shall be free of large stones, plant stumps, large roots, objectionable litter, or other substances potentially harmful to plant growth.
3. Grass seed shall be of a properly proportioned mixture approved for use in Zone Two, as detailed in the Georgia Department of Transportation Standard Specifications.
4. Whenever possible, replace existing grassed areas with grass of similar characteristics and appearance, meeting at a minimum, the specification requirements included herein.

Section 4
Scope of Work and Technical Specifications
SECTION 31 23 00-29 TRENCH EXCAVATION AND BACKFILL

5. All seeded areas shall be uniformly mulched immediately after seeding and within 10 days of construction work completion.

6. Sediment control measures must remain in place and be maintained until a comprehensive vegetative cover is established.

3.19. TESTING AND INSPECTION

A. The Owner may direct tests to be made to determine the density of the compacted material. Cost of the testing laboratory, fieldwork, and analysis shall be paid for by the Contractor.

B. When directed by the Owner, the Contractor shall arrange to have compaction tests conducted by an independent testing firm.

C. The soils testing laboratory is responsible for the following:

1. Compaction tests in accordance with Article 1.02 of this Section.
2. Field density tests for each two feet of lift, one test for each 1,000 feet of pipe installed or more frequently if ordered by the Owner.
3. Inspecting and testing stripped site, subgrades and proposed fill materials.

D. The Contractor's duties relative to testing include:

1. Notifying laboratory of conditions requiring testing.
2. Coordinating with laboratory for field testing.
3. Paying costs for additional testing performed beyond the scope of that required and for re testing where initial tests reveal non conformance with specified requirements.
4. Providing excavation as necessary for laboratory personnel to conduct tests.

E. Inspection

1. Earthwork operations, acceptability of excavated materials for bedding or backfill, and placing and compaction of bedding and backfill is subject to inspection by the Owner.

3.20 DISPOSAL OF MATERIAL

A. The Contractor shall be required to remove from the site of the work all earth in excess of that required to backfill the excavation or to create necessary fill.

B. This shall be performed immediately after the backfill is completed to the satisfaction of the Owner.

Section 4
Scope of Work and Technical Specifications
SECTION 31 23 00-30 TRENCH EXCAVATION AND BACKFILL

- C. All material removed shall become the property of the Contractor and he shall make his own arrangements for its disposition.
- D. All surplus material, shot rock, organics, clearing debris, stumps, and other such material deemed unfit for use as backfill, shall be disposed of by the Contractor, and shall be performed in such manner so as to give a minimum of inconvenience to the public.
- E. Comply with applicable codes, ordinances, rules, regulations and laws of local, municipal, state or federal authorities having jurisdiction.

END OF SECTION

SECTION 31 25 00

EROSION AND SEDIMENTATION CONTROL

PART 1 – GENERAL

1.01 SCOPE

- A. The Work specified in this Section consists of providing and maintaining temporary and permanent erosion and sedimentation controls as shown on the Drawings. This Section also specifies the subsequent removal of temporary erosion and sedimentation controls.
- B. Temporary and permanent erosion and sedimentation controls include grassing and mulching of disturbed areas and structural barriers at those locations which will ensure that erosion during construction will be maintained within acceptable limits.
- C. Acceptable limits are as established by the Georgia Erosion and Sedimentation Control Act of 1975, as amended, Section 402 of the Federal Clean Water Act, and applicable codes, ordinances, rules, regulations and laws of Federal, State, local and municipal authorities having jurisdiction.
- D. Land disturbance activity shall not commence until the Land Disturbance Permit has been issued.

1.02 SUBMITTALS

- A. Submit product data in accordance with the requirements of Section 01 33 23 of these Specifications.

1.03 QUALITY ASSURANCE

- A. The temporary and permanent erosion and sedimentation control measures shown on the Drawings are minimum suggested requirements. Any additional erosion and sedimentation control measures required by the Contractor's means, methods, techniques and sequence of operation shall be installed by the Contractor at no additional cost to the Owner.
- B. Perform all work under this Section in accordance with all pertinent rules and regulations including, but not necessarily limited to, those stated in these Specifications. Where provisions of pertinent rules and regulations conflict with these Specifications, the more stringent provisions shall govern.
- C. Provide all materials and promptly take all actions necessary to achieve effective erosion and sedimentation control in accordance with the Georgia Erosion and Sedimentation Control Act of 1975 as amended (OCGA §12-7-1, et. seq.), local ordinances, other permits, local enforcing agency guidelines and these Specifications.
- D. Basic principles:

Section 4
Scope of Work and Technical Specifications
SECTION 31 25 00-2 EROSION AND SEDIMENTATION CONTROL

1. Coordinate the land disturbance activities to fit the topography, soil types and conditions.
2. Minimize the disturbed area and the duration of exposure to erosive elements.
3. Provide temporary or permanent stabilization to disturbed areas immediately after rough grading is complete.
4. Safely convey run-off from the site to a stable outlet to prevent flooding and damage to downstream facilities resulting from increased runoff from the site.
5. Retain sediment on-site that was generated on-site.
6. Minimize encroachment upon watercourses.

E. Implementation:

1. The Contractor is solely responsible for the control of erosion within the Project site and the prevention of sedimentation from leaving the Project site or entering waterways.
2. The Contractor shall install temporary and permanent erosion and sedimentation controls which will ensure that runoff from the disturbed area of the Project site shall pass through a filter system before exiting the Project site.
3. The Contractor shall provide temporary and permanent erosion and sedimentation control measures to prevent silt and sediment from entering the waterways and designated wetland areas. The Contractor shall maintain an undisturbed vegetative buffer a minimum of 25 feet from the top of the bank.
4. The Contractor shall limit land disturbance activity to those areas shown on the Drawings.
5. The Contractor shall maintain erosion and sedimentation control measures within disturbed areas on the entire site until the final acceptance of the Project at no additional cost to the Owner.
6. Maintenance shall include mulching, re-seeding, clean-out of sediment barriers and sediment ponds, replacement of washed-out or undermined rip rap and erosion control materials, to the satisfaction of the Owner and Owner.
7. All fines imposed for improper erosion and sedimentation control shall be paid by the Contractor.

PART 2 – PRODUCTS

2.01 SEDIMENT BARRIER

Section 4
Scope of Work and Technical Specifications
SECTION 31 25 00-3 EROSION AND SEDIMENTATION CONTROL

A. Silt fence:

1. Type NS silt fence shall meet the requirements of Section 171 of the Georgia Department of Transportation Standard Specifications, latest edition.
2. Type S Silt Fence is a combination of Type NS silt Fence with woven wire reinforcement. Type S Silt Fence reinforcement shall meet the requirements of Section 171 of Georgia D.O.T. Specifications, latest edition.
3. Silt fence fabric shall be an approved product on the Georgia DOT Qualified Product List No. 36, latest edition.

B. Hay Bales: Hay bales shall be clean, seed-free cereal hay, rectangular in shape, and contain five cubic feet or more of material. Hay bales shall be bound with wire or nylon to securely contain the material.

1. Pine straw bales may be used in lieu of hay bales.
2. Bales shall be placed in a single row, lengthwise, on the contour and embedded in the soil to a depth of four (4) inches.
3. Bales must be securely anchored in place by stake or bars driven through the bales.

C. Concrete Blocks: Concrete blocks shall be hollow, non-load-bearing type.

2.02 CONSTRUCTION EXIT STONE

A. Use sound, tough, durable stone resistant to the action of air and water. Slabby or shaley pieces will not be acceptable.

B. Aggregate size shall be in accordance with the National Stone Association Size R-2 (1.5 to 3.5-inch stone) or Type 3 rip rap stone conforming to Section 805.01 of the Georgia Department of Transportation Standard Specifications.

2.03 RIP RAP

A. Stone Rip Rap: Use sound, tough, durable stones resistant to the action of air and unless noted otherwise, stone rip rap shall be Type 1.

1. Type 1 Rip Rap: Rip rap size and gradation shall conform to Section 805.01 of the Georgia Department of Transportation Standard Specification for Type 1 Stone Dumped Rip Rap.
2. Type 3 Rip Rap: Rip rap size and gradation shall conform to Section 805.01 of the Georgia Department of Transportation Standard Specifications for Type 3 Stone Dumped Rip Rap.

B. Sand Cement Bag Rip Rap: Sand cement bag rip rap shall conform to the Georgia Department of Transportation Standard Specifications, Section 603.

2.04 GABIONS

- A. Gabions shall be constructed of heavy galvanized steel wire mesh with a zinc coating of triple hexagon weave. The mesh wire diameter for the galvanized gabions shall be 2.2 mm (0.0866") + 2 1/2%; the mesh edge wire shall be not less than 2.7 mm – 2 1/2%. The lacing wire for binding the netting units together shall be 2.2 mm (0.0866") + 2 1/2%.
- B. Geotextiles when used behind gabion structures shall be in accordance with AASHTO M288-96 Section 7.5, "Permanent Erosion Control Requirements."

2.05 PLASTIC FILTER FABRIC

- A. Plastic filter fabric shall conform to the Georgia Department of Transportation Standard Specifications, Section 881, for filter fabrics.
- B. Plastic filter fabric shall be an approved product on the Georgia Department of Transportation Qualified Product List No. 28, latest edition.
- C. Seams - Fabric may be sewn together with thread of a material having the same chemical requirements as the material forming the fabric or shall be bonded by cementing or by heat. The strength of the seams shall be equal to that of the unaged fabric. Fabrics to be used under riprap are allowed to be bonded or sewn together forming sections not less than 6 feet wide.

2.06 GRASSING

- A. Grassing materials shall meet the requirements of the Georgia Department of Transportation Standard Specifications, latest edition; as shown in the table:

Material	Section No.
Topsoil	893.01
Seed and Sod	890
Fertilizer	891.01
Agricultural Lime	882.02
Mulch	893.02
Inoculants	893.04

- B. Seed species shall be provided as shown on the Drawings.
- C. Mulch Binder: Mulch on slopes exceeding 3 (horizontal) to 1 (vertical) shall be held in place by the use of a mulch binder, as approved by the Owner. The mulch binder shall be non-toxic to plant and animal life and shall be approved by the Owner.
- D. Water: Water shall be free of excess and harmful chemicals, organisms, and substances which may be harmful to plant growth or obnoxious to traffic. Salt or brackish water shall not be used. Water shall be furnished by the Contractor.

PART 3 – EXECUTION

3.01 GENERAL

- A. The Contractor must utilize Best Management Practices to minimize siltation and erosion consistent with the Manual for Erosion and Sediment Control in Georgia.
- B. Temporary and permanent erosion and sedimentation control measures shall prevent erosion and prevent sediment from exiting the site.
 - 1. If, in the opinion of the Owner, Owner or State inspector, the Contractor's temporary erosion and sedimentation control measures are inadequate, the Contractor shall provide additional maintenance for existing measures or additional devices to control erosion and sedimentation on the site at no additional cost to the Owner.
- C. All erosion and sedimentation control devices and structures shall be inspected by the Contractor at least once a week and immediately after each rainfall occurrence. Any device or structure found to be damaged shall be repaired or replaced by the end of the day.
- D. All erosion and sedimentation control measures and devices shall be constructed and maintained as indicated on the Drawings or specified herein until adequate permanent disturbed area stabilization has been provided and accepted by the Owner.
- E. Once adequate permanent stabilization has been provided and accepted by the Owner, all temporary erosion and sedimentation control structures and devices shall be removed.

3.02 SEDIMENT CONTROL

- A. Construction exit:
 - 1. Construction exit(s) shall be placed as shown on the Drawings and as directed by the Owner.
 - a. A construction exit shall be located at any point traffic will be leaving a disturbed area to a public right-of-way, street, alley, sidewalk or parking area.
 - b. The construction exit shall consist of a minimum of six (6) inch thick pad of aggregate as specified above and of the necessary length to accomplish the task for which it is intended.
 - 2. Placement of Construction Exit Material: The ground surface upon which the construction exit material is to be placed shall be prepared to a smooth condition free from obstructions, depressions or debris.

Section 4
Scope of Work and Technical Specifications
SECTION 31 25 00-6 EROSION AND SEDIMENTATION CONTROL

- a. Filter fabrics shall be required to keep the aggregate stone from becoming contaminated with subgrade soils and must be placed the full length and width of the entrance.
- b. The plastic filter fabric shall be placed to provide a minimum number of overlaps and a minimum width of one foot of overlap at each joint.
- c. The stone shall be placed with its top elevation conforming to the surrounding ground elevations. The stone shall be dropped from no more than a three feet height during construction.

3. Construction Exit Maintenance: The Contractor shall regularly maintain the exit with the top dressing of stone to prevent tracking or flow of soil onto public rights-of-way and paved surfaces as directed by the Owner.

4. Construction Exit Removal: Construction exit(s) shall be removed and properly disposed of when the disturbed area has been properly stabilized, the tracking or flow of soil onto public rights-of-way or paved surfaces has ceased and as directed by the Owner.

B. Sediment barriers:

1. Sediment barriers shall include, but are not necessarily limited to, silt fences, hay bales and any device which prevents sediment from exiting the disturbed area.
2. Silt fences and hay bales shall not be used in any flowing stream, creek or river.
3. Sediment barriers shall be installed as shown on the Drawings and as directed by the Owner.
4. Sediment barriers shall be maintained to ensure the depth of impounded sediment is no more than one-half of the original height of the barrier or as directed by the Owner.
5. Torn, damaged, destroyed or washed-out barriers shall be repaired, reinforced or replaced with new material and installed as shown on the Drawings and as directed by Owner.
6. Accumulated sediment shall be removed from the barrier and the barrier replaced and stabilized on-site as directed by the Owner.
7. Sediment barrier shall be removed once the disturbed area has been stabilized with a permanent vegetative cover and the sediment barrier is no longer required as directed by the Owner.
8. All non-biodegradable parts of the barrier shall be disposed of properly.

Section 4
Scope of Work and Technical Specifications
SECTION 31 25 00-7 EROSION AND SEDIMENTATION CONTROL

9. The disturbed area created by barrier removal shall be permanently stabilized.

C. Sediment Boxes: All inlet grates shall be covered with sediment boxes during grading operations and shall remain so covered until all open areas are permanently stabilized against erosion.

D. Where construction dewatering pumps discharge, the water must be filtered to minimize stream siltation. As a minimum, filter fabrics or silting basins are required.

3.03 EROSION CONTROL

A. Rip rap

1. Rip rap shall be placed as shown on the Drawings and as directed by the Owner.

a. Rip rap shall be placed at all points where natural vegetation is disturbed on the banks of active streams.

b. Compact backfill and place rip rap to prevent subsequent settlement and erosion.

c. This requirement applies equally to construction alongside a stream as well as crossing a stream or drainage ditch.

2. When trenching across a stream or drainage ditch, place rip rap over the entire disturbed area upstream and downstream of the trench excavation.

a. Place rip rap across creek bottom, across creek banks, and extend rip rap placement five feet beyond the top of each creek bank.

3. Preparation of Foundations: The ground surface upon which the rip rap is to be placed shall be brought to the correct lines and grades before placement is commenced.

a. Where filling of depressions is required, the new material shall be compacted with hand or mechanical tampers.

b. Unless at creek banks or otherwise shown or specified, rip rap shall begin in a toe ditch constructed in original ground around the toe of the fill or the cut slope.

c. The toe ditch shall be two feet deep in original ground, and the side next to the fill or cut shall have that same slope. After the rip rap is placed, the toe ditch shall be backfilled and the excess dirt spread neatly on the site.

4. Placement of Plastic Filter Fabric:

Section 4
Scope of Work and Technical Specifications
SECTION 31 25 00-8 EROSION AND SEDIMENTATION CONTROL

- a. Plastic filter fabric shall be placed under all rip rap unless shown or specified otherwise.
- b. Filter fabric shall not be placed under rip rap on stream or drainage ditch crossings.
- c. The surface to receive filter fabric shall be prepared to a smooth condition free from obstructions, depressions and debris.
- d. The filter fabric shall be installed with the long dimension running up the slope and shall be placed to provide a minimum number of overlaps.
- e. The fabric shall be placed to provide a minimum width of one foot of overlap at each joint. The fabric shall be placed so that the upstream strip overlaps the downstream strip.
- f. The fabric shall be anchored in place with securing pins of the type recommended by the fabric manufacturer. Pins shall be placed on or within 3 inches of the centerline of the overlap.
- g. The fabric shall be placed loosely to avoid stretching and tearing during placement of the stone.
- h. The fabric shall be protected at all times during construction from clogging due to clay, silts, chemicals, or other contaminants.
- i. Contaminated fabric or fabric damaged during installation or during placement of rip rap shall be removed and replaced with uncontaminated and undamaged fabric at no additional cost to the Owner.

5. Placement of Rip Rap: Rip rap shall be placed on a 6-inch layer of soil, crushed stone or sand overlaying the filter fabric.

- a. Rip rap shall be placed with its top elevation conforming to the finished grade or the natural existing slope of the stream bank and stream bottom.
- b. The stone shall be dropped from no more than a three foot height during construction.
- c. Stone rip rap shall be placed to provide a uniform surface to the thickness shown on the Drawings.
- d. The thickness tolerance for the course shall be -3 inches and +6 inches.

B. Grassing:

Section 4
Scope of Work and Technical Specifications
SECTION 31 25 00-9 EROSION AND SEDIMENTATION CONTROL

1. Temporary Stabilization: Temporary stabilization shall be provided as shown on the Drawings and conforming to these Specifications to control erosion on the site.
 - a. Temporary stabilization shall be provided to any area that will not receive permanent stabilization within the next 14 calendar days.
 - b. Partial payment requests may be withheld for those portions of the Project not complying with this requirement.
2. Permanent Stabilization:
 - a. Permanent stabilization shall be provided as shown on the Drawings and conforming to these Specifications to control erosion on the site. Permanent stabilization shall be provided to all areas of land disturbance within seven calendar days of the completion of land disturbance for any area greater than 0.25 acre.
 - b. Where permanent stabilization cannot be immediately established because of an inappropriate season, the Contractor shall provide temporary stabilization.
 - c. The Contractor shall return to the site at the appropriate season to provide permanent stabilization in areas that received only temporary stabilization.
3. Grassing shall meet the requirements of Section 700 of the Georgia Department of Transportation Standard Specifications, latest edition, unless specified otherwise.
4. Seed rate, fertilization and other requirements shall be provided as shown on the Drawings.

3.04 CLEAN-UP

- A. Dispose of all excess erosion and sedimentation control materials in a manner satisfactory to the Owner.
- B. Final clean-up shall be performed in accordance with the requirements of these Specifications and to the satisfaction of the Owner.

END OF SECTION

SECTION 32 12 16

REMOVING AND REPLACING PAVEMENT

PART 1 – GENERAL

1.01 SUMMARY

- A. The work to be performed under this Section shall consist of removing and replacing existing pavement, sidewalks and curbs in paved areas where necessary for construction of utilities and all other sewer appurtenances and structures.
- B. Existing pavement, sidewalks and curbs shall be replaced to the current Fulton County standards or to match existing, whichever is more stringent.

1.02 SUBMITTALS

- A. Certificates: Provide certificates stating that materials supplied comply with Specifications. Certificates shall be signed by the asphalt producer and the Contractor.
- B. Traffic paint manufacturer's application instructions and a description and other data relative to the Contractor's application equipment and methods shall be submitted to the Owner for approval.

1.03 CONDITIONS

- A. Weather Limitations
 - 1. Apply bituminous prime and tack coats only when the ambient temperature has been at least 55° F for 12 hours immediately prior to application.
 - 2. Do not conduct paving operations when surface is wet or contains excess of moisture which would prevent uniform distribution and required penetration.
 - 3. Construct asphaltic courses only when atmospheric temperature in the shade is above 40° F, when the underlying base is dry and when weather is not rainy.
 - 4. Place base course when air temperature is above 35° F and rising.
- B. Grade Control: Establish and maintain the required lines and grades for each course during construction operations.

PART 2 – PRODUCTS

2.01 MATERIALS AND CONSTRUCTION

- A. Graded Aggregate Base Course: Graded aggregate base course shall be of uniform quality throughout and shall meet the requirements of Section 815.01 of the Georgia Department of Transportation Standard Specifications.

Section 4
Scope of Work and Technical Specifications
SECTION 32 12 16-2 REMOVING AND REPLACING PAVEMENT

B. Black Base: Black base course shall be of uniform quality throughout and shall conform to the requirements of Section 828 of the Georgia Department of Transportation Standard Specifications.

C. Binder Course: The binder course of all paved roadways shall conform to the requirements of Section 400, 12.5 mm Superpave of the Georgia Department of Transportation Standard Specifications.

D. Surface Course: The surface course for all pavement, including prime or tack coat when required by the Owner, shall conform to the requirements of Section 400, 9.5 mm Superpave of the Georgia Department of Transportation Standard Specifications

E. Concrete: Provide concrete and reinforcing for concrete pavement or base courses in accordance with the requirements of the Georgia Department of Transportation Standard Specifications, Section 430. Concrete shall be of the strength classifications shown on the Drawings.

F. Special Surfaces: Where driveways or roadways constructed of specialty type surfaces such as brick or stone are disturbed or damaged, these driveways and roadways shall be restored utilizing similar, if not original, materials. Where the nature of these surfaces dictate, a specialty contractor shall be used to restore the surfaces to their previous or better condition. Special surfaces shall be removed and replaced to the limits to which they were disturbed.

2.02 TYPES OF PAVEMENTS

A. General:

1. All existing pavement removed, destroyed or damaged by construction shall be replaced with the same type and thickness of pavement as that existing prior to construction, unless otherwise directed by the Owner.

2. Materials, equipment and construction methods used for paving work shall conform to the Georgia Department of Transportation specifications applicable to the particular type required for replacement, repair or new pavements.

B. Aggregate Base:

1. Aggregate base shall be constructed in accordance with the requirements of Section 310 of the Georgia Department of Transportation Standard Specifications.

2. The maximum thickness to be laid in a single course shall be 6 inches compacted. If the design thickness of the base is more than 6 inches, it shall be constructed in two or more courses of approximate equal thickness.

Section 4
Scope of Work and Technical Specifications
SECTION 32 12 16-3 REMOVING AND REPLACING PAVEMENT

3. After the material placed has been shaped to line, grade and cross section, it shall be rolled until the course has been uniformly compacted to at least 100 percent of the maximum dry density when Group 2 aggregate is used, or to at least 98 percent of maximum dry density when Group 1 aggregate is used.

C. Concrete Pavement:

1. Concrete pavement or base courses shall be replaced with concrete.
2. The surface finish of the replaced concrete pavement shall conform to that of the existing pavement.
3. The surface of the replaced concrete base course shall be left rough.
4. The slab depth shall be equivalent to the existing concrete pavement or base course, but in no case less than 6 inches thick.
5. Transverse and longitudinal joints removed from concrete pavement shall be replaced at the same locations and to the same types and dimensions as those removed.
6. Concrete pavements or concrete base courses shall be reinforced.

D. Asphaltic Concrete Base, Binder and Surface Course:

1. Asphaltic concrete base, binder and surface course construction shall conform to Georgia Department of Transportation Standard Specifications, Section 400.
2. The pavement mixture shall not be spread until the designated surface has been previously cleaned and prepared, is intact, firm, properly cured, dry and the tack coat has been applied.
3. Apply and compact the base in maximum layer thickness by asphalt spreader equipment of design and operation approved by the Owner.
4. After compaction, the black base shall be smooth and true to established profiles and sections.
5. Apply and compact binder and the surface course in a manner approved by the Owner.
6. Immediately correct any high, low or defective areas by cutting out the course, replacing with fresh hot mix, and immediately compacting to conform and thoroughly bond to the surrounding area.

E. Surface Treatment Pavement:

Section 4
Scope of Work and Technical Specifications
SECTION 32 12 16-4 REMOVING AND REPLACING PAVEMENT

1. Bituminous penetration surface treatment pavement shall be replaced with a minimum thickness of 1 inch conforming to Section 424, Georgia Department of Transportation Standard Specifications.

F. Gravel Surfaces:

1. Existing gravel road, drive and parking area replacement shall meet the requirements of graded aggregate base course.
2. This surfacing may be authorized by the Owner as a temporary surface for paved streets until replacement of hard surfaced pavement is authorized.

G. Temporary Measures:

1. During the time period between pavement removal and complete replacement of permanent pavement, maintain highways, streets and roadways by the use of steel running plates anchored to prevent movement.
2. The backfill above the pipe shall be compacted, as specified, up to the existing pavement surface to provide support for the steel running plates. All pavement shall be replaced within seven calendar days of its removal.

PART 3 – EXECUTION

3.01 LOCATIONS FOR PAVEMENT REPLACEMENT

A. Pavement shall be removed and replaced with similar type and thickness as the original pavement, for the entire length of pipe laying and up to required trench width as per details shown on the Drawings.

3.02 REMOVING PAVEMENT

A. General: Remove existing pavement as necessary for installing the pipe line and appurtenances.

B. Marking: Before removing any pavement, mark the pavement neatly paralleling pipe lines and existing street lines. Space the marks the width of the trench.

C. Breaking: Break asphalt pavement along the marks using pavement shearing equipment, jack hammers or other suitable tools. Break concrete pavement along the marks by scoring with a rotary saw and breaking below the score by the use of jack hammers or other suitable tools.

D. Machine Pulling: Do not pull pavement with machines until the pavement is completely broken and separated from pavement to remain.

E. Damage to Adjacent Pavement: Do not disturb or damage the adjacent pavement. If the adjacent pavement is disturbed or damaged, remove and replace the damaged pavement.

Section 4
Scope of Work and Technical Specifications
SECTION 32 12 16-5 REMOVING AND REPLACING PAVEMENT

F. Sidewalk: Remove and replace any sidewalks disturbed by construction for their full width and to the nearest undisturbed joint.

G. Curbs: Tunnel under or remove and replace any curb disturbed by construction to the nearest undisturbed joint.

H. Cutting: Before removing any existing pavement, saw cut the pavement in full thickness.

3.03 REPLACING PAVEMENT

A. Preparation of Subgrade: Upon completion of backfilling and compaction of the backfill, arrange to have the compaction tested by an independent testing laboratory approved by the Owner. After compaction testing has been satisfactorily completed, replace all pavements, sidewalks and curbs removed.

1. The existing street pavement or surface shall be removed along the lines of the work for the allowable width specified for the trench or structure.

2. After the installation of the pipelines and after the backfill has been compacted suitably, the additional width of pavement to be removed, as shown on the Drawings, shall be done immediately prior to replacing the pavement.

3. Trench backfill shall be compacted for the full depth of the trench as specified in Section 31 23 00 of these Specifications.

4. Temporary trench backfill along streets and driveways shall include 6 inches of crushed stone or cherty clay as a temporary surfacing of the trenches.

a. This temporary surface shall be maintained carefully at grade and dustfree by the Contractor until the backfill of the trench has thoroughly compacted in the opinion of the Owner and permission is granted to replace the street pavement.

5. When temporary crushed stone or chert surface is considered by the Owner to be sufficient surface for gravel pavement, the surface shall be graded smooth and to an elevation that will make the final permanent surfacing level with the adjacent surfacing that was undisturbed.

B. Pavement Replacement

1. Prior to replacing pavement, make a final cut in concrete pavement 12 inches back from the edge of the damaged pavement with a concrete saw.

2. Remove asphalt pavement 12 inches back from the edge of the damaged pavement using pavement shearing equipment, jack hammers or other suitable tools.

Section 4
Scope of Work and Technical Specifications
SECTION 32 12 16-6 REMOVING AND REPLACING PAVEMENT

- a. Pavement cuts shall be parallel or perpendicular to the road centerline as much as practical.
- b. On parallel installations the final cut shall be long and straight and consistent.

3. Replace all street and roadway pavement as shown on the Drawings. Replace driveways, sidewalks and curbs with the same material, to nearest existing undisturbed construction joint and to the same dimensions as those existing.

4. If the temporary crushed stone or chert surface is to be replaced, the top 6 inches shall be removed and the crushed stone surfacing for unpaved streets or the base for the bituminous surface shall be placed.

5. Following this preparation, the chert or crushed stone base shall be primed with a suitable bituminous material and surfaced with the proper type of bituminous surface treatment.

6. Where the paved surface is to be replaced with asphaltic concrete pavement, concrete pavement or with a concrete base and a surface course, the temporary chert or crushed stone surface and any necessary backfill material, additional existing paving and new excavation shall be removed to the depth and width shown on the Drawings.

- a. All edges of the existing pavement shall be cut to a straight, vertical edge.
- b. Care shall be used to get a smooth joint between the old and new pavement and to produce an even surface on the completed street.
- c. Concrete base slabs and crushed stone bases, if required, shall be placed and allowed to cure for three days before bituminous concrete surface courses are applied.
- d. Expansion joints, where applicable, shall be replaced in a manner equal to the original joint.

7. Where driveways or roadways, constructed of specialty type surfaces, such as brick or stone are disturbed or damaged, these driveways and roadways shall be restored utilizing similar materials.

- a. Where the nature of these surfaces dictate, a specialty contractor shall be used to restore the surfaces to their previous or better condition.
- b. Special surfaces shall be removed and replaced to the limits to which they were disturbed.

C. Pavement Resurfacing:

Section 4
Scope of Work and Technical Specifications
SECTION 32 12 16-7 REMOVING AND REPLACING PAVEMENT

1. Certain areas to be resurfaced are specified or noted on the Drawings.
 - a. After all pipe line installations are complete and existing pavement has been removed and the trench route has been repaired, mill entire area to be resurfaced 1-1/2 inches, then apply tack coat and 1-1/2 inches of 9.5 mm Superpave surface course as specified.
 - b. Where pavement to be resurfaced has been damaged with potholes, the Contractor shall remove all existing loose pavement material and fill the hole with black base, as specified, to the level of the existing pavement.
2. Resurfacing limits shall be perpendicular to the road centerline.
3. The limits of resurfacing shall be 10 feet beyond the edge of the pavement replacement on the main road being resurfaced, and to the point of tangency of the pavement on the side streets.

D. Pavement Striping:

1. Pavement striping removed or paved over shall be replaced with the same type, dimension and material as original unless directed otherwise by the Owner.

3.04 SIDEWALK AND CURB REPLACEMENT

A. Construction

1. All concrete sidewalks and curbs shall be replaced with concrete.
2. The Contractor shall restore all curbs and combination curbs and gutters which have been removed or disturbed in the progress of the work. Curbing shall be made to conform accurately in size, line, grade and materials with the adjoining curb.
3. The Contractor shall restore all sidewalks which have been removed or disturbed in the progress of the work.
 - a. Sidewalks shall be constructed to the same dimensions and materials as the adjoining sections.
 - b. Where necessary to cut a sidewalk, entire sections shall be removed and replaced unless otherwise directed by the Owner.
4. Preformed joints shall be 1/2 inch thick, conforming to the latest edition of AASHTO M59 for sidewalks and AASHTO M 123 for curbs.
5. Forms for sidewalks shall be of wood or metal, shall be straight and free from warp and shall be of sufficient strength, when in place, to hold the concrete true to line and grade without springing or distorting.

Section 4
Scope of Work and Technical Specifications
SECTION 32 12 16-8 REMOVING AND REPLACING PAVEMENT

6. Forms for curbs shall be metal and of an approved section.
 - a. They shall be straight and free from distortions, showing no vertical variation greater than 1/8 inch in 10 feet and no lateral variation greater than 1/4 inch in 10 feet from the true plain surface on the vertical face of the form.
 - b. Forms shall be of the full depth of the structure and constructed such as to permit the inside forms to be securely fastened to the outside forms.
7. Wood forms may be used on sharp turns and for special sections as approved by the Owner. Where wooden forms are used, they shall be free from warp and shall be the nominal depth of the structure.
8. All mortar and dirt shall be removed from forms and all forms shall be thoroughly oiled or wetted before any concrete is deposited.
- B. When a section is removed, the existing sidewalk or curb shall be cut to a neat line, perpendicular to both the centerline and the surface of the concrete slab.
- C. Existing concrete shall be cut along the nearest existing construction joints. If such joints do not exist, the cut shall be made at minimum distances shown on the Drawings.
- D. Existing concrete sidewalks and curbs that have been cut and removed for construction purposes shall be replaced with the same width and surface as the portion removed.
- E. Sidewalks shall have a minimum uniform thickness of 4 inches. The new work shall be neatly jointed to the existing concrete so that the surface of the new work shall form an even, unbroken plane with the existing surfaces.
- F. The subgrade shall be formed by excavating to a depth equal to the thickness of the concrete, plus 2 inches.
 1. Subgrade shall be of such width as to permit the proper installation and bracing of the forms.
 2. Subgrades shall be compacted by hand tamping or rolling. Soft, yielding or unstable material shall be removed and backfilled with satisfactory material.
 3. Place 2 inches of porous crushed stone under all sidewalks and curbs and compacted thoroughly, then finish to a smooth, unyielding surface at proper line, grade and cross section.
- G. Joint for Curbs

Section 4
Scope of Work and Technical Specifications
SECTION 32 12 16-9 REMOVING AND REPLACING PAVEMENT

1. Joints shall be constructed as indicated on the Drawings and as specified. Construct joints true to line with their faces perpendicular to the surface of the structure and within 1/4 inch of their designated position.
2. Thoroughly spade and compact the concrete at the faces of all joints filling all voids.
3. Install expansion joint materials at the point of curve at all street returns. Install expansion joint material behind the curb at abutment to sidewalks and adjacent structures.
4. Place contraction joints every 10 feet along the length of the curbs and gutters.
 - a. Form contraction joints using steel templates or division plates which conform to the cross section of the structure.
 - b. Leave the templates in place until the concrete has set sufficiently to hold its shape, but remove them while the forms are still in place.
 - c. Contraction joint templates or plates shall not extend below the top of the steel reinforcement or they shall be notched to permit the reinforcement to be continuous through the joint.
 - d. Contraction joints shall be a minimum of 1 1/2 inches deep.

H. Expansion joints shall be required to replace any removed expansion joints or in new construction wherever shown on the Drawings. Expansion joints shall be true and even, shall present a satisfactory appearance, and shall extend to within 1/2 inch of the top of finished concrete surface.

I. Finishing

1. Strike off the surface with a template and finish the surface with a wood float using heavy pressure, after which, contraction joints shall be made and the surface finished with a wood float or steel trowel.
2. Finish the face of the curbs at the top and bottom with an approved finishing tool of the radius indicated on the Drawings.
3. Finish edges with an approved finishing tool having a 1/4 inch radius.
4. Provide a final broom finish by lightly combing with a stiff broom after troweling is complete.
5. The finished surface shall not vary more than 1/8 inch in 10 feet from the established grade.

3.05 RESTORING DRIVEWAY PAVEMENTS

Section 4
Scope of Work and Technical Specifications
SECTION 32 12 16-10 REMOVING AND REPLACING PAVEMENT

A. The Contractor shall repair or replace all driveway sections disturbed by the process of the work.

1. Driveways shall be constructed of the same materials and to the same thickness of the adjoining wearing surface.
2. In restoring driveways, the subsoil and foundation material shall be well compacted so as to prevent any future settlement or cracking of the driveway pavement.
3. Where necessary to cut a concrete driveway, the cuts shall be made with a masonry saw providing a smooth, straight line completely across the driveway.
4. Partial cut-outs, crooked cuts or cuts made by any methods other than masonry saw are not permitted. In general, where directed, concrete slab removal shall be made in entire pavement sections to the nearest existing expansion-joint.

B. Driveway and Sidewalk Ramp Openings

1. Provide driveway openings of the widths and at the locations indicated on the Drawings and as directed by the Owner.
2. Provide sidewalk ramp openings as indicated on the Drawings in conformance with the applicable regulations and as directed by the Owner.

C. Concrete shall be suitably protected from freezing and excessive heat. It shall be kept covered with burlap or other suitable material and kept wet until cured. Provide necessary barricades to protect the work. All damage caused by people, vehicles, animals, rain, the Contractor's operations and the like shall be repaired by the Contractor, at no additional expense to the Owner.

3.06 MAINTENANCE

A. The Contractor shall maintain the surfaces of roadways built and pavements replaced until the acceptance of the Project.

1. Maintenance shall include replacement, scraping, reshaping, wetting and rerolling as necessary to prevent raveling of the road material, the preservation of reasonably smooth surfaces and the repair of damaged or unsatisfactory surfaces, to the satisfaction of the Owner.
2. Maintenance shall include sprinkling as may be necessary to abate dust from the gravel surfaces.

3.07 SUPERVISION AND APPROVAL

Section 4
Scope of Work and Technical Specifications
SECTION 32 12 16-11 REMOVING AND REPLACING PAVEMENT

- A. Pavement restoration shall meet the requirements of the regulatory agency responsible for the pavement. Obtain agency approval of pavement restorations before requesting final payment.
- B. Obtain the Owner's approval of restoration of pavement, such as private roads and drives, that are not the responsibility of a regulatory agency.
- C. Complete pavement restoration as soon as possible after backfilling.
- D. Failure of Pavement: Should any pavement restoration or repairs fail or settle during the life of the Contract, including the bonded period, promptly restore or repair defects.

3.08 CLEANING

- A. The Contractor shall remove all surplus excavation materials and debris from the street surfaces and rights of way and shall restore street, roadway or sidewalk surfacing to its original condition. The right-of-way shall be restored to its original condition.

END OF SECTION

SECTION 32 14 33

PERMEABLE PLASTIC PAVING

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Base material, over sub base prepared by others.
- B. Porous pavement system with S-flexural joints for seasonal expansion and contraction.
- C. Parking, fire lane, and traffic delineation.
- D. Gravel fill.
- E. Grass fill.

1.02 RELATED REQUIREMENTS

- A. None.

1.03 PREINSTALLATION MEETINGS

- A. Convene pre-installation meeting a minimum of two weeks prior to start of porous paving systems Specifier Notes:
- B. Verify project requirements, subbase and base conditions, manufacturer's installation instructions and coordinate with other related work.
- C. Require attendance of parties directly affecting work of this section, including the contractor, architect, engineer, and installer. Manufacturer's representative may attend by phone conference as needed.

1.04 SUBMITTALS

- A. Submit under provisions of Section 01.
- B. Product Data: Submit manufacturer's product data.
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Installation methods.
- C. Shop drawings: Submit manufacturer's shop drawings including laying pattern and parking delineation locations.
- D. Samples: Submit two square samples of TRUEGRID Paver units.

E. LEED and other Sustainable Design Submittals: Provide documentation of how the requirements for credit/certification will be met including, but not limited to: Recycled content, stormwater management, heat-island mitigation, water use reduction, site development, and regional materials.

F. Manufacturer's Certificates: Certify products meet or specified requirements.

G. Closeout Submittals: Provide manufacturer's maintenance instructions that include recommendations for periodic fertilizing and maintenance.

1.05 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Manufacturer with a minimum of five years documented experience with products specified.

B. Installer Qualifications: Installer experienced in performing work of this section that has specialized in installation of work similar to that required for this project. Installer must also be able to provide skilled workman with satisfactory record of performance on landscaping or paving projects of comparable size and quality.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Protect porous paver units from damage during delivery and store under tarp when the time from delivery to installation exceeds 30 days.

C. Protect materials during handling and installation to prevent damage.

1.07 SEQUENCING

A. Ensure that products of this section are supplied to affected trades in time to prevent interruption of construction progress.

1.08 PROJECT CONDITIONS

A. Maintain environmental conditions recommended by manufacturer for desired results. Do not install products under conditions outside manufacturer's absolute limits.

B. Do not begin installation of porous pavements until all hard surface paving adjacent to porous pavement areas, including concrete walks and asphalt paving, is completed.

C. Install turf when ambient air temperature is at least 55 degrees F.

D. In wet weather, do not build on wet, saturated or muddy subgrade.

E. In cold weather, do not use frozen materials or materials coated with ice or frost, and do not build on frozen base or wet, saturated or muddy subgrade.

F. Protect partially completed porous paving against damage from other construction traffic when work is in progress.

G. Protect grass fill / sodded paving areas from traffic until grass root system has matured for at least 3 to 4 weeks. Use barricades to only permit access by emergency and fire equipment.

1.09 WARRANTY

A. Provide the manufacturer's 10-year limited warranty.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Acceptable Manufacturer: Airlite Plastics Co. DBA TRUEGRID Pavers, 6110 Abbott Dr, Omaha, NE 68110. Phone: 1-855-355-GRID. Email: info@truegridpaver.com Website: www.truegridpaver.com.

B. Approved Equal.

2.02 PRODUCTS

A. Permeable Pavers, TRUEGRID PRO PLUS for grass or gravel applications.

1. AASHTO H20, HS20 Rated.
2. Manufactured in the USA.
3. High density polyethylene (HDPE): 100 percent post-consumer recycled materials
4. Recycled and recyclable content: 100 percent.
5. S-Flexural joints molded in for soil seasonal expansion and contraction.
6. Color: black- carbon black additive for long-term UV stabilization.
7. Paver size: 24 inches by 24 inches by 1.8 inches.
8. Pre-assembled: 4-foot by 4-foot sections.
9. Cylindrical cell design for column strength.
10. Cell size: 3.30 inch inside diameter.
11. Co-joined cells at 48 places for strength.
12. Wall thickness: 0.150 inches /.250-inch nominal.
13. A minimum of 2 co-joined common walls per cell for structural integrity.
14. Connections:

Section 4
Scope of Work and Technical Specifications
SECTION 32 14 33-4 PERMEABLE PLASTIC PAVING

- a. No clips or stakes necessary.
 - b. No additional parts or tools needed.
 - c. Integral male-female three-point locking system.
 - d. Wall thickness at tabs: 0.290 inch.
- 15. Molded in X-anchors to stabilize pavers.
- 16. Nominal Coverage per Paver: 4 square feet.
- 17. Weight per paver: 5.25 lbs.
- 18. Permeability of System: 100 percent.
- 19. Compressive Strength (filled): 17,729 psi.
- 20. Material Safety: Groundwater neutral, 100 percent inert.
- 21. Chemical Resistant: Excellent: highly resistant to hydrocarbons, oils.
- B. Parking Delineators: TRUEGRID SuperSpots for grass or gravel applications.
 - 1. H20, HS20 rated.
 - 2. Domed for high visibility and ribbed for high strength.
 - 3. 0.90-inch profile above grid.
 - 4. Long-term UV stabilized.
 - 5. 3.25-inch diameter.
 - 6. Available Colors: Yellow, white, blue, and red.
- C. Parking Delineators: TRUEGRID SnowSpots for grass or gravel applications.
 - 1. H20, HS20 rated.
 - 2. Snow plowable and ADA compliant.
 - 3. Level (0.00-inch) profile above grid.
 - 4. Long-term UV stabilized.
 - 5. 3.25-inch diameter.
 - 6. Available Colors: Yellow, white, blue, and red
- D. Reflective Parking Delineators: TRUEGRID Reflectors for grass or gravel applications.
 - 1. H20, HS20 rated.

Section 4
Scope of Work and Technical Specifications
SECTION 32 14 33-5 PERMEABLE PLASTIC PAVING

2. Long-term UV stabilized.
3. 0.90-inch profile above grid.
4. 3.25-inch diameter.
5. Available Colors: Translucent yellow, white, and red.

E. Surface Signage, ADA, Traffic, and Parking Identifiers: TRUEGRID Plates for grass or gravel applications.

1. Durable, long lasting, weather resistant and highly visible.
2. Snap-fit into TRUEGRID PRO PLUS grid.
3. 0.20-inch profile above grid
4. ADA compliant.

F. Base Material: TRUEGRID PRO PLUS was developed to accept multiple acceptable base materials. Locally sourced angular stone/clean for base material. Crushed granite, sandy gravel material, crushed concrete, and limestone rock are some of the acceptable materials. Common base materials include:

1. Hard, clean, angular, and open-graded (uniform size) drain rock -- from 1" to 1-1/2" (19mm to 38mm). Commonly #4 stone when size limits are met.
2. Base Course: Graded aggregate base course conforming to the following sieve analysis and requirements:
 - a. Percent Passing: 100 - Sieve Size: 3/4 – 1 inch
 - b. Percent Passing: 85 - Sieve Size: 3/8 inch
 - c. Percent Passing: 60 - Sieve Size: #4
 - d. Percent Passing: 30 - Sieve Size: #40
 - e. Percent Passing: <3 - Sieve Size: #200, or 3 to 8 Percent for Grass Infill

G. Gravel Fill: Obtain clean, washed angular rock to fill the 1.8-inch-tall TRUEGRID PRO PLUS cells and spaces between. TRUEGRID PRO PLUS should be filled level to the top of the cells or only slightly above for compaction and settling. Fill rock should be 5/8 inch to 3/4-inch diameter.

H. Base Course for Grass Filled TRUEGRID: Use base course from above Section 2.2 F 2 or comparable base material suitable for grass growth and traffic loads. Choose materials with neutral pH ranges and avoid sources from recycled/reclaimed concrete or asphalt.

- I. Grass Surface with Soil Fill: A sandy loam or loam soil should be used to fill the empty TRUEGRID PRO PLUS grid. The selection of sandy loam or loam soil should be made based upon the soil requirements of the turf variety selected for the project. Other soils if compatible with type of seed or sod are acceptable.
 - 1. Choose turf grasses with deep-growing vertical roots, high wear capacity, and for the local growing zone and climate.
 - 2. Grass – Choose either sod or seed:
 - a. Seed – The Preferred Method: Hydro-seeding/mulching is recommended with a wood or paper cellulose commercial mulch.
 - b. Sod shall be grown in sand or sandy loam soils only. Sod grown in soils of clay, silt, or high organic materials such as peat, will not be accepted.
- J. Base Course for Sloped Areas Above 3 degrees (5%): Use base course from above Section 2.2 F 2 or other dense-graded base common for road use.
- K. Geotextile Fabric, Geomembrane, or Geogrid by Others.
 - 1. Choose for properties suitable for soil conditions, loading requirements, and permeability / impermeability requirements.
- L. Anchor Nails by others.
 - 1. 3/8-inch by 10-inch galvanized ring shank nail common for landscape use.
 - a. Choose for high frequency traffic areas, areas with breaking and acceleration, transitions, and areas subject to surface water from other sources.
 - b. For sloped areas above 3 degrees (5%).

PART 3 EXECUTION

3.01 EXAMINATION

- A. Before beginning installation, verify site conditions are as indicated on the drawings. Notify the Architect if site conditions are not acceptable. Do not begin preparation or installation until unacceptable conditions have been corrected.
- B. Ensure that adjacent hard-surfaced paving work is completed before installing porous pavement system.

3.02 PREPARATION

- A. Subgrade:

1. Prepare subgrade as specified in Section 31 20 00. Verify subgrade in accordance with porous paving system manufacturer's instructions.
 2. Excavate area allowing for unit thickness and the engineered base depth (where required).
 3. Provide adequate drainage from excavated area if area has potential to collect water when working with in-place soils that have poor permeability.
 4. Ensure in-place soil is relatively dry and free from standing water.
 5. Uniformly grade base.
 6. Level and clear base of large objects, such as rocks and pieces of wood.
 7. Install and secure geotextile fabric, geomembrane, or geogrid mesh as needed for soil stabilization and loading requirements.
- B. Install Base as specified in Section 31 20 00. Verify engineered base is installed in accordance with porous paving system manufacturer's instructions.
2. If required, place a geotextile separation layer between the natural ground and the engineered base.
 3. Place base course material over prepared sub base to grades indicated on the drawings or from manufacturer's recommended depths per application type.
 4. Place in lifts not to exceed 4 inches, compacting each lift separately to 95 percent Modified Proctor for non-open grade material. Open grade base material to be leveled and heavily compacted in 4-inch lifts to settle and lock in angular stone.
 5. Leave minimum 1.8 inches for Permeable Paver unit for final elevation.

3.03 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install TRUEGRID PRO PLUS Permeable Paver units by placing cells face up. Sheets are preassembled in 4-foot by 4-foot sheets are connected with friction fit interlocking connectors. No tooling is required to connect or disconnect units. Sheets may be separated into 4 Individual 24 inch by 24-inch pieces and reconfigured as needed. Cut units around curves and organic shapes with an electrical handsaw. Place units to maintain a 1-inch clearance to any pre-installed object or surface structure. Top of cells shall be level (0.00 inch) to 0.5 inch below the surface of adjacent hard-surface pavements. Utilize TRUEGRID's S-Flexural joints for undulations or grade reversals when required by design or in freeze-thaw climates for expansion and contraction.

C. Parking, Traffic, and Fire Lane Delineators: Install TRUEGRID SuperSpots, TRUEGRID SnowSpots, TRUEGRID Reflectors, and TRUEGRID Plates as indicated on the drawings or per manufacturer's recommendations.

1. Align SuperSpots, SnowSpots, Reflectors, and Plates locking tabs with grooves in TRUEGRID PRO PLUS grid.
2. Push SuperSpots, SnowSpots, Reflectors, and Plates into TRUEGRID PRO PLUS grid until it locks.
3. All TRUEGRID delineators and markers can be removed and repositioned by disconnecting the locking tabs and pulling out of the grid.

D. Anchors: Stake TRUEGRID PRO PLUS to the base as indicated on the drawings or per manufacturer's recommendations.

1. Pre-drill pilot hole with ¼" (6mm) through a PRO PLUS cell containing an X-Anchor.
2. Drive anchor until head makes contact with X-Anchor using a hammer or impact hammer with suitable driver head.

E. Gravel Surfacing: Install Gravel into TRUEGRID cavities by back dumping directly from dump truck or from buckets mounted to tractors. Hand shoveling fill gravel into the cells is also acceptable for smaller jobs.

1. Direct vehicles to exit the site by driving forward. Avoid sharp turns over unfilled rings.
2. Spread gravel fill using steer loaders, power brooms, blades, flat-bottomed shovels, and/or wide "asphalt rakes" to fill the cells.
3. Place and maintain infill gravel to be level to the top of the cell walls after settling, natural compaction, and use. A rolling compactor, plate compactor, or hand tamper may be used for final leveling of infill aggregate within the TRUEGRID cells.

F. Grass Surfacing:

1. Install soil into TRUEGRID cavities by back dumping directly from dump truck or from buckets mounted to tractors. Hand shoveling soil mix into the cells is also acceptable for smaller jobs.
 - a. For Seeding Applications: Fill soil mix level to the top of the TRUEGRID PRO PLUS cell wall, 1.8-inch depth.
 - b. For Sodding Applications: Fill soil mix into cells at 1.8-inch minus the root (soil) depth of the sod.

2. Hydroseeding/Hydro-Mulch Surfacing: Provide and place as specified in 32 92 00 – Turf and Grasses. Homogeneously mix a combination of water, seed, and fertilizer in a truck mounted tank. Spray the seed mixture onto the site at specification rates. Coverage should be uniform and complete. Following germination of the seed, areas lacking germination larger than 8-inches by 8-inches must be reseeded immediately. Seeded areas must be fertilized and kept moist during development of the turf.

3.04 PROTECTION

- A. Protect installed products until completion of project.
- B. Gravel fill: Avoid sharp turns or “jack knives” in trailered vehicles when cells are empty. Damage due to buckling can occur. TRUEGRID can be driven on pre-fill by gravel trucks and construction equipment to speed the installation process.
- C. Grass Fill / Seeded: Protect seeded areas from any traffic, other than emergency vehicles, for a period of 4 to 6 weeks, or until the grass is mature to handle traffic. Avoid sharp turns or “jack knives” in trailered vehicles when cells are empty. Damage due to buckling can occur.
- D. Grass Fill / Sodded: Sodded areas must be protected from any traffic, other than emergency vehicles, for a period of 3 to 4 weeks, or until root system has been established.
- E. Dumpster areas: A concrete pad is recommended for dumpster areas due to the drop and drag action. Permeable pavers are not recommended in these areas under and directly around the dumpster.
- F. Repair or replace damaged products before substantial completion.

3.05 MAINTENANCE

- A. For gravel fill surfaces, maintain the stone fill inside the TRUEGRID to be level to the cell wall height - level to the top of the grid. Surface should be inspected from time to time to identify signs of slight cell infill loss.
- B. Maintain grass in accordance with manufacturer's instructions and as specified in Section 32 92 00 – Turf and Grasses.
 - 1. Maintain the soil or growing media inside the TRUEGRID to be level to the cell wall height -- level to the top of the grid. Do not overfill with soil above grid.
- C. Monitor pavement to ensure traffic frequency and loading does not exceed the pavement design.
- D. When snow removal is required, keep a metal edged plow blade from coming in contact with the surface during plowing operations to avoid causing damage to the units.

Section 4
Scope of Work and Technical Specifications
SECTION 32 14 33-10 PERMEABLE PLASTIC PAVING

Use a plow blade a minimum of 1 inch above the surface and with a flexible rubber edge or with skids on the lower outside corners so the plow blade does not come in contact with the units.

END OF SECTION

SECTION 32 31 13

CHAIN LINK FENCES AND GATES

PART 1 – GENERAL

1.01 SECTION INCLUDES

- A. This section includes requirements and specifications for chain link fencing and gates for site perimeter and areas requiring separation.

1.02 RELATED SECTIONS

- A. Section 03 30 00 – Cast-In-Place Concrete

1.03 SUBMITTALS

- A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.

1.04 QUALITY ASSURANCE

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers that have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

1.05 REFERENCE STANDARDS

- A. ASTM F 567 – Standard Practice for Installation of Chain-Link Fence; current edition.
- B. ASTM F 668 – Standard Specification for Polyvinyl Chloride (PVC) and Other Organic Polymer-Coated Steel Chain-Link Fence Fabric; current edition.
- C. ASTM F 934 – Standard Specification for Standard Colors for Polymer-Coated Chain Link Fence Materials; current edition.
- D. ASTM F 1083 – Standard Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures; current edition.
- E. CID A-A-1928 – Padlocks; current edition.
- F. Fed.Spec. RR-F-191/2 – Fencing, Wire and Post, Metal (Chain-Link Fence Gates); current edition.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Steel Chain-Link Fence Fabric:

1. Polymer Coated Steel Fabric: ASTM F 668, wire gauge specified is that of the metallic coated steel core wire, Class 1 extruded, Color: black in compliance with ASTM F 934.

B. Framework:

1. Acceptable Types:
 - a. ASTM F 1083, galvanized round steel pipe, standard weight (schedule 40), hot dip galvanized with not less than 1.8 oz./sq. ft.
 - b. Round steel pipe from ASTM A 1011 or ASTM A 653 steel; 50,000 psi minimum yield strength; in compliance with AASHTO M181 requirements for interior and exterior coatings.
2. Line Posts: 2.375 inches O.D.
3. End, Corner, and Pull posts: 2.875 inches O.D.
4. Gate Posts (for nominal width of gate leaf):
 - a. Up to 6 feet – 2.875 inches O.D.
 - b. 6 to 13 feet – 4.000 inches O.D.
 - c. 13 to 18 feet – 6.625 inches O.D.
 - d. Over 18 feet – 8.625 inches O.D.
5. Top Rail: 1.66 inches O.D.; not less than 18 foot lengths; with expansion type couplings not less than six inches long; provided with means for securely attaching top rail to each end, corner, pull, and gate post.
6. Brace Rail: 1.66 O.D.; trussed to line posts with 3/8 inch diameter rod and adjustable tightener.
7. Gate Frame: Fed.Spec. RR-F-191/2; Type(s) [I, single swing] [II, double swing] [III, single cantilever sliding, wheel sliding]. Shape and size of the gate frame shall be as indicated. Framing and bracing members shall be round or square of steel or aluminum alloy. Steel member finish shall be zinc coated. Gate fabric shall be as specified herein for chain-link fencing fabric. Special gate frames shall be as indicated. Gate leaves more than 8 feet wide shall have intermediate members as necessary to provide rigid construction, free from sag or twist. Gate leaves less than eight feet wide shall have truss rods or intermediate braces. Attach gate fabric to the gate frame by method standard

with the manufacturer, except that welding will not be permitted. Arrange padlocking latches to be accessible from both sides of the gate regardless of latching arrangement.

- C. Post Tops: Combination with single, 45-degree barbed wire supporting arm; furnished with opening to permit passage of top rail; hot dip galvanized steel; fitted with clips or other means for attaching three rows of barbed wire; of sufficient strength to withstand a weight of 250 pounds applied at outermost end.
- D. Couplings, Bands, Clips, Wire Ties, Tension Bars, Fasteners, and Fittings: Hot dip galvanized steel.
- E. Bottom Tension Wire: 7 gage, coil-spring wire, galvanized or aluminized steel.
- F. Barbed Wire: 12-1/2 gage wire, two (2) strands, with 14 gage, 4-point barbs at not more than five inches o.c.; galvanized or aluminized steel.
- G. Gate Hardware (Latches, Hinges, Stops, Keepers, and Accessories): Zinc-coated steel, with weight of zinc-coating not less than 2.0 ounces per square foot.
 - 1. Hinges: Non-lift-off type, offset to permit 180 degree gate opening; three hinges per gate leaf.
 - 2. Latches:
 - a. Single Gate Latches: Gravity drop bar type with positive locking features.
 - b. Double Gate Latches: A positive locking gravity device.
 - 3. Keepers: Mechanical device that automatically engages gate leaf and holds it in open position until manually released; provided at vehicle gates.
 - 4. Stops: Gate stop pipe to engage center drop rod; provided at double gates.
 - 5. Padlocks: CID A-A-1928, Type EPB, 1 3/4-inch size, with chain.
- H. Concrete: As specified in Section 03 30 00 – Cast-In-Place Concrete.

PART 3 – EXECUTION

3.01 INSTALLATION

- A. Install materials in accordance with manufacturer's instructions and approved submittals. Comply with ASTM F 567. Install materials in proper relation with adjacent construction and with uniform appearance. Coordinate with work of other sections. Install posts to depth to avoid frost heave.
- B. Cut pipe with pipe-cutters only. Cutting with backsaws is not acceptable. Tack weld gates for strength. Use spring-loaded latches, not yokes.
- C. Restore or replace damaged components. Clean and protect work from damage.

END OF SECTION

SECTION 32 73 00

WETLANDS PROTECTION

PART 1 - GENERAL

1.01 SUMMARY

A. SECTION INCLUDES:

Section	Title
1.02	References
1.03	Definitions
1.04	Overview
1.05	Work Included
1.06	Submittals
3.01	Conditions Applicable Only to Specific Nationwide Permits
3.02	Construction Activities Near Wetlands
3.03	Enforcement

B. RELATED SECTIONS

The following listed sections do not purport to be all inclusive, as it is the Contractor's responsibility to do all the Work in accordance with the Contract Documents.

1. Clearing and Grubbing (31 11 10).
2. Trench Excavation and Backfill (31 23 00).
3. Erosion and Sedimentation Controls (31 25 00).
4. Tree Removal and Protection (32 92 10)
5. Seeding (32 92 19).
6. Plants (32 93 00)

1.02 REFERENCES

- A. Drawings and general provisions of the Contract, including general and supplementary conditions and Division 1 Specification Sections, apply to this section.

1.03 DEFINITIONS

- A. Contractor: For the purposes of this item, the term "Contractor" is synonymous with Contractor, General Contractor, Discharger, Operator, and Primary Permittee, as

used in the Individual, or Nationwide Permit language, as it relates to laws, rules, regulations, ordinances and other wetland protection and permitting references.

B. Designer: For the purpose of this item, the term “Designer” means the person who has designed and stamped the Erosion Sedimentation and Pollution Control Plan, as used in language of permits, laws, rules, regulations, ordinances, and other soil erosion and sediment control references. This person has successfully obtained Georgia professional registration, met certain education requirements, and been certified as Level II Certified Design Professional, as prescribed by the Georgia Soil and Water Conservation Commission in consultation with the Georgia EPD and the Stakeholder Advisory Board.

C. Qualified Person: For the purposes of this item, the term “Qualified Person” means a person, as used in language of permits, laws, rules, regulations, ordinances, and other soil erosion and sediment control references, who has successfully met certain education requirements and been certified as Level 1A, as prescribed by the Georgia Soil and Water Conservation Commission in consultation with the Georgia EPD and the Stakeholder Advisory Board.

D. Other Definitions: Definitions as listed in the NPDES General Permit GAR 100002, Part I.B. shall apply in this section.

1.04 OVERVIEW

A. Contractor shall meet minimum requirements for complying with Federal Register Code of Federal Regulations (CFR) 33, Part 330.

1. Wetlands: Wetland areas shall be indicated on the Drawings, or identified in the field by the Designer.

2. Compliance: In accordance with General Conditions of the NWP, the Contractor shall comply with the current Section 33 CFR Part 330, as well as all laws, rules, regulations, ordinances, and/or other requirements concerning wetlands protection and permitting designated and established by the United States, the State of Georgia, or Gwinnett County.

3. Time: Land disturbing activities are not authorized to begin until after all required wetland permits and buffer variances are obtained from the U.S. Army Corps of Engineers (USACE), the State of Georgia, and Gwinnett County.

4. For the purposes of this item, the Designer may at any time during the project, provide direction.

1.05 WORK INCLUDED

A. The Contractor is responsible for using construction techniques and implementing other measures that ensure compliance with all of the general and specific conditions prescribed in Federal Register 33 CFR Part 330, as prescribed in the Final

Notice of Issuance, Reissuance, and Modification of Nationwide Permits (NWP) in the Federal Register (Volume 61, Number 241) on December 13, 1996, or most current version. In addition, the Contractor is also responsible for complying with all project-specific conditions indicated on the Drawings, and in the Contract Documents. This item covers the Work necessary to comply with the above referenced regulations before, during, and after construction in, and adjacent to, wetlands. The Contractor shall furnish all material and labor necessary for compliance with Federal Register 33 CFR Part 330 under this item.

1.06 SUBMITTALS

A. Contractor shall submit, in accordance with Section 01 33 00 SUBMITTAL PROCEDURES, all working drawings and schedules of materials and methods proposed to be followed in the execution of the Work under this item, the following documents for approval:

Spill Plan: The Contractor shall prepare a Spill Plan that addresses handling of fuels, lubricants, chemicals, and other toxic materials that may be used. The plan must include:

1. Identification of refueling sites.
2. Identification of storage areas for fuels, lubricants, chemicals, and other toxic materials.
3. Procedures for refueling and maintaining pontoon-mounted backhoes, trench dewatering pumps, and other similar equipment used in wetlands or other water bodies.
4. Contingency plan for cleaning up spills and other releases of fuels, lubricants, chemicals, and other toxic materials.

B. Certification of Completed Work: The Contractor shall submit to the Engineer a signed certification regarding the completed Work and any required mitigation. GCDWR shall forward this certification to the USACE with the authorization letter. The certification shall include:

1. A statement that the authorized Work was done in accordance with the USACE authorization, including any general or specific conditions,
2. A statement that any required mitigation was completed in accordance with the permit conditions if completed by the Contractor,
3. The signature of the Contractor certifying the completion of the Work and mitigation if completed by the Contractor.

PART 2 – PRODUCTS

(NOT USED)

PART 3 - EXECUTION

3.01 CONDITIONS APPLICABLE ONLY TO SPECIFIC NATIONWIDE PERMITS

A. The following sections of this item describe conditions specific to certain NWP's. Based on the permits granted by the USACE for a specific project, GCDWR or Designer shall notify the Contractor of the applicability of the following terms and conditions:

1. NWP 12 - Utility Line Activities: The Contractor shall meet the following requirements for those areas covered under NWP 12.
 - a. Temporary Sidecast: Material resulting from trench excavation may be temporarily sidecast (for up to three months) into waters of the United States, provided that the material is not placed in such a manner that it is dispersed by currents or other forces. GCDWR cannot extend this time period without approval from the USACE. As such, the Contractor must provide the Engineer with at least 30 days notice if an extension to the temporary side-cast time limit is desired (such a request does not guarantee approval of the extension, and does not release the Contractor from the responsibility to comply with the requirements of this Section).
 - b. Disturbed Area: The area of Waters of the United States that is disturbed must be limited to the minimum necessary to construct the utility line.
 - c. Trench Backfill: In wetlands, the top 6" to 12" of the trench must be backfilled with topsoil from the trench, unless otherwise authorized by the USACE, the State of Georgia, and the Designer.
 - d. Excess Material: Excess material must be removed to upland areas within 24 hours of completion of construction.
 - e. Exposed Slopes: Any exposed slopes and stream banks must be stabilized within 24 hours of completion of the utility line.
2. NWP 13 - Bank Stabilization: The Contractor shall meet the following requirements for those areas covered under NWP 13:
 - a. Material Placement: No material may be placed in excess of the minimum needed for erosion protection.
 - b. Bank Stabilization: The bank stabilization activity must be less than 500 feet in length.
 - c. Activity Limitations: The activity must not exceed an average of one (1) cubic yard per running foot placed along the bank below the plane of the ordinary high water mark or the high tide line.

Section 4
Scope of Work and Technical Specifications
SECTION 32 73 00-5 WETLANDS PROTECTION

- d. Special Aquatic Site: No material may be placed in any special aquatic site, including wetlands.
 - e. Flow Into and Out of Wetlands: No material may be of the type, or placed in any location or in any manner so as to impair surface water flow into or out of any wetland area.
 - f. Erosion by Flows: No material may be placed in a manner that shall be eroded by normal or expected high flows (properly anchored trees and treetops may be used in low energy areas).
3. NWP 14 – Linear Transportation Projects: The Contractor shall meet the following requirements for those areas covered under NWP 14.
- a. Width of Fill: The width of the fill must be limited to the minimum necessary for the actual crossing.
 - b. Limitations of Fill: A fill placed in Waters of the United States must be limited to a filled area of no more than 1/3 acre. Furthermore, no more than a total of 200 linear feet of the fill for the roadway can occur in special aquatic sites, including wetlands.
 - c. Crossing Design: The crossing must be culverted, bridged, or otherwise designed to prevent the restriction of, and to withstand, expected high flows, and to prevent the restriction of low flows and the movement of aquatic organisms.
 - d. Single Project: The crossing, including all attendant features, both temporary and permanent, must be part of a single and complete project for crossing of Waters of the U.S.
 - e. Prevention of Sedimentation: The crossing must be constructed in such a manner so as to preclude sedimentation of downstream areas.
4. NWP 18 - Minor Discharges: The Contractor shall meet the following requirements for those areas covered under NWP 18.
- a. Quantity of Discharged Material: The quantity of discharged material and the volume of the excavated area cannot exceed 25 cubic yards below the plane of the ordinary high water mark.
 - b. Special Aquatic Site: The discharge cannot cause the loss of more than 1/10 acre of a special aquatic site, including wetlands. This acreage limitation includes the filled area, and excavated area, plus special aquatic sites that are adversely affected by flooding and special aquatic sites that are drained so that they would no longer be Waters of the U.S. as a result of the project.

5. NWP 33 - Temporary Construction, Access and Dewatering: The Contractor shall meet the following requirements for those areas covered under NWP 33:

- a. Downstream Flows: Appropriate measures must be taken to maintain normal downstream flows and to minimize flooding.
- b. Placement of Fill: Fill must be of materials, and placed in a manner, such that it shall not be eroded by expected high flows.
- c. Dredged Material: The use of dredged material may be allowed only if authorized by the Engineer after consultation with the USACE, the State of Georgia, and the Designer to determine adverse effects on aquatic resources.
- d. Temporary Fill: Temporary fill must be entirely removed to upland areas, or dredged material returned to its original location, following completion of the construction activity, and the affected areas must be restored to the pre-project conditions.
- e. Cofferdams: Cofferdams cannot be used to dewater wetlands or other aquatic areas so as to change their use.
- f. Navigable Waters: Structures located in navigable Waters of the United States must not be left in place after cofferdams are removed, unless authorized by the Engineer after obtaining a Section 10 Permit.

6. NWP 35 - Maintenance Dredging of Existing Basins: The Contractor shall meet the following requirements for those areas covered under NWP 35.

- a. Dredged Material: Dredged material must be disposed of at an upland site.
- b. Siltation Control: Proper siltation control measures must be used.

3.02 CONSTRUCTION ACTIVITIES NEAR WETLANDS

A. The Contractor shall complete the following:

- 1. Marking of Locations: Wetland locations affected by the project shall be permanently marked (surveyed, staked, and flagged) so that inadvertently removed markers can be relocated. The marking shall be clearly visible to all site personnel and equipment operators. Markings shall be maintained during the construction period.
- 2. Access: All site personnel, including all equipment operators, shall use pre-designated access and egress points to the site and pre-designated access roads within the construction site. No access or egress point shall be located in a wetland or other Waters of the United States. Access roads through wetlands

and other Waters of the United States shall be limited to those approved by the USACE, State of Georgia, and the Designer.

3. **Staging Areas:** All staging areas, spoil storage areas, and additional work areas shall be placed at least 50 feet from wetlands and other water bodies. No clearing of vegetation between these areas and adjacent wetlands is permitted.
4. **Right-of-Way Stabilization:** Dirt, rock fill, tree stumps, brush, rip rap, or other material that would not promote a natural system shall not be used to stabilize a right-of-way.
5. **Equipment:** Low-ground-weight equipment shall be used, or conventional equipment shall be operated from mats or other approved bedding material in wetlands and other water bodies.
6. **Trench Breakers:** Trench breakers shall be constructed or the bottom of the trench shall be sealed with approved material in areas where the trench could drain adjacent wetlands or other water bodies.
7. **Equipment, Fuel, and Hazardous Material Storage:** Equipment, fuels, and hazardous materials shall be stored at least 100 feet from wetlands and other water bodies. In addition, land-based equipment shall not be refueled or maintained within 100 feet of a wetland or other water body.
8. **Sediment and Erosion Control:** Appropriate sediment and erosion control devices shall be installed and maintained to prevent sediment or other materials from reaching adjacent wetlands and water bodies. All exposed soil and other fills, as well as any Work below the ordinary high water mark, must be permanently stabilized at the earliest practicable date. Erosion and sediment control devices shall be installed in advance of the start of construction and shall be maintained in accordance with Specification Section 31 25 00 Erosion and Sedimentation Controls.
9. **Crossings:** Wetland and water body crossings shall be limited to the minimum size required to safely construct the project. Crossings shall be constructed perpendicular to the water body channel, unless prior approval for other methods is obtained from the Engineer, the USACE, the State of Georgia, and the Designer.
10. **Flow in Water Bodies:** Flows in all water bodies affected by a project shall be maintained at all times unless prior approval is obtained from the Engineer, the USACE, the State of Georgia, and the Designer.
11. **Water Quality Standards:** State water quality standards in streams and other water bodies affected by or adjacent to the project area shall be maintained in accordance with Georgia EPD Section 4 of Georgia's Rules and Regulations for Water Quality Control (Chapter 391-3-6-.03). Water quality in adjacent

waterways shall be maintained as specified by the Engineer, the USACE, the State of Georgia, and the Designer.

12. **Schedule:** All wetland and water body crossings shall be completed using a compressed schedule to minimize disturbance in these areas.

13. **Temporary Roads and Bridges:** Temporary roads and bridges shall be removed as soon as the wetland or water body permanent crossing has been constructed and the project has been completed.

14. **Metropolitan River Protection Act:** The terms, provisions, and requirements of the Metropolitan River Protection Act shall be abided by at all times.

15. **Restoration:** Disturbed areas shall be restored through seeding and planting of trees and shrubs as directed by the Engineer, the USACE, the State of Georgia, and the Designer. Liquid and granular fertilizers shall not be spread within 25 feet of the stream bank.

16. **Long-Term Maintenance:** The site shall be inspected as specified by the Engineer, the USACE, the State of Georgia, and the Designer to assure re-establishment of vegetation.

17. **Topsoil:** Topsoil shall be segregated from spoil and stored within sediment-filtering enclosures. Topsoil shall be backfilled into the top 6-12 inches of any trench through wetlands.

18. **Access Barriers:** Barriers shall be installed to prevent access to the site and any adjacent rights-of-way by off-road vehicles.

19. **Navigation:** No activity may cause more than a minimal adverse effect on navigation.

20. **Maintenance:** Any structure or fill authorized by the Permit shall be properly maintained, including maintenance to ensure public safety.

21. **Aquatic Life Movements:** No activity may substantially disrupt the movement of those species of aquatic life indigenous to the water body, including those species which normally migrate through the area, unless the activity's primary purpose is to impound water. The Contractor shall not construct perennial water body crossings from March 1 through May 30 unless otherwise authorized by the USACE, the State of Georgia, and the Designer.

22. **Regional and Case-by-Case Conditions:** The activity must comply with any regional or case-by-case conditions which may have been added by the USACE.

23. Wild and Scenic Rivers: No activity may occur in a component of the National Wild and Scenic River system, or in a river officially designated by Congress, as a study river for possible inclusion in the system.
24. Tribal Rights: No activity or its operation may impair reserved tribal rights, including but not limited to, reserved water rights and treaty fishing and hunting rights.
25. Endangered Species: No activity is authorized under any NWP which is likely to jeopardize the continued existence of a threatened or endangered species, or a species proposed for such designation as identified under the Federal Endangered Species Act, or which is likely to destroy or adversely modify the critical habitat of such species.
26. Historic Properties: No activity which may affect historic properties listed, or eligible for listing in the National Register of Historic Places, is permitted unless authorized by GCDWR, State Historic Preservation Office (SHPO), the USACE, the State of Georgia, and the Designer (33 CFR part 325, appendix C).
27. Discharge of Dredged or Fill Material: The following conditions apply to activities that involve the discharge of dredged or fill material into waters of the U.S.:
 - a. Water Supply Intakes: No discharge of dredged or fill material may occur in proximity to a public water supply intake except where the discharge is for repair of the public water supply intake structures and/or adjacent bank stabilization.
 - b. Suitable Material: No discharge of dredged or fill material may consist of unsuitable material (e.g., trash, debris, car bodies, asphalt, etc.) and material discharged must be free from toxic pollutants in toxic amounts (as defined in section 307 of the Clean Water Act).
 - c. Spawning Areas: Discharges in spawning areas during spawning seasons must be avoided to the maximum extent practicable. The Contractor shall not construct perennial water body crossings from March 1 through May 30 unless otherwise authorized by GCDWR, USACE, the State of Georgia, and the Designer.
 - d. Obstruction of High Flows: Discharges must not permanently restrict or impede the passage of normal or expected high flows or cause the relocation of the water (unless the primary purpose of the fill is to impound waters) unless authorized by GCDWR, the USACE, the State of Georgia, and the Designer.
 - e. Adverse Effects from Impoundments: If the discharge creates an impoundment of water, the accelerated passage of water and/or

Section 4
Scope of Work and Technical Specifications
SECTION 32 73 00-10 WETLANDS PROTECTION

restriction of its flow shall not adversely affect the aquatic system unless authorized by GCDWR, the USACE, the State of Georgia, and the Designer.

f. Waterfowl Breeding Areas: Discharges into breeding areas for migratory waterfowl must be avoided unless authorized by GCDWR, the USACE, the State of Georgia, and the Designer.

g. Removal of Temporary Fills: Any temporary fills must be removed in their entirety and the affected areas returned to their preexisting elevation.

3.03 ENFORCEMENT

A. The Contractor is responsible for conducting any restoration and/or paying any fine resulting from a violation of the requirements of these specifications or of an applicable permit or regulatory requirement (including work outside an easement). This responsibility is in effect even if the action is initially directed at GCDWR.

END OF SECTION

SECTION 32 91 13

SOIL PREPARATION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section includes planting soils and layered soil assemblies specified by composition of the mixes.
- B. Related Requirements:
 - 1. Section 31 10 00 - "Site Preparation" for topsoil stripping and stockpiling.
 - 2. Section 32 92 19 - "Seeding" for planting grasses and herbaceous seeds.
 - 3. Section 32 93 00 - "Plants" for placing planting soil for plantings.

1.03 ALLOWANCES

- A. Preconstruction and field quality-control testing is part of testing and inspecting allowance.

1.04 DEFINITIONS

- A. AAPFCO: Association of American Plant Food Control Officials.
- B. Backfill: The earth used to replace or the act of replacing earth in an excavation. This can be amended or unamended soil as indicated.
- C. CEC: Cation exchange capacity.
- D. Compost: The product resulting from the controlled biological decomposition of organic material that has been sanitized through the generation of heat and stabilized to the point that it is beneficial to plant growth.
- E. Duff Layer: A surface layer of soil, typical of forested areas, that is composed of mostly decayed leaves, twigs, and detritus.
- F. Imported Soil: Soil that is transported to Project site for use.
- G. Layered Soil Assembly: A designed series of planting soils, layered on each other, that together produce an environment for plant growth.
- H. Manufactured Soil: Soil produced by blending soils, sand, stabilized organic soil amendments, and other materials to produce planting soil.

- I. NAPT: North American Proficiency Testing Program. An SSSA program to assist soil-, plant-, and water-testing laboratories through interlaboratory sample exchanges and statistical evaluation of analytical data.
- J. Organic Matter: The total of organic materials in soil exclusive of undecayed plant and animal tissues, their partial decomposition products, and the soil biomass; also called "humus" or "soil organic matter."
- K. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified as specified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.
- L. RCRA Metals: Hazardous metals identified by the EPA under the Resource Conservation and Recovery Act.
- M. SSSA: Soil Science Society of America.
- N. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.
- O. Subsoil: Soil beneath the level of subgrade; soil beneath the topsoil layers of a naturally occurring soil profile, typified by less than 1 percent organic matter and few soil organisms.
- P. Surface Soil: Soil that is present at the top layer of the existing soil profile. In undisturbed areas, surface soil is typically called "topsoil"; but in disturbed areas such as urban environments, the surface soil can be subsoil.
- Q. USCC: U.S. Composting Council.

1.05 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include recommendations for application and use.
 - 2. Include test data substantiating that products comply with requirements.
 - 3. Include sieve analyses for aggregate materials.
 - 4. Material Certificates: For each type of imported soil, soil amendment and fertilizer before delivery to the site, according to the following:
 - a. Manufacturer's qualified testing agency's certified analysis of standard products.
 - b. Analysis of fertilizers, by a qualified testing agency, made according to AAPFCO methods for testing and labeling and according to AAPFCO's SUIP #25.

- c. Analysis of nonstandard materials, by a qualified testing agency, made according to SSSA methods, where applicable.

B. Samples: For each bulk-supplied material, 1-quart volume of each in sealed containers labeled with content, source, and date obtained. Each Sample shall be typical of the lot of material to be furnished; provide an accurate representation of composition, color, and texture.

1.06 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For each testing agency.
- B. Preconstruction Test Reports: For preconstruction soil analyses specified in "Preconstruction Testing" Article.
- C. Field quality-control reports.

1.07 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent, state-operated, or university-operated laboratory; experienced in soil science, soil testing, and plant nutrition; with the experience and capability to conduct the testing indicated; and that specializes in types of tests to be performed.

- 1. Laboratories: Subject to compliance with requirements, provide testing by the following:

- a. University of Georgia Soil, Plant & Water Laboratory
2400 College Station Road
Athens, GA 30602-9105
soiltest@uga.edu

- b. Local UGA Extension Office: 1-800-ASK-UGA1

- 2. Multiple Laboratories: At Contractor's option, work may be divided among qualified testing laboratories specializing in physical testing, chemical testing, and fertility testing.

1.08 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Owner will engage a qualified testing agency to perform preconstruction soil analyses on existing, on-site soil and imported soil.

- 1. Notify Owner seven days in advance of the dates and times when laboratory samples will be taken.

B. Preconstruction Soil Analyses: For each unamended soil type, perform testing on soil samples and furnish soil analysis and a written report containing soil-amendment

and fertilizer recommendations by a qualified testing agency performing the testing according to "Soil-Sampling Requirements" and "Testing Requirements" articles.

1. Have testing agency identify and label samples and test reports according to sample collection and labeling requirements.

1.09 SOIL-SAMPLING REQUIREMENTS

- A. General: Extract soil samples according to requirements in this article.
- B. Sample Collection and Labeling: Have samples taken and labeled by Contractor under the direction of the testing agency.
 1. Number and Location of Samples: Minimum of ONE soil sample representative per acre from varied site locations for each soil to be used or amended for landscaping purposes.
 2. Procedures and Depth of Samples: Per testing laboratory directions.
 3. Labeling: Label each sample with the date, location keyed to a site plan or other location system, visible soil condition, and sampling depth.

1.10 TESTING REQUIREMENTS

- A. General: Perform tests on soil samples according to requirements in this article.
- B. Physical Testing:
 1. Soil Texture: Soil-particle, size-distribution analysis according to standard laboratory protocol by one of the following methods according to SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods":
 - a. Sieving Method: Report sand-gradation percentages for very coarse, coarse, medium, fine, and very fine sand; and fragment-gradation (gravel) percentages for fine, medium, and coarse fragments; according to USDA sand and fragment sizes.
 - b. Hydrometer Method: Report percentages of sand, silt, and clay.
 2. Total Porosity: Calculate using particle density and bulk density according to SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods."
 3. Water Retention: According to SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods."
 4. Saturated Hydraulic Conductivity: According to SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods"; at 85% compaction according to ASTM D 698 (Standard Proctor).
- C. Chemical Testing:

1. CEC: Analysis by sodium saturation at pH 7 according to SSSA's "Methods of Soil Analysis - Part 3- Chemical Methods."
 2. Clay Mineralogy: Analysis and estimated percentage of expandable clay minerals using CEC by ammonium saturation at pH 7 according to SSSA's "Methods of Soil Analysis - Part 1- Physical and Mineralogical Methods."
 3. Metals Hazardous to Human Health: Test for presence and quantities of RCRA metals including aluminum, arsenic, barium, copper, cadmium, chromium, cobalt, lead, lithium, and vanadium. If RCRA metals are present, include recommendations for corrective action.
 4. Phytotoxicity: Test for plant-available concentrations of phytotoxic minerals including aluminum, arsenic, barium, cadmium, chlorides, chromium, cobalt, copper, lead, lithium, mercury, nickel, selenium, silver, sodium, strontium, tin, titanium, vanadium, and zinc.
- D. Fertility Testing: Soil-fertility analysis according to standard laboratory protocol of SSSA NAPT NCR-13, including the following:
1. Percentage of organic matter.
 2. CEC, calcium percent of CEC, and magnesium percent of CEC.
 3. Soil reaction (acidity/alkalinity pH value).
 4. Buffered acidity or alkalinity.
 5. Nitrogen ppm.
 6. Phosphorous ppm.
 7. Potassium ppm.
 8. Manganese ppm.
 9. Manganese-availability ppm.
 10. Zinc ppm.
 11. Zinc availability ppm.
 12. Copper ppm.
 13. Sodium ppm and sodium absorption ratio.
 14. Soluble-salts ppm.
 15. Presence and quantities of problem materials including salts and metals cited in the Standard protocol. If such problem materials are present, provide additional recommendations for corrective action.

16. Other deleterious materials, including their characteristics and content of each.

E. Organic-Matter Content: Analysis using loss-by-ignition method according to SSSA's "Methods of Soil Analysis - Part 3- Chemical Methods."

F. Recommendations: Based on the test results, state recommendations for soil treatments and soil amendments to be incorporated to produce satisfactory planting soil suitable for healthy, viable plants indicated. Include, at a minimum, recommendations for nitrogen, phosphorous, and potassium fertilization, and for micronutrients.

1. Fertilizers and Soil Amendment Rates: State recommendations in weight per 1000 sq. ft. for 6-inch depth of soil.

2. Soil Reaction: State the recommended liming rates for raising pH or sulfur for lowering pH according to the buffered acidity or buffered alkalinity in weight per 1000 sq. ft. for 6-inch depth of soil.

1.11 DELIVERY, STORAGE, AND HANDLING

A. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and compliance with state and Federal laws if applicable.

B. Bulk Materials:

1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.

2. Provide erosion-control measures to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.

3. Do not move or handle materials when they are wet or frozen.

4. Accompany each delivery of bulk fertilizers and soil amendments with appropriate certificates.

5. Topsoil and/or planting soil stockpile(s) shall be formed under normal industry standards. Stockpile height shall not exceed highest point of lifting mechanism of equipment (maximum height: 72 inches; maximum width: 12") creating the stockpile. Stockpile will be considered defective if equipment drives or otherwise compacts stockpile. Do not stockpile within protection zones.

PART 2 - PRODUCTS

2.01 PLANTING SOILS SPECIFIED BY COMPOSITION

A. General: Soil amendments, fertilizers, and rates of application specified in this article are guidelines that may need revision based on testing laboratory's recommendations after preconstruction soil analyses are performed.

B. Planting-Soil: Existing, on-site surface soil, with the duff layer, if any, retained; and stockpiled on-site; modified to produce viable planting soil. Blend existing, on-site surface soil with the following soil amendments and fertilizers in quantities recommended by the testing agency to produce planting soil.

C. Planting-Soil Type: Imported, naturally formed soil from off-site sources and consisting of loam soil according to USDA textures; and modified to produce viable planting soil.

1. Sources: Take imported, unamended soil from sources that are naturally well-drained sites where topsoil occurs at least 4 inches deep, not from agricultural land, bogs, or marshes; and that do not contain undesirable organisms; disease-causing plant pathogens; or obnoxious weeds and invasive plants including, but not limited to, quackgrass, Johnsongrass, poison ivy, nutsedge, nimblewill, Canada thistle, bindweed, bentgrass, wild garlic, ground ivy, perennial sorrel, and brome grass.

2. Additional Properties of Imported Soil before Amending: Soil reaction of pH 6 to 7 and minimum of 6 percent organic-matter content, friable, and with sufficient structure to give good tilth and aeration.

3. Unacceptable Properties: Clean soil of the following:

- a. Unacceptable Materials: Concrete slurry, concrete layers or chunks, cement, plaster, building debris, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, acid, and other extraneous materials that are harmful to plant growth.

- b. Unsuitable Materials: Stones, roots, plants, sod, clay lumps, and pockets of coarse sand that exceed a combined maximum of 8 percent by dry weight of the imported soil.

- c. Large Materials: Stones, clods, roots, clay lumps, and pockets of coarse sand exceeding 2 inches in any dimension.

4. Amended Soil Composition: Blend imported, unamended soil with soil amendments and fertilizers in the quantities recommended by the testing agency to produce the planting soil.

2.02 INORGANIC SOIL AMENDMENTS

A. Lime: ASTM C 602, agricultural liming material containing a minimum of 80 percent calcium carbonate equivalent and as follows:

1. Class: T, with a minimum of 99 percent passing through a No. 8 sieve and a minimum of 75 percent passing through a No. 60 sieve.
 2. Class: O, with a minimum of 95 percent passing through a No. 8 sieve and a minimum of 55 percent passing through a No. 60 sieve.
 3. Form: Provide lime in form of ground dolomitic limestone or mollusk shells.
- B. Sulfur: Granular, biodegradable, and containing a minimum of 90 percent elemental sulfur, with a minimum of 99 percent passing through a No. 6 sieve and a maximum of 10 percent passing through a No. 40 sieve.
- C. Iron Sulfate: Granulated ferrous sulfate containing a minimum of 20 percent iron and 10 percent sulfur.
- D. Perlite: Horticultural perlite, soil amendment grade.
- E. Agricultural Gypsum: Minimum 90 percent calcium sulfate, finely ground with 90 percent passing through a No. 50 sieve.
- F. Sand: Clean, washed, natural or manufactured, free of toxic materials, and according to ASTM C 33/C 33M.

2.03 ORGANIC SOIL AMENDMENTS

- A. Compost: Well-composted, stable, and weed-free organic matter produced by composting feedstock, and bearing USCC's "Seal of Testing Assurance," and as follows:
1. Feedstock: Limited to leaves and other green waste (grass clippings, twigs, green food waste).
 2. Reaction: pH of 5.5 to 8.
 3. Soluble-Salt Concentration: Less than 4 dS/m.
 4. Moisture Content: 35 to 55 percent by weight.
 5. Organic-Matter Content: 50 to 60 percent of dry weight.
 6. Particle Size: Minimum of 98 percent passing through a 2-inch sieve.
- B. Sphagnum Peat: Partially decomposed sphagnum peat moss, finely divided or of granular texture with 100 percent passing through a 1/2-inch sieve, a pH of 3.4 to 4.8, and a soluble-salt content measured by electrical conductivity of maximum 5 dS/m.
- C. Muck Peat: Partially decomposed moss peat, native peat, or reed-sedge peat, finely divided or of granular texture with 100 percent passing through a 1/2-inch sieve, a pH of 6 to 7.5, a soluble-salt content measured by electrical conductivity of maximum 5 dS/m, having a water-absorbing capacity of 1100 to 2000 percent, and containing no sand.

D. Wood Derivatives: Shredded and composted, nitrogen-treated sawdust, ground bark, or wood waste; of uniform texture and free of chips, stones, sticks, soil, or toxic materials.

E. Manure: Well-rotted, unleached, stable or cattle manure containing not more than 25 percent by volume of straw, sawdust, or other bedding materials; free of toxic substances, stones, sticks, soil, weed seed, debris, and material harmful to plant growth.

2.04 FERTILIZERS

A. Superphosphate: Commercial, phosphate mixture, soluble; a minimum of 20 percent available phosphoric acid.

B. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:

1. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified testing agency.

C. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:

1. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified testing agency.

D. Chelated Iron: Commercial-grade FeEDDHA for dicots and woody plants, and commercial-grade FeDTPA for ornamental grasses and monocots.

PART 3 - EXECUTION

3.01 GENERAL

A. Place planting soil and fertilizers according to requirements in other Specification Sections.

B. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in planting soil.

C. Proceed with placement only after unsatisfactory conditions have been corrected.

3.02 PREPARATION OF UNAMENDED, ON-SITE SOIL BEFORE AMENDING

A. Excavation: Excavate soil from designated area(s) to a depth of 6 inches and stockpile until amended.

B. Unacceptable Materials: Clean soil of concrete slurry, concrete layers or chunks, cement, plaster, building debris, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, acid, and other extraneous materials that are harmful to plant growth.

C. Unsuitable Materials: Clean soil to contain a maximum of 8 percent by dry weight of stones, roots, plants, sod, clay lumps, and pockets of coarse sand.

D. Screening: Pass unamended soil through a 2-inch sieve to remove large materials.

3.03 PLACING AND MIXING PLANTING SOIL OVER EXPOSED SUBGRADE

A. General: Apply and mix unamended soil with amendments on-site to produce required planting soil. Do not apply materials or till if existing soil or subgrade is frozen, muddy, or excessively wet.

B. Subgrade Preparation: Till subgrade to a minimum depth of 6 inches. Remove stones larger than 2 inches in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.

1. Apply, add soil amendments, and mix approximately half the thickness of unamended soil over prepared, loosened subgrade according to "Mixing" Paragraph below. Mix thoroughly into top 4 inches of subgrade. Spread remainder of planting soil.

C. Mixing: Spread unamended soil to total depth of 8 inches, but not less than required to meet finish grades after mixing with amendments and natural settlement. 110Do not spread if soil or subgrade is frozen, muddy, or excessively wet.

1. Amendments: Apply soil amendments, except compost, and fertilizer, if required, evenly on surface, and thoroughly blend them with unamended soil to produce planting soil.

- a. Mix lime and/or sulfur with dry soil before mixing fertilizer.

- b. Mix fertilizer with planting soil no more than seven days before planting.

2. Lifts: Apply and mix unamended soil and amendments in lifts not exceeding 12 inches in loose depth for material compacted by compaction equipment, and not more than 6 inches in loose depth for material compacted by hand-operated tampers.

D. Compaction: Compact each blended lift of planting soil to 75 to 82 percent of maximum Standard Proctor density according to ASTM D 698 and tested in-place.

E. Finish Grading: Grade planting soil to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.

3.04 PLACING MANUFACTURED PLANTING SOIL OVER EXPOSED SUBGRADE

- A. General: Apply manufactured soil on-site in its final, blended condition. Do not apply materials or till if existing soil or subgrade is frozen, muddy, or excessively wet.
- B. Subgrade Preparation: Till subgrade to a minimum depth of 4 inches. Remove stones larger than 2 inches in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.
 - 1. Apply approximately half the thickness of planting soil over prepared, loosened subgrade. Mix thoroughly into top 4 inches of subgrade. Spread remainder of planting soil.
- C. Application: Spread planting soil to total depth of 8 inches but not less than required to meet finish grades after natural settlement. Do not spread if soil or subgrade is frozen, muddy, or excessively wet.
 - 1. Lifts: Apply planting soil in lifts not exceeding 12 inches in loose depth for material compacted by compaction equipment, and not more than 6 inches in loose depth for material compacted by hand-operated tampers.
- D. Compact each blended lift of planting soil to 75 to 82 percent of maximum Standard Proctor density according to ASTM D 698 and tested in-place.
- E. Finish Grading: Grade planting soil to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.

3.05 BLENDING PLANTING SOIL IN PLACE

- A. General: Mix amendments with in-place, unamended soil to produce required planting soil. Do not apply materials or till if existing soil or subgrade is frozen, muddy, or excessively wet.
- B. Preparation: Till unamended, existing soil in planting areas to a minimum depth of 6 inches. Remove stones larger than 2 inches in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.
- C. Mixing: Apply soil amendments and fertilizer (excluding compost), if required, evenly on surface, and thoroughly blend them into full depth of unamended, in-place soil to produce planting soil.
 - 1. Mix lime and/or sulfur with dry soil before mixing fertilizer.
 - 2. Mix fertilizer with planting soil no more than seven days before planting.
- D. Compaction: Compact each blended lift of planting soil to 75 to 82 percent of maximum Standard Proctor density according to ASTM D 698 and tested in-place.

3.06 APPLYING COMPOST TO SURFACE OF PLANTING SOIL

A. Application: Apply compost component of planting-soil mix 6 inches to surface of in-place planting soil. Do not apply materials or till if existing soil or subgrade is frozen, muddy, or excessively wet.

B. Finish Grading: Grade surface to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.

3.07 FIELD QUALITY CONTROL

A. Testing Agency: Contractor to engage a qualified testing agency to perform tests and inspections.

B. Perform the following test:

1. Compaction: Test planting-soil compaction after placing each lift and at completion using a densitometer or soil-compaction meter calibrated to a reference test value based on laboratory testing according to ASTM D 698. Space tests at no less than one for each 1000 sq. ft. of in-place soil or part thereof.

C. Soil will be considered defective if it does not pass compaction tests.

D. Prepare test reports.

E. Label each sample and test report with the date, location keyed to a site plan or other location system, visible conditions when and where sample was taken, and sampling depth.

3.08 PROTECTION

A. Protection Zone: Identify protection zones according to Section 31 10 00 "Temporary Tree and Plant Protection."

B. Protect areas of in-place soil from additional compaction, disturbance, and contamination. Prohibit the following practices within these areas except as required to perform planting operations:

1. Storage of construction materials, debris, or excavated material.
2. Parking vehicles or equipment.
3. Vehicle traffic.
4. Foot traffic.
5. Erection of sheds or structures.
6. Impoundment of water.
7. Excavation or other digging unless otherwise indicated.

C. If planting soil or subgrade is overcompacted, disturbed, or contaminated by foreign or deleterious materials or liquids, remove the planting soil and contamination; restore the subgrade as directed by Architect and replace contaminated planting soil with new planting soil.

3.09 CLEANING

A. Protect areas adjacent to planting-soil preparation and placement areas from contamination. Keep adjacent paving and construction clean and work area in an orderly condition.

B. Remove surplus soil and waste material including excess subsoil, unsuitable materials, trash, and debris and legally dispose of them off Owner's property unless otherwise indicated.

1. Dispose of excess subsoil and unsuitable materials on-site where directed by Owner.

END OF SECTION

SECTION 32 92 10

TREE REMOVAL AND PROTECTION

PART 1 – GENERAL

1.01 SCOPE

- A. The work specified in this Section includes furnishing all labor, equipment and material required to locate, identify, verify condition and remove or protect existing trees as shown on the Drawings and/or as directed by the Owner.
- B. The Contractor shall install orange tree protection fencing (barrier) around each tree to be protected, as shown on the Drawings and as ordered by the Owner.
- C. No trees or vegetation shall be removed except as specifically exempted or approved by the Owner.

1.02 REFERENCE

- A. “Trenching and Tunneling near Trees,” by James R. Fazio. Published by the National Arbor Day Foundation.
- B. “Tree Preservation Ordinance and Administrative Guide Lines,” Fulton County, latest edition.

1.03 QUALIFICATIONS

- A. Contractor shall have on staff for the project at least one person with a minimum of 5 years’ experience as nurseryman in planting and protecting trees.

1.04 SUBMITTALS

- A. Contractor shall walk the site with local City’s Arborist, to understand (in more detail than shown on the Drawings) the scope and requirements of tree protection for this Project.
- B. Prepare a Tree Protection Work Plan describing how tree protection will be handled during installation of the water lines. The Work Plan shall include, but is not limited to:
 - 1. Confirmation of identification of specimen trees (shown on the Drawings) and other trees to be protected.
 - 2. Scope of general protection of trees within right-of-ways and along the sewer line trench alignment.
 - 3. Determination of drip line limits of protected trees and approximate free bore lengths.

Section 4
Scope of Work and Technical Specifications
SECTION 32 92 10-2 TREE REMOVAL AND PROTECTION

4. Scope of general protection of trees outside right-of-ways but in close proximity to work areas.
 5. Extent of approved or required tree limb cutting and trimming to make space for work area.
 6. Extent of approved or required tree root cutting, if necessary within trench area.
 7. Confirmation of the type of protective fencing, other protective measures as required, and installation details.
- C. Contractor shall submit five copies of the Tree Protection Work Plan to the Owner for approval. Contractor shall not begin any field activity prior to approval of this Work Plan by the Owner and City Arborist.

PART 2 – PRODUCTS

2.01 PRODUCTS

- A. Protective Fencing
1. Orange Safety Fencing: Minimum 4 feet in width and shall be made of high density polyethylene resin, extruded and stretched to provide a highly visible bright orange, non-fading fence.
 - a. The fabric shall remain flexible from -60° F to 200° F and shall be inert to most chemicals and acids.
 - b. The fabric pattern may vary from diamond to circular with a minimum unit weight of 0.4 lbs. and a maximum opening size of 2 inches.
 - c. The fabric shall have minimum tensile yield strength (horizontal) of 2,000 psi and ultimate tensile strength of 2,680 psi.
 2. The fencing material shall be supported by steel pipe tee posts or U posts, that are minimum 5 ½ feet in height and spaced no more than 8 feet on centers. The fabric shall be secured to post by bands or wire ties.
- B. Warning Signs: A weather proof warning sign shall be prominently displayed on each tree protection fence at 20-foot intervals. The sign shall be minimum 8.5-inches X 11-inches and clearly state in half inch tall letters: “Warning – Tree Protection Zone”.
- C. Silt Fence (Type S): Silt fence shall be installed 2 feet from the outside of the tree protection fence where required or directed by the Owner and City Arborist.
- D. Trunk Protection: When directed by the City Arborist, the tree trunk protection shall be provided using either 2x4-inch or 2x6-inch planking or plastic strapping.

- E. Tree Dressing: Dressing of any damaged areas shall be accomplished using any approved asphaltic tree wound paint immediately after damage occurs.

PART 3 – EXECUTION

3.01 EXECUTION

- A. Protective Fencing:
1. All trees and shrubs in the proximity of the construction site shall be carefully checked for damage prior to initiation of any construction activity.
 2. All individual trees, shrubs and natural areas scheduled for preservation shall be protected during construction with temporary fencing as indicated on the Drawings or directed by the City Arborist.
 3. Protective fences shall be installed prior to the start of any site preparation work (clearing, grubbing or grading) and shall be maintained in functioning condition throughout all phases of the construction project.
 4. Protective fence locations in close proximity to intersecting streets or drives shall adhere to the site distance requirements.
- B. Protective fences shall be constructed around trees to be protected, at the locations (typically the outer limits of the Critical Root Zone) and with materials indicated on the Drawings to prevent the following:
1. Soil compaction in the root zone area resulting from vehicular traffic or storage of equipment or materials.
 2. Root zone disturbances due to grade changes greater than 6-inch cut or fill or trenching not reviewed and authorized by the City Arborist or the Owner.
 3. Damage to exposed roots, trunks or limbs by mechanical equipment.
 4. Other activities detrimental to trees such as chemical storage, concrete truck cleaning and fires.
- C. Exceptions to the installation of protective fences at the tree drip lines may be permitted in the following cases:
1. Where there is to be an approved grade change, impermeable paving surface, tree well or other such site development, the fence shall be erected approximately 2 to 4 feet beyond the areas of disturbance.
 2. When permeable paving is to be installed within a tree drip line, the fence shall be erected at the outer limits of the permeable paving area prior to any site grading so that this enclosed area is graded separately to minimize root damage.

Section 4
Scope of Work and Technical Specifications
SECTION 32 92 10-4 TREE REMOVAL AND PROTECTION

3. When trees are located close to a proposed building or other construction activity, the fence shall be erected to allow 6 to 10 feet work space between the fence and the structure and apply organic mulch to a depth of 4 to 6 inches in the unprotected root zone area.

4. When there are street-side pedestrian walkways, fences shall be constructed in a manner that does not obstruct safe passage.

5. When there are severe space constraints due to tract size or other special requirements, the Contractor shall contact the Arborist or the Owner to discuss alternatives.

6. When any of the exceptions listed above will result in a fence being located closer than five (5) feet to a tree trunk, the Contractor shall also protect the trunk with strapped-on planking to a height of 8 feet or to the limits of lower branching in addition to the reduced fencing required.

D. Repair of Damage:

1. Tree roots scarred by equipment shall be cut cleanly and covered with topsoil.

2. When tree roots are pruned, a comparable portion of selected branches shall be cut from the tree on the opposite side.

3. Limb pruning shall be made at the branch collar. All limbs greater than 1-inch in diameter shall be precut in accordance with ANSI 300 pruning methods to prevent splitting.

4. All cut limbs shall be treated with an approved tree dressing. Tools shall be disinfected with alcohol or 5 ppm chlorine solution between repairs to trees to prevent the transmission of diseases from one tree to another.

5. All trees damaged during construction shall receive an application of fertilizer within the drip line at the rate of 4 pounds per caliper inch.

E. Cutting and Filling Around Trees:

1. When the depth of an excavation or embankment exceeds 6 inches of any tree with a diameter greater than 8 inches, a tree well shall be constructed to protect the tree.

F. Free Bore:

1. Where a pipe is to be installed within critical root zone (CRZ) and inside drip line area, installation of the pipe by free bore method is required to protect trees.

Section 4
Scope of Work and Technical Specifications
SECTION 32 92 10-5 TREE REMOVAL AND PROTECTION

2. The length of free bore shall extend a minimum of five feet beyond drip line on both sides or as recommended length in the table provided on the Drawings, whichever is greater. The depth of free bore shall be such that there is a minimum of 4 feet of cover on top of pipe.
 3. The location and procedures shall be approved by the Owner and City Arborist.
- G. Paving Around Trees:
1. Where paving within the drip line of any tree greater than a 6 inch diameter is necessary, a permeable pavement and aeration system must be installed except for street construction.
- H. Tree Removal:
1. Trees which directly interfere with construction may only be removed if approval of the Construction Project Manager and City Arborist has been obtained.
 2. When a tree or shrub is scheduled for removal, it shall be cut to a depth of 12 inches below the surrounding ground line.
 3. After removal, soil shall be placed in the hole to a depth matching the existing grade.
 4. The tree shall be cut into sections that can be managed, removed from the site and disposed of.
 5. All work shall be conducted in such a manner as to protect all facilities, improvements and vegetation in the work area. All damage resulting from tree removal or pruning shall be repaired at the Contractor's own expense.
- I. Final Cleanup:
1. All temporary tree and shrub preservation and protection measures shall be removed when the construction has been completed.
- J. Roots larger than 2-inch diameter shall not be cut without written permission from the City Arborist.

END OF SECTION

SECTION 32 92 19

SEEDING

PART 1 – GENERAL

1.01 SCOPE

- A. The work covered by this Section consists of furnishing all labor, equipment and material required to place topsoil, seed, commercial fertilizer, agricultural limestone and mulch material, including seedbed preparation, harrowing, compacting and other placement operations on graded earthen areas as described herein and/or shown on the Drawings.
- B. In general, seeding operations shall be conducted on all newly graded earthen areas not covered by structures, pavement or sidewalks, all cleared or grubbed areas which are to remain as finish grade surfaces; and on all existing turf areas which are disturbed by construction operations and which are to remain as finish grade surfaces.
- C. Areas disturbed by borrow activities shall also be seeded according to these Specifications.
- D. The work shall include temporary seeding operations to stabilize earthen surfaces during construction or inclement weather and to minimize stream siltation and erosion.
- E. Temporary seeding shall be performed at the times and locations as directed by the Owner.
- F. All work shall in accordance with the Manual for Erosion and Sediment Control in Georgia, latest edition.

1.02 QUALITY ASSURANCE

- A. Prior to seeding operations, the Contractor shall furnish to the Owner labels or certified laboratory reports from an accredited commercial seed laboratory or a state seed laboratory showing the analysis and germination of the seed to be furnished.
- B. Acceptance of the seed test reports shall not relieve the Contractor of any responsibility or liability for furnishing seed meeting the requirements of this Section.
- C. Prior to topsoil operations, the Contractor shall obtain representative samples and furnish soil test certificates including textural, pH, and organic analysis from the State University Agricultural Extension Services or other certified testing laboratory.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. All materials shall conform to the requirements and standards of this Section.

B. Wood cellulose fiber mulch shall be manufactured by Weyerhaeuser Company or Conway Corporation.

2.02 TOPSOIL

A. Utilizing designated stockpiles or borrow areas on site, the Contractor shall place a minimum of 4 inches of topsoil over all graded earthen areas and over any other areas to be seeded.

1. Sources of topsoil shall be approved by the Owner prior to disturbance.

2. Importing topsoil from offsite sources shall be at the discretion of the Owner and shall be justification for additional compensation to the Contractor.

3. A change order properly authorized by the Owner shall be agreed upon prior to importing offsite topsoil. No additional compensation will be allowed for spreading of topsoil.

B. Topsoil shall be a friable loam containing a large amount of humus and shall be original surface soil of good, rich, uniform quality, free from any material such as hard clods, stiff clay, hardpan, partially disintegrated stone, pebbles larger than 1/2 inch in diameter, lime, cement, bricks, ashes, cinders, slag, concrete, bitumen or its residue, boards, sticks, chips or other undesirable material harmful or unnecessary to plant growth.

C. Topsoil shall be reasonably free from perennial weeds and shall not contain objectionable plant material, toxic amounts of either acid or alkaline elements or vegetable debris undesirable or harmful to plant life.

D. Topsoil shall be natural topsoil without admixture of subsoil material, and shall be classifiable as loam, silt loam, clay loam, sandy loam or a combination thereof. The pH shall range from 5.5 to 7.0.

E. Topsoil shall contain not less than five percent nor more than 20 percent, by weight, of organic matter as determined by loss on ignition of oven dried samples to 65 degrees C.

2.03 SEED

A. Seed shall be delivered in new bags or bags that are sound and labeled in accordance with the U.S. Department of Agriculture Federal Seed Act.

B. All seeds shall be from the last crop available at time of purchase and shall not be moldy, wet or otherwise damaged in transit or storage.

C. Seed shall bear the growers analysis testing to 98 percent for purity and 90 percent for germination. At the discretion of the Owner, samples of seed may be taken for verification against the grower's analysis.

D. Species, rate of seeding, and planting dates are shown in Table 1 for Native Grasses, Table 2 for Herbaceous Plants and for temporary grassing refer to Table 3.

2.04 FERTILIZER AND LIMING MATERIALS

A. Fertilizer and liming materials shall comply with applicable state, local and federal laws concerning their production and use.

B. Container bags shall have the name and address of the manufacturer, the brand name, net weight and chemical composition.

C. Agricultural limestone shall be a pulverized dolomitic limestone having a calcium carbonate content of not less than 85 percent by weight. Agricultural limestone shall be crushed so that at least 85 percent of the material will pass a No. 10 mesh screen and 50 percent will pass a No. 40 mesh screen.

2.05 MULCH MATERIAL

A. All mulch materials shall be air dried and reasonably free of noxious weeds and weed seeds or other materials detrimental to plant growth.

B. Mulch shall be composed of wood cellulose fiber, straw or stalks, as specified herein. Mulch shall be suitable for spreading with standard mulch blowing equipment.

C. Straw mulch shall be partially decomposed stalks of wheat, rye, oats or other approved grain crops.

D. Stalks shall be the partially decomposed, shredded residue of corn, cane, sorghum or other approved standing field crops.

2.06 MULCH BINDER

A. Mulch on slopes exceeding 3 to 1 ratio shall be held in place by the use of an approved mulch binder. The mulch binder shall be nontoxic to plant life and shall be acceptable to the Owner.

B. Emulsified asphalt binder shall be Grade SS 1, ASTM D 977. Cutback asphalt binder shall be Grade RC 70 or RC 250.

2.07 LEGUMES

A. All leguminous seeds shall be inoculated prior to seeding with a standard culture of nitrogen fixing bacteria that is adapted to the particular seed involved.

2.08 WATER

A. Water shall be clean, clear water free from any objectionable or harmful chemical qualities or organisms and shall be furnished by the Contractor.

PART 3 – EXECUTION

3.01 SECURING AND PLACING TOPSOIL

- A. Topsoil shall be secured from areas from which topsoil has not been previously removed, either by erosion or mechanical methods. Topsoil shall not be removed to a depth in excess of the depth approved by the Owner.
- B. The area or areas from which topsoil is secured shall possess such uniformity of soil depth, color, texture, drainage and other characteristics as to offer assurance that, when removed, the product will be homogeneous in nature and will conform to the requirements of these Specifications.
- C. All areas from which topsoil is to be secured, shall be cleaned of all sticks, boards, stones, cement, ashes, cinders, slag, concrete, bitumen or its residue and any other refuse which will hinder or prevent growth.
- D. In securing topsoil from a designated pit or elsewhere, should strata or seams of material occur which do not come under the requirements for topsoil, such material shall be removed from the topsoil or if required by the Owner, the pit shall be abandoned.
- E. Before placing or depositing topsoil upon any areas, all improvement within the area shall be completed, unless otherwise approved by the Construction
- F. The areas in which topsoil is to be placed or incorporated shall be prepared before securing topsoil for use.

3.02 SEEDBED PREPARATION

- A. Before fertilizing and seeding, the topsoil surfaces shall be trimmed and worked to true line from unsightly variation, bumps, ridges and depressions and all detrimental material, roots and stones larger than 3 inches in any dimension shall be removed from the soil.
- B. No earlier than 24 hours before the seed is to be sown, the soil surface to be seeded shall be thoroughly cultivated to a depth of not less than 4 inches with a weighted disc, tiller, pulvimixer or other equipment, until the surface is smooth and, in a condition, acceptable to the Owner.
- C. If the prepared surface becomes eroded as a result of rain or for any other reasons, or becomes crusted before the seed is sown, the surface shall again be placed in a condition suitable for seeding.
- D. Ground preparation operations shall be performed only when the ground is in a tillable and workable condition, as determined by the Owner. For native grasses, the seedbed must be worked up and firmed with a cultipacker or similar equipment.

3.03 FERTILIZATION AND LIMING

A. Fertilizer analysis and rates will be based on a laboratory soil test report. The Contractor is responsible for ensuring the tests are performed by an approved laboratory. A copy of the test results is to be provided to the Engineer. Refer to Section 32 91 13 Preparation for Landscaping specification for soil sampling procedures.

B. Lime rates will be based on a laboratory soil test report. The Contractor is responsible for ensuring the tests are performed by an approved laboratory. A copy of the test results is to be provided to the Engineer. Refer to Section 32 91 13 Preparation for Landscaping specification for soil sampling procedures.

C. Fertilizer and lime applications should be omitted within riparian areas.

3.04 SEEDING

A. Seed of the specified group shall be sown as soon as preparation of the seedbed has been completed. No seed shall be sown during high winds, nor until the surface is suitable for working and is in a proper condition.

B. Seeding shall be performed during the dates shown in Tables 1 and 2 or Table 3 if temporary seeding is required unless otherwise approved by the Owner. Seed mixtures may be sown together provided they are kept in a thoroughly mixed condition during the seeding operation.

C. Seed shall be uniformly sown by any approved mechanical method suitable for the slope and size of the areas to be seeded within 24 hours after preparing the seed bed. Use approved mechanical no-till seed drills, rotary hand seeders, hydroseeding equipment or other equipment to uniformly apply the seed. Do Not distribute seed by hand.

D. Hydro seeding and hydro mulching may be used on steep embankments, provided full coverage is obtained.

E. Care shall be taken to adjust the seeder for seeding at the proper rate before seeding operations are started and to maintain their adjustment during seeding. Seed in hoppers shall be agitated to prevent segregation of the various seeds in a seeding mixture.

F. Immediately after sowing, the seeds shall be covered and compacted to a depth of 1/8 inch by a cultipacker or suitable roller.

G. Leguminous seeds shall be inoculated prior to seeding with an approved and compatible nitrogen fixing inoculant in accordance with the manufacturer's mixing instructions.

3.05 MULCHING

A. All seeded areas shall be uniformly mulched in a continuous blanket immediately after seeding.

B. The mulch shall be applied evenly to permit sunlight to penetrate and the air to circulate and at the same time shade the ground, reduce erosion and conserve soil moisture.

1. Approximately 45 percent of the ground shall be visible through the mulch blanket.

C. One of the following mulches shall be spread evenly over the seeded areas at the following application rates:

1. Wood Cellulose Fiber: 1,400 pounds/acre.
2. Straw: 4,000 pounds/acre.
3. Stalks: 4,000 pounds/acre.
4. These rates may be adjusted, at the discretion of the Owner, depending on the texture and condition of the mulch material and the characteristics of the seeded area at no additional cost to the Owner.

D. Mulch on slopes greater than 3 to 1 ratio shall be held in place using an approved mulch binder.

1. Binder shall be thoroughly mixed and applied with the mulch.
2. Emulsified asphalt or cutback asphalt shall be applied at the approximate rate of five gallons per 1,000 square feet as required to hold the mulch in place.

E. The Contractor shall cover structures, poles, fences and appurtenances if the mulch binder is applied in such a way that it would come in contact with or discolor the structures.

F. Mulch and binder shall be applied by suitable blowing equipment at closely controlled application rates in a manner acceptable to the Owner.

3.06 WATERING

A. The Contractor shall be responsible for maintaining the proper moisture content of the soil to ensure adequate plant growth until a satisfactory stand is obtained. If necessary, watering shall be performed to maintain an adequate water content in the soil.

B. Watering shall be accomplished by hoses, tank trucks or sprinklers in such a way to prevent erosion, excessive runoff and over-watered spots.

3.07 MAINTENANCE

A. Upon completion of seeding operations, the Contractor shall clear the area of all equipment, debris and excess material and the premises shall be left in a neat and orderly condition.

B. The Contractor shall maintain all seeded areas without additional payment until final acceptance of the work by the Owner, and any regrading, refertilizing, reliming, reseeding or remulching shall be done at Contractor's own expense. Seeding work shall be repeated on defective areas until a satisfactory uniform stand is accomplished.

C. Damage resulting from erosion, gulleys, washouts or other causes shall be repaired by filling with topsoil, compacting and repeating the seeding work at Contractor's expense.

D. Unwanted vegetation that is taller than the native grasses/planted vegetation should be controlled through mowing, burning or applying herbicides until the native grasses/planted vegetation have taken hold. Native grasses should not be mowed lower than 12" to ensure plant health.

TABLE 1: NATIVE GRASS SEEDING

For Non-mowable Slopes or Areas Designated as Permanent Native Grass Plots.

Plant native seed mixes on back slopes, fill slopes and areas which will not be subject to frequent mowing (slopes steeper than 3:1).

Common Name	Botanical Name	Class/Type	Rate/Acre	Planting Dates
Canada Wild Rye	<i>Elymus canadensis</i>	Cool Season	Minimum 2 (2)	October 31 - March 31
Virginia Wild Rye	<i>Elymus virginicus</i>	Cool Season	Minimum 2 (2)	October 31 - March 31
Bottle-brush Grass	<i>Hystrix patula</i>	Cool Season	Minimum 2 (2)	October 31 - March 31
Little Bluestem	<i>Schizachyrium scoparium</i> (<i>Andropogon scoparius</i>)	Warm Season	Minimum 2 (2)	March 31 - August 31
Indiangrass	<i>Sorghastrum nutans</i>	Warm Season	Minimum 2 (2)	March 31 - August 31
Eastern Gama Grass	<i>Tripsacum dactyloides</i>	Warm Season	Minimum 2 (2)	March 31 - August 31
Rice Cut Grass	<i>Leersia oryzoides</i>	Warm Season	Minimum 2 (2)	March 31 - August 31
Deertongue	<i>Panicum clandestinum</i>	Warm Season	Minimum 2 (2)	March 31 - August 31
Switchgrass	<i>Panicum virgatum</i>	Warm Season	Minimum 2 (2)	March 31 - August 31
Woolgrass	<i>Scirpus cyperinus</i>	Cool Season	Minimum 2 (2)	October 31 - March 31
River Oats	<i>Chasmanthium latifolium</i>	Cool Season	Minimum 2 (2)	October 31 - March 31

Section 4
Scope of Work and Technical Specifications
SECTION 32 92 19-8 SEEDING

Purple Top	Tridens flavus	Warm Season	Minimum 2 (2)	March 31 - August 31

See plan sheets/plant lists for detailed native restoration and riparian mitigation seed mix combinations to be applied at a minimum rate total of 10 (11) lbs. per acre (kg/hectare) for each combined mix. If the mix is not provided in the plan sheets, use a minimum of 3 species based on planting dates shown above.

TABLE 2: HERBACEOUS PLANT SEEDING

(Approved for Riparian Mitigation and for Seed Mixes on Slopes Steeper than 3:1 Requiring Permanent Planting)

Common Name	Botanical Name	Class/Type	Rate/Acre	Planting Dates
Joe Pye Weed	Eupatorium fistulosum	Herbaceous Perennial	Minimum 2 (2)	September 1 – May 1
Ironweed	Vernonia novaboracensis	Herbaceous Perennial	Up to 10(11)	March 1 - August 31
White snakeroot	Ageratina altissima (Eupat rugosum)	Herbaceous Perennial	Up to 10(11)	September 1 – May 1
Swamp milkweed	Asclepias incarnata	Herbaceous Perennial	Up to 10(11)	March 1 - August 31
Frost aster	Aster pilosus (Symphyotric)	Herbaceous Perennial	Up to 10(11)	September 1 – May 1
Partridge pea	Chamaecrista fasciculata	Herbaceous Perennial	Up to 10(11)	March 1 - August 31
Lance-leaf coreopsis	Coreopsis lanceolata	Herbaceous Perennial	Up to 10(11)	September 1 – May 1
Tall coreopsis	Coreopteris tripteris	Herbaceous Perennial	Up to 10(11)	September 1 – May 1
Boneset	Eupatorium perfoliatum	Herbaceous Perennial	Up to 10(11)	September 1 – May 1
Sneezeweed	Helenium autumnale	Herbaceous Perennial	Up to 10(11)	September 1 – May 1
Swamp sunflower	Helianthus angustifolius	Herbaceous Perennial	Up to 10(11)	March 1 - August 31
Fringed loosestrife	Lysimachia ciliata	Herbaceous Perennial	Up to 10(11)	September 1 – May 1
Wild bergamot	Monarda fistulosa	Herbaceous Perennial	Up to 10(11)	September 1 – May 1
Mountain mint	Pycnanthemum tenuifolium	Herbaceous Perennial	Up to 10(11)	September 1 – May 1
Black-eyed Susan	Rudbeckia hirta	Herbaceous Perennial	Up to 10(11)	September 1 – May 1
Goldenrod	Solidago nemoralis	Herbaceous Perennial	Up to 10(11)	September 1 – May 1

Section 4
Scope of Work and Technical Specifications
SECTION 32 92 19-9 SEEDING

Butterfly Weed	Aesclepias tuberosa	Herbaceous Perennial	Up to 10(11)	March 1 - August 31

For native restoration and riparian mitigation seed mix combinations, use Table 2 for approved native herbaceous seed types in combination with Table 1 of native grass seeds. Native restoration and riparian seed mixes should incorporate a mix of 60% native grass types (see Table 1) and 40% native herbaceous types (see Table 2) applied at a minimum rate total of 10 (11) lbs per acre (kg/hectare) for each combined mix.

TABLE 3: TEMPORARY GRASSING

Species	Rates per 1000 sq. ft.	Rates per Acre	PLANTING DATE
Rye (Grain)	3.9 lbs	168 lbs	8/15 - 12/1
Ryegrass	0.9 lbs	40 lbs	9/1 - 12/15
Rye & Annual Lespedeza	0.6 lbs 0.6 lbs	28 lbs 24 lbs	2/1 - 3/1
Weeping Lovegrass	0.1 lbs	4 lbs	3/15 - 7/15
Sudangrass	1.0 lbs	60 lbs	4/1 - 8/31
Browntop Millet	1.1 lbs	50 lbs	4/1 - 7/15
Wheat	3.9 lbs	168 lbs	9/1 - 12/31

When stage construction or other conditions prevent completing a project, apply temporary grassing to control erosion. Temporary grassing is used to stabilize disturbed areas for more than sixty (60) calendar days. Temporary grass may be applied any time of the year, utilizing the appropriate seed species and application rate as shown in the chart above. Apply mulch to areas planted in temporary grass at the rate of $\frac{3}{4}$ inch to 1.5 inches. Do not place slope mats on areas planted in temporary grass.

END OF SECTION

SECTION 32 93 00

PLANTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section Includes:
 - 1. Plants.
 - 2. Tree stabilization.
 - 3. Tree-watering devices.
- B. Related Requirements:
 - 1. Section 32 91 13 - "Soil Preparation for Landscaping".

1.03 ALLOWANCES

- A. Allowances
 - 1. Perform planting work under quantity allowances and only as authorized. Authorized work includes work required by Drawings and the Specifications work authorized in writing by Architect.
 - 2. Notify Architect weekly of extent of work performed that is attributable to quantity allowances.
 - 3. Perform work that exceeds quantity allowances only as authorized by Change Orders.
- B. Furnish trees as part of tree allowance.

1.04 UNIT PRICES

- A. Unit prices apply to authorized work covered by quantity allowances.
- B. Unit prices apply to additions to and deletions from the Work as authorized by Change Orders.

1.05 DEFINITIONS

- A. Backfill: The earth used to replace or the act of replacing earth in an excavation.

- B. **Balled and Burlapped Stock:** Plants dug with firm, natural balls of earth in which they were grown, with a ball size not less than diameter and depth recommended by ANSI Z60.1 for type and size of plant required; wrapped with burlap, tied, rigidly supported, and drum laced with twine with the root flare visible at the surface of the ball as recommended by ANSI Z60.1.
- C. **Balled and Potted Stock:** Plants dug with firm, natural balls of earth in which they are grown and placed, unbroken, in a container. Ball size is not less than diameter and depth recommended by ANSI Z60.1 for type and size of plant required.
- D. **Bare-Root Stock:** Plants with a well-branched, fibrous-root system developed by transplanting or root pruning, with soil or growing medium removed, and with not less than the minimum root spread according to ANSI Z60.1 for type and size of plant required.
- E. **Container-Grown Stock:** Healthy, vigorous, well-rooted plants grown in a container, with a well-established root system reaching sides of container and maintaining a firm ball when removed from container. Container shall be rigid enough to hold ball shape and protect root mass during shipping and be sized according to ANSI Z60.1 for type and size of plant required.
- F. **Fabric Bag-Grown Stock:** Healthy, vigorous, well-rooted plants established and grown in-ground in a porous fabric bag with well-established root system reaching sides of fabric bag. Fabric bag size is not less than diameter, depth, and volume required by ANSI Z60.1 for type and size of plant.
- G. **Finish Grade:** Elevation of finished surface of planting soil.
- H. **Pesticide:** A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. Pesticides include insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. They also include substances or mixtures intended for use as a plant regulator, defoliant, or desiccant. Some sources classify herbicides separately from pesticides.
- I. **Pests:** Living organisms that occur where they are not desired or that cause damage to plants, animals, or people. Pests include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.
- J. **Planting Area:** Areas to be planted.
- K. **Planting Soil:** Existing, on-site soil; imported soil; or manufactured soil that has been modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth. See Section 32 91 13 "Soil Preparation" for drawing designations for planting soils.

L. Plant; Plants; Plant Material: These terms refer to vegetation in general, including trees, shrubs, vines, ground covers, ornamental grasses, bulbs, corms, tubers, or herbaceous vegetation.

M. Root Flare: Also called "trunk flare." The area at the base of the plant's stem or trunk where the stem or trunk broadens to form roots; the area of transition between the root system and the stem or trunk.

N. Stem Girdling Roots: Roots that encircle the stems (trunks) of trees below the soil surface.

O. Subgrade: The surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

1.06 COORDINATION

A. Coordination with Grassed Areas: Plant trees and other plants after finish grades are established and before planting grassed areas unless otherwise indicated.

1.07 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Plant Materials: Include quantities, sizes, quality, and sources for plant materials.

2. Plant Photographs: Include color photographs in digital 3-inch by 5-inch format of each required species and size of plant material as it will be furnished to Project. Take photographs from an angle depicting true size and condition of the typical plant to be furnished. Include a scale rod or other measuring device in each photograph. For species where more than 20 plants are required, include a minimum of [three] photographs showing the average plant, the best quality plant, and the worst quality plant to be furnished. Identify each photograph with the full scientific name of the plant, plant size, and name of the growing nursery.

B. Samples for Verification: For each of the following:

1. Trees: Three Samples of each variety and size delivered to site for review. Maintain approved Samples on-site as a standard for comparison.

2. Compost Mulch: 1-quart volume of each organic mulch required; in sealed plastic bags labeled with composition of materials by percentage of weight and source of mulch. Each Sample shall be typical of the lot of material to be furnished; provide an accurate representation of color, texture, and organic makeup.

3. Mineral Mulch: 2 lb of each mineral mulch required, in sealed plastic bags labeled with source of mulch. Sample shall be typical of the lot of material

to be delivered and installed on-site; provide an accurate indication of color, texture, and makeup of the material.

4. Weed Control Barrier: 12 by 12 inches.
5. Proprietary Root-Ball-Stabilization Device: One unit.
6. Slow-Release, Tree-Watering Device: One unit of each size required.

1.08 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For landscape Installer. Include list of similar projects completed by Installer demonstrating Installer's capabilities and experience. Include project names, addresses, and year completed, and include names and addresses of owners' contact persons.
- B. Product Certificates: For each type of manufactured product, from manufacturer, and complying with the following:
 1. Manufacturer's certified analysis of standard products.
 2. Analysis of other materials by a recognized laboratory made according to methods established by the Association of Official Analytical Chemists, where applicable.
- C. Pesticides and Herbicides: Product label and manufacturer's application instructions specific to Project.
- D. Sample Warranty: For special warranty.

1.09 CLOSEOUT SUBMITTALS

- A. Maintenance Data: Recommended procedures to be established by Owner for maintenance of plants during a calendar year. Submit before expiration of required maintenance periods.

1.10 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified landscape installer whose work has resulted in successful establishment of plants.
 1. Professional Membership: Installer shall be a member in good standing of either the Professional Landcare Network or the American Nursery and Landscape Association.
 2. Experience: Five years' experience in landscape installation in addition to requirements in Section 014000 "Quality Requirements."
 3. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.

4. Personnel Certifications: Installer's field supervisor shall have certification in one of the following categories from the Professional Landcare Network:

- a. Landscape Industry Certified Technician - Exterior.
- b. Landscape Industry Certified Interior.
- c. Landscape Industry Certified Horticultural Technician.

5. Pesticide Applicator: State licensed, commercial.

B. Provide quality, size, genus, species, and variety of plants indicated, complying with applicable requirements in ANSI Z60.1.

1. Selection of plants purchased under allowances is made by Architect, who tags plants at their place of growth before they are prepared for transplanting.

C. Measurements: Measure according to ANSI Z60.1. Do not prune to obtain required sizes.

1. Trees: Measure with branches and trunks or canes in their normal position. Take height measurements from or near the top of the root flare for field-grown stock and container-grown stock. Measure main body of tree or shrub for height and spread; do not measure branches or roots tip to tip. Take caliper measurements 6 inches above the root flare for trees up to 4-inch caliper size, and 12 inches above the root flare for larger sizes.

2. Other Plants: Measure with stems, petioles, and foliage in their normal position.

D. Plant Material Observation: Architect may observe plant material either at place of growth or at site before planting for compliance with requirements for genus, species, variety, cultivar, size, and quality. Architect may also observe trees and shrubs further for size and condition of balls and root systems, pests, disease symptoms, injuries, and latent defects and may reject unsatisfactory or defective material at any time during progress of work. Remove rejected trees or shrubs immediately from Project site.

1. Notify Architect of sources of planting materials seven days in advance of delivery to site.

1.11 DELIVERY, STORAGE, AND HANDLING

A. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of compliance with state and Federal laws if applicable.

B. Bulk Materials:

1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
 2. Provide erosion-control measures to prevent erosion or displacement of bulk materials; discharge of soil-bearing water runoff; and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
 3. Accompany each delivery of bulk materials with appropriate certificates.
- C. Deliver bare-root stock plants within 24 hours of digging. Immediately after digging up bare-root stock, pack root system in wet straw, hay, or other suitable material to keep root system moist until planting. Transport in covered, temperature-controlled vehicles, and keep plants cool and protected from sun and wind at all times.
- D. Do not prune trees and shrubs before delivery. Protect bark, branches, and root systems from sun scald, drying, wind burn, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees or shrubs in such a manner as to destroy their natural shape. Provide protective covering of plants during shipping and delivery. Do not drop plants during delivery and handling.
- E. Handle planting stock by root ball.
- F. Apply antidesiccant to trees and shrubs using power spray to provide an adequate film over trunks (before wrapping), branches, stems, twigs, and foliage to protect during digging, handling, and transportation.
1. If deciduous trees or shrubs are moved in full leaf, spray with antidesiccant at nursery before moving and again two weeks after planting.
- G. Wrap trees and shrubs with burlap fabric over trunks, branches, stems, twigs, and foliage to protect from wind and other damage during digging, handling, and transportation.
- H. Deliver plants after preparations for planting have been completed and install immediately. If planting is delayed more than six hours after delivery, set plants and trees in their appropriate aspect (sun, filtered sun, or shade), protect from weather and mechanical damage, and keep roots moist.
1. Heel-in bare-root stock. Soak roots that are in less than moist condition in water for two hours. Reject plants with dry roots.
 2. Set balled stock on ground and cover ball with soil, peat moss, sawdust, or other acceptable material.
 3. Do not remove container-grown stock from containers before time of planting.

4. Water root systems of plants stored on-site deeply and thoroughly with a fine-mist spray. Water as often as necessary to maintain root systems in a moist, but not overly wet condition.

1.12 FIELD CONDITIONS

A. Field Measurements: Verify actual grade elevations, service and utility locations, irrigation system components, and dimensions of plantings and construction contiguous with new plantings by field measurements before proceeding with planting work.

B. Planting Restrictions: Plant during one of the following periods. Coordinate planting periods with maintenance periods to provide required maintenance from date of Substantial Completion.

1. Spring Planting: March to May
2. Fall Planting: September to November
3. Winter Planting (Trees only): Late October to Early April

C. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions and warranty requirements.

1.13 WARRANTY

A. Special Warranty: Installer agrees to repair or replace plantings and accessories that fail in materials, workmanship, or growth within specified warranty period.

1. Failures include, but are not limited to, the following:
 - a. Death and unsatisfactory growth, except for defects resulting from abuse, lack of adequate maintenance, or neglect by Owner.
 - b. Structural failures including plantings falling or blowing over.
 - c. Faulty performance of tree stabilization.
 - d. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
2. Warranty Periods: From date of planting completion.
 - a. Trees, Shrubs, Vines, and Ornamental Grasses: 12 months.
 - b. Ground Covers, Biennials, Perennials, and Other Plants: 12 months.
 - c. Annuals: Three months.
3. Include the following remedial actions as a minimum:

- a. Immediately remove dead plants and replace unless required to plant in the succeeding planting season.
- b. Replace plants that are more than 25 percent dead or in an unhealthy condition at end of warranty period.
- c. A limit of one replacement of each plant is required except for losses or replacements due to failure to comply with requirements.
- d. Provide extended warranty for period equal to original warranty period, for replaced plant material.

PART 2 - PRODUCTS

2.01 PLANT MATERIAL

A. General: Furnish nursery-grown plants true to genus, species, variety, cultivar, stem form, shearing, and other features indicated in Plant List, Plant Schedule, or Plant Legend indicated on Drawings and complying with ANSI Z60.1; and with healthy root systems developed by transplanting or root pruning. Provide well-shaped, fully branched, healthy, vigorous stock, densely foliated when in leaf and free of disease, pests, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement.

- 1. Trees with damaged, crooked, or multiple leaders; tight vertical branches where bark is squeezed between two branches or between branch and trunk ("included bark"); crossing trunks; cut-off limbs more than 3/4 inch in diameter; or with stem girdling roots are unacceptable.
- 2. Collected Stock: Do not use plants harvested from the wild, from native stands, from an established landscape planting, or not grown in a nursery unless otherwise indicated.

B. Provide plants of sizes, grades, and ball or container sizes complying with ANSI Z60.1 for types and form of plants required. Plants of a larger size may be used if acceptable to Architect, with a proportionate increase in size of roots or balls.

C. Root-Ball Depth: Furnish trees with root balls measured from top of root ball, which begins at root flare according to ANSI Z60.1. Root flare shall be visible before planting.

D. Labeling: Label at least one plant of each variety, size, and caliper with a securely attached, waterproof tag bearing legible designation of common name and full scientific name, including genus and species. Include nomenclature for hybrid, variety, or cultivar, if applicable for the plant.

E. If formal arrangements or consecutive order of plants is indicated on Drawings, select stock for uniform height and spread, and number the labels to assure symmetry in planting.

2.02 FERTILIZERS

A. Planting Tablets: Tightly compressed chip-type, long-lasting, slow-release, commercial-grade planting fertilizer in tablet form. Tablets shall break down with soil bacteria, converting nutrients into a form that can be absorbed by plant roots.

1. Size: 5-gram tablets.
2. Nutrient Composition: 20 percent nitrogen, 10 percent phosphorous, and 5 percent potassium, by weight plus micronutrients.

2.03 MULCHES

A. Organic Mulch: Free from deleterious materials and suitable as a top dressing of trees and shrubs, consisting of one of the following:

1. Type: Pine straw.
2. Size Range: 3 inches maximum, 1/2 inch minimum.
3. Color: Natural.

B. Compost Mulch: Well-composted, stable, and weed-free organic matter, pH of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through a 1-inch sieve; soluble-salt content of 2 to 5 dS/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings; and as follows:

1. Organic Matter Content: 50 to 60 percent of dry weight.
2. Feedstock: Agricultural residuals; biosolids; yard trimmings; or source-separated or compostable mixed solid waste.

2.04 WEED-CONTROL BARRIERS

A. Nonwoven Geotextile Filter Fabric: Polypropylene or polyester fabric, 3 oz./sq. yd. minimum, composed of fibers formed into a stable network so that fibers retain their relative position. Fabric shall be inert to biological degradation and resist naturally encountered chemicals, alkalis, and acids.

B. Composite Fabric: Woven, needle-punched polypropylene substrate bonded to a nonwoven polypropylene fabric, 4.8 oz./sq. yd.

2.05 PESTICIDES

A. General: Pesticide registered and approved by the EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each

specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.

B. Pre-Emergent Herbicide (Selective and Nonselective): Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the mulch layer.

C. Post-Emergent Herbicide (Selective and Nonselective): Effective for controlling weed growth that has already germinated.

2.06 TREE-STABILIZATION MATERIALS

A. Trunk-Stabilization Materials:

1. Upright and Guy Stakes: Rough-sawn, sound, new hardwood, free of knots, holes, cross grain, and other defects, 2-by-2-inch nominal by length indicated, pointed at one end.

2. Wood Deadmen: Timbers measuring 8 inches in diameter and 48 inches long, treated with specified wood pressure-preservative treatment.

3. Flexible Ties: Fabric straps of length required to reach stakes or turnbuckles.

4. Tree-Tie Webbing: UV-resistant polypropylene or nylon webbing with brass grommets.

5. Flags: Standard surveyor's plastic flagging tape, white, 6 inches long.

a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

- 1) Arborbrace; ArborBrace Tree Guying System.
- 2) Bio-Plex, Tree Guying kits and Ties.
- 3) Better Bilt Products, Inc; Tree Anchor Kit.
- 4) DeepRoot Green Infrastructure, LLC; ArborTie AT LD100 Professional Anchoring Kit
- 5) J. R. Partners; Tree Grate Stakes

B. Root-Ball Stabilization Materials:

1. Upright Stakes and Horizontal Hold-Down: Rough-sawn, sound, new hardwood or softwood, free of knots, holes, cross grain, and other defects, 2-by-2-inch nominal by length indicated; stakes pointed at one end.

2. Wood Screws: ASME B18.6.1.

3. Proprietary Root-Ball Stabilization Devices: Proprietary at- or below-grade stabilization systems to secure each new planting by root ball and that do not encircle the trunk; sized according to manufacturer's written recommendations unless otherwise indicated.

a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

- 1) Border Concepts, Inc; Tomahawk Tree Stabilizers.
- 2) Foresight Products, LLC; Duckbill Rootball Fixing System.
- 3) Platipus Anchors, Inc. Earth Anchoring Systems
- 4) Tree Staple, Inc; Tree Staples.

2.07 TREE-WATERING DEVICES

A. Watering Pipe: PVC pipe 4 inches in diameter, site-cut to length as required, and with snug-fitting removable cap.

B. Slow-Release Watering Device: Standard product manufactured for drip irrigation of plants and emptying its water contents over an extended time period; manufactured from UV-light-stabilized nylon-reinforced polyethylene sheet, PVC, or HDPE plastic.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

- a. BIO-PLEX.
- b. Engineered Watering Solutions; PQ Partners, LLC.
- c. Spectrum Products, Inc.

2. Color: As selected by Architect from manufacturer's full range.

2.08 MISCELLANEOUS PRODUCTS

A. Wood Pressure-Preservative Treatment: AWPA U1, Use Category UC4a; acceptable to authorities having jurisdiction, and containing no arsenic or chromium.

B. Antidesiccant: Water-insoluble emulsion, permeable moisture retarder, film forming, for trees and shrubs. Deliver in original, sealed, and fully labeled containers and mix according to manufacturer's written instructions.

C. Burlap: Non-synthetic, biodegradable.

D. Mycorrhizal Fungi: Dry, granular inoculant containing at least 5300 spores per lb of vesicular-arbuscular mycorrhizal fungi and 95 million spores per lb of ectomycorrhizal fungi, 33 percent hydrogel, and a maximum of 5.5 percent inert material.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas to receive plants, with Installer present, for compliance with requirements and conditions affecting installation and performance of the Work.

1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
2. Verify that plants and vehicles loaded with plants can travel to planting locations with adequate overhead clearance.
3. Suspend planting operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
4. Uniformly moisten excessively dry soil that is not workable, or which is dusty.

B. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Architect and replace with new planting soil.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities and turf areas and existing plants from damage caused by planting operations.

B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

C. Lay out individual tree and shrub locations and areas for multiple plantings. Stake locations, outline areas, adjust locations when requested, and obtain Architect's acceptance of layout before excavating or planting. Make minor adjustments as required.

D. Lay out plants at locations directed by provided landscape plans or Architect. Stake locations of individual trees and shrubs and outline areas for multiple plantings.

3.03 PLANTING AREA ESTABLISHMENT

- A. General: Prepare planting area for soil placement and mix planting soil according to Section 32 91 13 "Soil Preparation."
- B. Placing Planting Soil: Blend planting soil in place.
- C. Before planting, obtain Engineer's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.
- D. Application of Mycorrhizal Fungi: At time directed by Architect, broadcast dry product uniformly over prepared soil at application rate according to vendors recommendation.

3.04 EXCAVATION FOR TREES

- A. Planting Pits and Trenches: Excavate circular planting pits.
 - 1. Excavate planting pits with sides sloping inward at a 45-degree angle. Excavations with vertical sides are unacceptable. Trim perimeter of bottom leaving center area of bottom raised slightly to support root ball and assist in drainage away from center. Do not further disturb base. Ensure that root ball will sit on undisturbed base soil to prevent settling. Scarify sides of planting pit smeared or smoothed during excavation.
 - 2. Excavate approximately three times as wide as ball diameter for balled and burlapped stock.
 - 3. Excavate at least 12 inches wider than root spread and deep enough to accommodate vertical roots for bare-root stock.
 - 4. Do not excavate deeper than depth of the root ball, measured from the root flare to the bottom of the root ball.
 - 5. If area under the plant was initially dug too deep, add soil to raise it to the correct level and thoroughly tamp the added soil to prevent settling.
 - 6. Maintain angles of repose of adjacent materials to ensure stability. Do not excavate subgrades of adjacent paving, structures, hardscapes, or other new or existing improvements.
 - 7. Maintain supervision of excavations during working hours.
 - 8. Keep excavations covered or otherwise protected overnight.
 - 9. If drain tile is indicated on Drawings or required under planting areas, excavate to top of porous backfill over tile.
- B. Backfill Soil: Subsoil and topsoil removed from excavations may not be used as backfill soil unless otherwise indicated.

C. Obstructions: Notify Architect if unexpected rock or obstructions detrimental to trees or shrubs are encountered in excavations.

1. Hardpan Layer: Drill 6-inch- diameter holes, 24 inches apart, into free-draining strata or to a depth of 10 feet, whichever is less, and backfill with free-draining material.

D. Drainage: Notify Architect if subsoil conditions show unexpected water seepage or retention in tree or shrub planting pits.

E. Fill excavations with water and allow to percolate away before positioning trees and shrubs.

3.05 TREE PLANTING

A. Inspection: At time of planting, verify that root flare is visible at top of root ball according to ANSI Z60.1. If root flare is not visible, remove soil in a level manner from the root ball to where the top-most root emerges from the trunk. After soil removal to expose the root flare, verify that root ball still meets size requirements.

B. Roots: Remove stem girdling roots and kinked roots. Remove injured roots by cutting cleanly; do not break.

C. Balled and Burlapped Stock: Set each plant plumb and in center of planting pit or trench with root flare 2 inches above adjacent finish grades.

1. Backfill: Planting soil for trees, use excavated soil for backfill.

2. After placing some backfill around root ball to stabilize plant, carefully cut and remove burlap, rope, and wire baskets from tops of root balls and from sides, but do not remove from under root balls. Remove pallets, if any, before setting. Do not use planting stock if root ball is cracked or broken before or during planting operation.

3. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.

4. Place planting tablets equally distributed around each planting pit when pit is approximately one-half filled. Place tablets beside the root ball about 1 inch from root tips; do not place tablets in bottom of the hole.

a. Quantity: Three for each caliper inch of plant.

5. Continue backfilling process. Water again after placing and tamping final layer of soil.

D. Balled and Potted and Container-Grown Stock: Set each plant plumb and in center of planting pit or trench with root flare 2 inches adjacent finish grades.

1. Backfill: Planting soil for trees, use excavated soil for backfill.
2. Carefully remove root ball from container without damaging root ball or plant.
3. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
4. Place planting tablets equally distributed around each planting pit when pit is approximately one-half filled. Place tablets beside the root ball about 1 inch from root tips; do not place tablets in bottom of the hole.
 - a. Quantity: Three for each caliper inch of plant.
5. Continue backfilling process. Water again after placing and tamping final layer of soil.

E. Fabric Bag-Grown Stock: Set each plant plumb and in center of planting pit or trench with root flare 2 inches above adjacent finish grades.

1. Backfill: Planting soil for trees, use excavated soil for backfill.
2. Carefully remove root ball from fabric bag without damaging root ball or plant. Do not use planting stock if root ball is cracked or broken before or during planting operation.
3. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
4. Place planting tablets equally distributed around each planting pit when pit is approximately one-half filled. Place tablets beside the root ball about 1 inch from root tips; do not place tablets in bottom of the hole.
 - a. Quantity: Three for each caliper inch of plant.
5. Continue backfilling process. Water again after placing and tamping final layer of soil.

F. Bare-Root Stock: Set and support each plant in center of planting pit or trench with root flare 2 inches (50 mm) above adjacent finish grade.

1. Backfill: Planting soil for trees, use excavated soil for backfill.

2. Spread roots without tangling or turning toward surface. Plumb before backfilling and maintain plumb while working.
3. Carefully work backfill in layers around roots by hand. Bring roots into close contact with the soil.
4. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
5. Place planting tablets equally distributed around each planting pit when pit is approximately one-half filled. Place tablets beside soil-covered roots about 1 inch from root tips; do not place tablets in bottom of the hole or touching the roots.
 - a. Quantity: Three for each caliper inch of plant.
6. Continue backfilling process. Water again after placing and tamping final layer of soil.

G. Watering Pipe: During backfilling, install watering pipe 4 feet deep into the planting pit outside the root ball with top of pipe 1 inch above the mulched surface.

H. Slopes: When planting on slopes, set the plant so the root flare on the uphill side is flush with the surrounding soil on the slope; the edge of the root ball on the downhill side will be above the surrounding soil. Apply enough soil to cover the downhill side of the root ball.

3.06 MECHANIZED TREE-SPADE PLANTING

- A. Trees may be planted with an approved mechanized tree spade at the designated locations. Do not use tree spade to move trees larger than the maximum size allowed for a similar field-grown, balled-and-burlapped root-ball diameter according to ANSI Z60.1, or larger than manufacturer's maximum size recommendation for the tree spade being used, whichever is smaller.
- B. Use the same tree spade to excavate the planting hole as will be used to extract and transport the tree.
- C. When extracting the tree, center the trunk within the tree spade and move tree with a solid ball of earth.
- D. Cut exposed roots cleanly during transplanting operations.
- E. Plant trees following procedures in "Tree, Shrub, and Vine Planting" section.
- F. Where possible, orient the tree in the same direction as in its original location.

3.07 TREE PRUNING

- A. Remove only dead, dying, or broken branches. Do not prune for shape.

- B. Prune, thin, and shape trees as directed by Architect.
- C. Prune, thin, and shape trees according to standard professional horticultural and arboricultural practices. Unless otherwise indicated by Architect, do not cut tree leaders; remove only injured, dying, or dead branches from trees and shrubs; and prune to retain natural character.
- D. Do not apply pruning paint to wounds.

3.08 TREE STABILIZATION

- A. Trunk Stabilization by Upright Staking and Tying: Install trunk stabilization as follows unless otherwise indicated:
 - 1. Upright Staking and Tying: Stake trees of 2- through 5-inch caliper. Stake trees of less than 2-inch caliper only as required to prevent wind tip out. Use a minimum of two stakes of length required to penetrate at least 18 inches below bottom of backfilled excavation and to extend at least one-third of trunk height above grade. Set vertical stakes and space to avoid penetrating root balls or root masses.
 - 2. Upright Staking and Tying: Stake trees with two stakes for trees up to 12 feet high and 2-1/2 inches or less in caliper; three stakes for trees less than 14 feet high and up to 4 inches in caliper. Space stakes equally around trees.
 - 3. Support trees with bands of flexible fabric web ties at contact points with tree trunk. Allow enough slack to avoid rigid restraint of tree.
- B. Trunk Stabilization by Staking and Guying: Install trunk stabilization as follows unless otherwise indicated on Drawings. Stake and guy trees more than 16 feet in height and more than 6 inches in caliper unless otherwise indicated.
 - 1. Site-Fabricated, Staking-and-Guying Method: Install no fewer than three guys spaced equally around tree.
 - a. Securely attach guys to stakes 30 inches long, driven to grade. Adjust spacing to avoid penetrating root balls or root masses. Provide turnbuckle for each guy wire and tighten securely.
 - b. For trees more than 6 inches in caliper, anchor guys to wood deadmen buried at least 36 inches below grade. Provide turnbuckle for each guy wire and tighten securely.
 - c. Support trees with bands of flexible ties at contact points with tree trunk and reaching to turnbuckle. Allow enough slack to avoid rigid restraint of tree.
 - d. Support trees with guy cable or multiple strands of tie wire, connected to the brass grommets of tree-tie webbing at contact points

with tree trunk and reaching to turnbuckle. Allow enough slack to avoid rigid restraint of tree.

- e. Attach flags to each guy wire, 30 inches above finish grade.
- f. Paint turnbuckles with luminescent white paint.

C. Root-Ball Stabilization: Install at- or below-grade stabilization system to secure each new planting by the root ball unless otherwise indicated.

- 1. Wood Hold-Down Method: Place vertical stakes against side of root ball and drive them into subsoil; place horizontal wood hold-down stake across top of root ball and screw at each end to one of the vertical stakes.
 - a. Install stakes of length required to penetrate at least 18 inches below bottom of backfilled excavation. Saw stakes off at horizontal stake.
 - b. Install screws through horizontal hold-down and penetrating at least 1 inch into stakes. Predrill holes if necessary to prevent splitting wood.
 - c. Install second set of stakes on other side of root trunk for larger trees.
- 2. Proprietary Root-Ball Stabilization Device: Install root-ball stabilization system sized and positioned as recommended by manufacturer unless otherwise indicated and according to manufacturer's written instructions.

3.09 PLANTING AREA MULCHING

- A. Install weed-control barriers before mulching according to manufacturer's written instructions. Completely cover area to be mulched, overlapping edges a minimum of 6 inches and secure seams with galvanized pins.
- B. Mulch backfilled surfaces of planting areas and other areas indicated.
 - 1. Organic Mulch in Planting Areas: Apply 3-inch average thickness of organic mulch extending 12 inches beyond edge of individual planting pit or trench and over whole surface of planting area, and finish level with adjacent finish grades. Do not place mulch within 6 inches of trunks or stems.
 - 2. Mineral Mulch in Planting Areas: Apply 2-inch average thickness of mineral mulch extending 12 inches beyond edge of individual planting pit or trench and over whole surface of planting area, and finish level with adjacent finish grades. Do not place mulch within 6 inches of trunks or stems.

3.10 INSTALLING SLOW-RELEASE WATERING DEVICE

- A. Provide one device for each tree.

B. Place device on top of the mulch at base of tree stem and fill with water according to manufacturer's written instructions.

3.11 PLANT MAINTENANCE

A. Maintain plantings by pruning, cultivating, watering, weeding, fertilizing, mulching, restoring planting saucers, adjusting and repairing tree-stabilization devices, resetting to proper grades or vertical position, and performing other operations as required to establish healthy, viable plantings.

B. Fill in, as necessary, soil subsidence that may occur because of settling or other processes. Replace mulch materials damaged or lost in areas of subsidence.

C. Apply treatments as required to keep plant materials, planted areas, and soils free of pests and pathogens or disease. Use integrated pest management practices to minimize use of pesticides and reduce hazards. Treatments include physical controls such as hosing off foliage, mechanical controls such as traps, and biological control agents.

3.12 PESTICIDE APPLICATION

A. Apply pesticides and other chemical products and biological control agents according to authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.

B. Pre-Emergent Herbicides (Selective and Nonselective): Apply to tree, shrub, and ground-cover areas according to manufacturer's written recommendations. Do not apply to seeded areas.

C. Post-Emergent Herbicides (Selective and Nonselective): Apply only as necessary to treat already-germinated weeds and according to manufacturer's written recommendations.

3.13 REPAIR AND REPLACEMENT

A. General: Repair or replace existing or new trees and other plants that are damaged by construction operations, in a manner approved by Architect.

1. Submit details of proposed pruning and repairs.
2. Perform repairs of damaged trunks, branches, and roots within 24 hours, if approved.
3. Replace trees and other plants that cannot be repaired and restored to full-growth status, as determined by Architect or municipality inspector.

B. Remove and replace trees that are more than 25 percent dead or in an unhealthy condition before the end of the corrections period or are damaged during construction operations that Architect determines are incapable of restoring to normal growth pattern.

1. Provide new trees of same size as those being replaced for each tree of 4 inches or smaller in caliper size.
2. Provide one new tree(s) of 4-inch caliper size for each tree being replaced those measures more than 6 inches in caliper size.
3. Species of Replacement Trees: Species selected by Architect.

3.14 CLEANING AND PROTECTION

- A. During planting, keep adjacent paving and construction clean and work area in an orderly condition. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.
- B. Remove surplus soil and waste material including excess subsoil, unsuitable soil, trash, and debris and legally dispose of them off Owner's property.
- C. Protect plants from damage due to landscape operations and operations of other contractors and trades. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged plantings.
- D. After installation and before Substantial Completion, remove nursery tags, nursery stakes, tie tape, labels, wire, burlap, and other debris from plant material, planting areas, and Project site.
- E. At time of Substantial Completion, verify that tree-watering devices are in good working order and leave them in place. Replace improperly functioning devices.

3.15 MAINTENANCE SERVICE

- A. Maintenance Service for Trees and Shrubs: Provide maintenance by skilled employees of landscape Installer. Maintain as required in "Plant Maintenance" section. Begin maintenance immediately after plants are installed and continue until plantings are acceptably healthy and well established, but for not less than maintenance period below:
 1. Maintenance Period: Twelve months from date of Substantial Completion or issuance of Certificate of Occupancy.

END OF SECTION

SECTION 33 05 23

BORE AND JACK CASINGS

PART 1 – GENERAL

1.01. SUMMARY

- A. The work covered by this Section includes furnishing all labor, materials and equipment required to bore and jack casings and to properly complete pipeline construction as described herein and/or shown on the Drawings.
- B. Work shall include but not limited to bore and receiving pits excavation, sheeting, shoring, plating and safety barriers for the protection of workers, traffic, and the general public.
 - 1. In general, the work shall include carrier pipe, steel pipe casing, excavation, backfill, restoration of site, sheeting, grout, brickwork, earth augers, jacking machine, welder and other accessories necessary for a complete installation as specified or directed.
- C. Supply all materials and perform all work in accordance with applicable American Society for Testing and Materials (ASTM), American Water Works Association (AWWA), American National Standards Institute (ANSI) or other recognized standards.
 - 1. Latest revisions of all standards are applicable.
 - 2. If requested by the Owner, submit evidence that manufacturer has consistently produced products of satisfactory quality and performance over a period of at least two years.

1.02. SUBMITTALS

- A. Submit shop drawings, product data, and experience in accordance with the requirements of Sections 01 33 00 and 01 33 23 of these Specifications.
- B. Material Submittals: The Contractor shall provide shop drawings and other pertinent specifications and product data as follows:
 - 1. Shop drawings for casing pipe showing sizes and connection details.
 - 2. Design mixes for concrete and grout.
 - 3. Casing Spacers.
- C. Experience Submittals
 - 1. Boring and jacking casings is deemed to be specialty contractor work.
 - 2. If the Contractor elects to perform the work, the Contractor shall provide evidence as required by the General Conditions.

- a. A minimum of five continuous years of experience in steel casing construction is required of the casing installer.
- b. Evidence of this experience must be provided with the shop drawings for review by the Owner.

D. The Contractor shall submit for approval, all working drawings and schedules of procedure proposed to be followed in the execution of boring and jacking operations.

- 1. Schedules shall set forth the sequence of the various operations together with the time proposed to begin and complete the phases of the work.

1.03. STORAGE AND PROTECTION

A. All materials shall be stored and protected in accordance with the manufacturer's recommendations and as approved by the Owner.

PART 2 – PRODUCTS

2.01. CASING PIPE

A. Steel Pipe:

- 1. Pipe shall be new and unused.
- 2. The casing shall be made from steel plate having a minimum yield strength of 35,000 psi.
- 3. The steel plate shall meet the chemical requirements of ASTM A139, Grade B.
- 4. The thicknesses of casing shown in Table 1 below are minimum thicknesses.
 - a. Actual thicknesses shall be determined by the casing installer, based on an evaluation of the required forces to be exerted on the casing when jacking.
 - b. Any buckling of the casing due to jacking forces shall be repaired at no additional cost to the Owner.
- 5. The diameters of casing shown in Table 1 below and shown on the Drawings are minimum.
 - a. Larger casings, with the Owner's approval, may be provided at no additional cost to the Owner, for whatever reasons the Contractor may decide, whether they be casing size availability, line and grade tolerances, soil conditions, etc.

Section 4
Scope of Work and Technical Specifications
SECTION 33 05 23-3 BORE AND JACK CASINGS

Pipe Diameter, inches	Pipe O.D. inches	Casing Size Inches	Casing I.D. inches
6	6.90	12	11.376
8	9.05	16	14.134
12	13.20	20	17.938
16	17.40	24	21.564
20	21.60	28	27.000
24	25.80	36	35.000
30	32.00	42	41.000
36	38.20	48	47.000

2.02. CASING SPACERS

A. Shell

1. Material: Minimum 14-gauge T-304 stainless steel.
2. Surfaces to be treated to reduce chemical reactivity.

B. Risers

1. Material: Minimum 10-gauge T-304 stainless steel.
2. Height shall be such that the pipe does not float within the casing.

C. Fasteners

1. Material: T-304 Stainless steel.

D. Liner

1. Material: PVC.
2. Thickness: 0.09 inch.
3. Hardness: 85 to 90 durometer.

E. Runners

1. Tensile Strength (ASTM D638): Minimum 3,500 psi.
2. Width: Minimum 2 in.
3. Runners shall be attached to stainless steel risers which shall be properly welded to the shell.
4. The height of the runners shall be such that the pipe does not float within the casing.

- F. Casing spacers shall be as manufactured by:
1. Cascade Waterworks Manufacturing Company
 2. Pipeline Seal and Insulator, Inc.
 3. Advanced Products and Systems, Inc.
 4. Or approved equal.

2.03. CASING END SEALS

- A. The ends of the casing shall be sealed with brick bulkheads using brick and mortar.

2.04. GROUT

- A. Grout may be used for filling the void between the casing pipe and the carrier pipe.
- B. Cement shall conform to ASTM C 150, Type I or Type II.
- C. Grout shall have a minimum compressive strength of 100 psi attained within 24 hours.

2.05. CARRIER PIPE

- A. Carrier pipes shall meet requirements as specified in Sections 33 30 00, 33 31 00, 33 32 00 and 33 33 00 of these Specifications.

2.06. SURFACE SETTLEMENT MARKERS

- A. Surface settlement markers within pavement areas shall be P.K. nails.
- B. Surface settlement markers within non paved areas shall be wooden hubs.

2.07. EQUIPMENT

- A. A cutting head shall be attached to a continuous auger mounted inside the casing pipe.
- B. Jacks for forcing the casing pipe through the roadbed shall have a jacking head constructed in such a manner as to apply uniform pressure around the ring of the pipe.
- C. The pipe to be jacked shall be set on guides, braced together to properly support the section of the pipe and direct it to the proper line and grade. In general roadbed material shall be excavated just ahead of the pipe.
- D. On casing pipe for pipelines over 60 feet in length, the installation equipment shall include a steering head and a grade indicator.
- E. The steering head shall be controlled manually from the bore pit.

F. The grade indicator shall consist of a water level attached to the casing which would indicate the elevation of the front end of the casing or some other means for grade indication approved by the Owner.

PART 3 – EXECUTION

3.01. GENERAL

A. The Contractor shall proceed with the work in such a manner as will permit regular transaction of business by the roadway owner and/or property owner without delay or danger of life or property and shall place necessary barricades, warning signs, signal lights, and if necessary, watchmen for the protection of the public.

B. All excavated material will be placed near the top of the working pit and disposed of as required. Use of water or other fluids will be permitted only to the extent necessary for lubrication. Jetting will not be permitted.

C. Contractor shall jack a steel casing pipe as indicated on the approved design, using a special earth auger machine. The casing shall be jacked to the line and grade indicated on the approved design.

D. All jacking/augering operations must be performed in compliance with the rules and regulations of the Fulton County Department of Transportation, Georgia Department of Transportation or other authorities having jurisdiction.

E. Any sheeting placed for the jacking/auguring operation must be completely removed by the Contractor prior to backfill.

F. When the bore pit excavation and/or jacking/auguring operation occurs along existing rights-of-way, care must be taken to ensure all work is performed within the right-of-way, or arrangements must be made with the owner of the affected private property to permit any encroachment on the private property.

G. All such arrangements shall be made in writing and a copy provided to the Owner prior to beginning the excavation.

H. The Contractor shall be fully responsible for protecting against surface subsidence, damage or disturbance to adjacent property and facilities from his construction methods.

1. If loose material is encountered and cave-ins occur or are anticipated, all jacking/augering shall be suspended, shoring provided, and all voids filled or pressure grouted.

2. Supplemental measures and alternative methods must receive the Owner's approval before jacking/augering operation re-commences.

3. Any settlement or upheaval of the existing roadway pavements during the boring and jacking operation, and throughout the warranty period for the overall

project, shall be repaired/restored by the Contractor immediately upon notification by the Owner of the pavement failure.

I. Interpretation of soil investigation reports and data, investigating the site and determination of the site soil conditions prior to bidding is the sole responsibility of the Contractor.

1. Any subsurface investigation by the Progressive Design-Build Contractor must be approved by the appropriate authority having jurisdiction over the site.

2. Rock and/or water, if encountered, shall not entitle the Contractor to additional compensation.

J. Casing construction shall be performed so as not to interfere with, interrupt or endanger roadway surface and activity thereon, and minimize subsidence of the surface, structures, and utilities above and in the vicinity of the casing.

1. Support the ground continuously in a manner that will prevent loss of ground and keep the perimeters and face of the casing, passages and shafts stable.

2. The Contractor shall be responsible for all settlement resulting from casing operations and shall repair and restore damaged property to its original or better condition at no cost to the Owner.

K. Face Protection: The face of the excavation shall be protected from the collapse of the soil into the casing.

L. Casing Design: Design of the bore pit and required bearing to resist jacking forces is the responsibility of the Contractor.

1. The excavation method selected shall be compatible with expected ground conditions.

2. The lengths of the casing shown on the Drawings are the minimum lengths required.

3. The length of the casing may be extended for the convenience of the Contractor at no additional cost to the Owner.

4. Due to restrictive right of way and construction easements, boring and jacking casing lengths less than the nominal 20 foot length may be necessary.

M. Roadway Crossings

1. The Contractor shall be held responsible and accountable for the coordinating and scheduling of all construction work within the roadway right of way.

2. Work along or across the roadway department rights of way shall be subject to inspection by such roadway department.
3. All installations shall be performed to leave free flows in drainage ditches, pipes, culverts or other surface drainage facilities of the roadway, street or its connections.
4. No excavated material or equipment shall be placed on the pavement or shoulders of the roadway without the express approval of the roadway department.
5. In no instance will the Contractor be permitted to leave equipment (trucks, backhoes, etc.) on the pavement or shoulder overnight.
6. Construction materials to be installed, which are placed on the right of way in advance of construction, shall be placed in such a manner as not to interfere with the safe operation of the roadway.

3.02. MAINTAINING TRAFFIC AND PUBLIC SAFETY

- A. All working operations of the Contractor, his subcontractors, and/or their agents or employees must be subordinated to the free and unobstructed use of the highway and structures encountered in the execution of jacking and boring operations.
- B. The Contractor shall proceed with the work in such a manner as will permit regular transaction of business by commercial operations adjacent to the project site without delay or danger to persons or property, permit free access to and from private residences, and will allow the safe flow of traffic and pedestrians around the work site.
- C. The Contractor shall employ the use of barricades, barriers, warning signs, signals, lights, and if necessary, watchmen, for the protection of the general public.
- D. The Contractor, when directed by Owner, shall suspend all operations relating to boring and jacking until necessary safety precautions have been met.

3.03. GROUNDWATER CONTROL

- A. The Contractor shall control the groundwater throughout the construction of the casing.
- B. Methods of dewatering shall be at the option and responsibility of the Contractor. Maintain close observation to detect settlement or displacement of surface facilities due to dewatering.
 1. Should settlement or displacement be detected, notify the Owner immediately and take such action as necessary to maintain safe conditions and prevent damage.

C. When water is encountered, provide and maintain a dewatering system of sufficient capacity to remove water on a 24 hour basis keeping excavations free of water until the backfill operation is in progress.

1. Dewatering shall be performed in such a manner that removal of soil particles is held to a minimum.
2. Dewater into a sediment trap and comply with requirements specified in Section 31 25 00 of these Specifications.

3.04. SAFETY

A. Provide all necessary bracing, bulkheads and shields to ensure complete safety for all traffic, persons and property at all times during the work. Perform the work in such a manner as to not permanently damage the roadbed or interfere with normal traffic over it.

B. Observe all applicable requirements of the regulations of the authorities having jurisdiction over this site. Conduct the operations in such a manner that all work will be performed below the level of the roadbed.

C. Perform all activities in accordance with the Occupational Safety and Health Act of 1970 (PL 596), as amended, applicable regulations of the Federal Government, OSHA 29CFR 1926 and applicable criteria of ANSI A10.16 81, "Safety Requirements for Construction of Tunnel Shafts and Caissons".

3.05. SURFACE SETTLEMENT MONITORING

A. Provide surface settlement markers, placed as specified and as directed by the Owner.

1. The Contractor shall place settlement markers outside of pavement area, along the centerline of the casing at 20 foot intervals and offset 10 feet each way from the centerline.
2. Markers shall also be placed at each shoulder of the roadway, at each edge of pavement, at the centerline of the pavement and at 10 and 25 feet in each direction from the centerline of the casing.
3. Tie settlement markers to benchmarks and indices sufficiently removed as not to be affected by the casing operations.

B. Make observations of surface settlement markers, placed as required herein, at regular time intervals acceptable to the Owner.

1. In the event settlement or heave on any marker exceeds 1 inch, the Contractor shall immediately cease work and using a method approved by the Owner and the authority having jurisdiction over the project site, to take

immediate action to restore surface elevations to that existing prior to start of casing operations.

C. Take readings and permanently record surface elevations prior to start of dewatering operations and/or shaft excavation.

1. The following schedule shall be used for obtaining and recording elevation readings:

- a. All settlement markers, once a week;
- b. All settlement markers within 50 feet of the casing heading, at the beginning of each day; more frequently at the Owner's direction if settlement is identified.
- c. Make all elevation measurements to the nearest 0.01 foot.

D. The Contractor shall cooperate fully with jurisdictional personnel. Any settlement shall be corrected by, and at the expense of, the Contractor.

E. Report any settlement and horizontal movement immediately to the Owner and take immediate remedial action.

3.06. BORING AND JACKING

A. Shaft

1. Conduct boring and jacking operations from a shaft excavated at one end of the section to be bored.

a. Where conditions and accessibility are suitable, place the shaft on the downstream end of the bore.

2. The shaft shall be rectangular and excavated to a width and length required for ample working space.

a. If necessary, sheet and shore shaft properly on all sides. Shaft sheeting shall be timber or steel piling of ample strength to safely withstand all structural loadings of whatever nature due to site and soil conditions.

b. Keep preparations dry during all operations. Perform pumping operations as necessary.

3. The bottom of the shaft shall be firm and unyielding to form an adequate foundation upon which to work.

a. In the event the shaft bottom is not stable, excavate to such additional depth as required and place a gravel subbase or a concrete subbase if directed by the Owner due to soil conditions.

B. Jacking Rails and Frame

1. Whenever possible, the pipe shall be jacked from the low or downstream end. At each end of the casing pipe, the void between the carrier pipe and casing shall be sealed with brick and mortar.
2. Set jacking rails to proper line and grade within the shaft. Secure rails in place to prevent settlement or movement during operations. The jacking rails shall cradle and hold the casing pipe on true line and grade during the progress of installing the casing.
3. Place backing between the heels of jacking rails and the rear of the shaft. The backing shall be adequate to withstand all jacking forces and loads.
4. The jacking frame shall be of adequate design for the magnitude of the job. Apply thrust to the end of the pipe in such a manner to impart a uniformly balanced load to the pipe barrel without damaging the joint ends of the pipe.

C. Boring and jacking of casing pipes shall be accomplished by the dry auger boring method without jetting, sluicing or wet boring.

D. Auger the hole and jack the casing through the soil simultaneously.

E. Bored installations shall have a bored hole diameter essentially the same as the outside diameter of the casing pipe to be installed. Any voids which develop during the installation operation shall be filled with pressure grout.

F. Execute boring ahead of the casing pipe with extreme care, commensurate with the rate of casing pipe penetration.

1. Boring may proceed slightly in advance of the penetrating pipe and shall be made in such a manner to prevent any voids in the earth around the outside perimeter of the pipe.
2. Make all investigations and determine if the soil conditions are such as to require the use of a shield.

G. As the casing is installed, check the horizontal and vertical alignment frequently. Make corrections prior to continuing operation.

H. Any casing pipe damaged in jacking operations shall be repaired, if approved by the Owner, or removed and replaced at Contractor's own expense.

I. Lengths of casing pipe, as long as practical, shall be used except as restricted otherwise.

1. Joints between casing pipe sections shall be butt joints with complete joint penetration, single groove welds, for the entire joint circumference, in accordance with AWS recommended procedures.

2. Prior to welding the joints, the Contractor shall ensure that both ends of the casing sections being welded are square.

J. The Contractor shall prepare a contingency plan which will allow the use of a casing lubricant, such as bentonite, in the event excessive frictional forces jeopardize the successful completion of the casing installation.

K. Once the jacking procedure has begun, it shall be continued without stopping until completed, subject to weather and conditions beyond the control of the Contractor.

L. Care shall be taken to ensure that casing pipe installed by boring and jacking method will be at the proper alignment and grade.

M. The Contractor shall maintain and operate pumps and other necessary drainage system equipment to keep work dewatered at all times.

N. Adequate sheeting, shoring and bracing for embankments, operating pits and other appurtenances shall be placed and maintained to ensure that work proceeds safely and expeditiously.

1. Upon completion of the required work, the sheeting, shoring and bracing shall be left in place, cut off or removed, as designated by the Owner.

O. Trench excavation, all classes and types of excavation, the removal of rock, muck, debris, the excavation of all working pits and backfill requirements of Section 31 23 00 are included under this Section.

P. All surplus material shall be removed from the right of way and the excavation finished flush with the surrounding ground.

Q. Grout backfill shall be used for unused holes or abandoned pipes.

R. Any replacement of carrier pipe in an existing casing shall be considered a new installation, subject to the applicable requirements of these Specifications.

3.07. VENTILATION AND AIR QUALITY

A. Provide, operate and maintain for the duration of casing project a ventilation system to meet safety and OSHA requirements.

3.08. ROCK EXCAVATION

A. In the event that rock is encountered during the installation of the casing pipe which, in the opinion of the Owner, cannot be removed through the casing, the Owner may authorize the Contractor to complete the crossing by a method established in a change order.

B. At the Contractor's option, the Contractor may continue to install the casing and remove the rock through the casing at no additional cost to the Owner.

3.09. INSTALLATION OF PIPE

- A. After construction of the casing is complete and has been accepted by the Owner, install the carrier pipe in accordance with the Drawings and Specifications.
- B. Care shall be exercised at all times to maintain tight, fully seated joints in the carrier pipe. The carrier pipe shall be fully supported by prefabricated casing spacers when feasible.
- C. Check the alignment and grade of the casing and prepare a plan to set the carrier pipe at proper alignment, grade and elevation, without any sags or high spots.
- D. The carrier pipe shall be held in the casing pipe by one of the following methods:
 - 1. The carrier pipe shall be held in the casing pipe by the use of hardwood blocks spaced radially around the pipe and secured together so that they remain firmly in place.
 - a. The spacing of such blocks longitudinally in the casing pipe shall not be greater than 10 feet or as recommended by the pipe manufacturer.
 - 2. The pipe shall be supported within the casing by use of casing spacers sized to limit radial movement to a maximum of 1 inch.
 - a. Provide a minimum of two casing spacers per nominal length of pipe. Casing spacers shall be attached to the pipe at maximum 9 to 10 foot intervals or as recommended by the pipe manufacturer.
- E. Fill the void between the carrier pipe and casing pipe with grout. Measures shall be taken by the Contractor to prevent floatation and other movement of the pipe as the grout is filling the void.
- F. At each end of the casing pipe, the void between the carrier pipe and casing shall be sealed with 4 inches of brick and mortar.

3.10. SHEETING REMOVAL

- A. Remove sheeting used for shoring from the shaft and off the job site. The removal of sheeting, shoring and bracing shall be done in such a manner as not to endanger or damage either new or existing structures, private or public properties and also to avoid cave ins or sliding in the banks.

3.11. FREE BORING

- A. Where permitted and directed by the Owner, the Contractor shall use a special earth auger machine to install the pipe by the free bore method.
 - 1. The allowed free bore method will be dry auger boring, without jetting, sluicing, or wet boring.

B. The diameter of the free bore shall not exceed the pipe bell outside diameter or the pipe barrel outside diameter plus 1 inch, whichever is greater.

1. If the annular space between the earthen hole and the carrier pipe exceeds six inches, the Contractor shall fill such space either by pressure grouting or pumping in a flowable fill to eliminate possible settlement.

C. The Contractor shall be responsible for any settlement of the surface (roadway, driveway, or otherwise) caused by the free bore construction activities.

D. Where ordered to use the free bore method to install a segment of pipe, the Contractor may elect to install the pipe by the conventional bore and jack casing method instead.

E. If the Contractor elects to free bore and an acceptable installation does not result for any reason, the Contractor shall install a casing pipe by the bore and jack method at no additional cost to the Owner.

F. At no time shall free bores in excess of forty (40) feet and for pipe larger than 12-inch be permitted.

G. The Contractor may elect to free bore other portions of the project in lieu of open cut installation. However, no additional payment for free bore will be made if the Contractor exercises this option.

3.12. DIRECTIONAL DRILLING

A. Where ordered by the Owner, the Contractor shall install the pipe by directional drilling.

B. The directional drilling method consists of drilling a small diameter pilot hole within the designated tolerances followed by enlargement of the hole to accommodate the ductile iron carrier pipe to be installed.

C. The Contractor shall provide all materials and equipment required, including but not limited to drilling equipment, water pumps, hoses, fittings, storage tanks, filters, hay bales, silt fences, drilling fluids including containment, collection, cleaning and disposal of, fuel and lubricants, bentonite and related mixing equipment, hydrostatic testing equipment and materials, side booms, cranes, backhoes, trucks, and other equipment or materials necessary to load and unload pipe, and to support and smoothly transition the pipe while being pulled into the reamed hole.

D. The Contractor shall submit to the Owner a detailed installation plan including operational sequences, details of the guidance or grade and alignment control system, and a plan and profile of the bore path.

Section 4
Scope of Work and Technical Specifications
SECTION 33 05 23-14 BORE AND JACK CASINGS

1. The bore path shall ensure that the pipe joints do not deflect more than 50 percent of the manufacturer's recommended maximum deflection for the ductile iron pipe.
- E. The drilling operation shall be conducted in a manner to eliminate the discharge of water, drilling mud, and cuttings to areas not involved in the construction process.
1. The Contractor shall immediately contain and clean-up any inadvertent returns.
 2. The Contractor shall also provide equipment and procedures to maximize the recirculation and reuse of drilling mud to minimize waste disposal.
 3. Proper disposal of water, drilling fluids, drilling mud, cuttings and muck is the Contractor's responsibility.
- F. Ductile iron pipe and fittings, inspection and testing shall be as specified in Section 33 33 00.

END OF SECTION

SECTION 33 05 73

POLYETHYLENE MANHOLES

PART 1- GENERAL

1.01 SCOPE

A. This specification covers the requirements of Spirolite® High Density Polyethylene manholes 36"-through 120-inch.

1.02 DEFINITIONS

A. Under this standard, the following definitions apply:

1. Purchaser: The person, firm, corporation or government agency engaging in a contract or agreement to purchase pipe according to this standard.
2. Inspector: The authorized representative of the purchaser entrusted with the duty of inspecting pipe produced and witnessing tests performed with under these standards.
3. Inspection: Inspection of the pipe and the tests by the inspector
4. Pipe Design: The pipe shall be manufactured by the continuous winding of a special profile onto suitably sized mandrels. It shall be produced to constant internal diameters. The pipe wall profile shall be in accordance with the manufacturer's recommendation.
5. Joints: The pipe shall be produced with bell and spigot end construction. Joining will be accomplished by rubber gasket, or thermal welding, as determined by the design engineer in accordance with the manufacturer's recommendations.

PART 2 – PRODUCTS

2.01 BASIC MATERIALS

A. Base Materials: The riser shaft, top base and stub out pipes shall be made of high density, high molecular weight polyethylene pipe material having a minimum cell classification of 445574C, as defined in ASTM D-3350 "Specification for Polyethylene Plastic Pipe and Fittings Materials". The manufacturer shall certify that the materials used to manufacture manholes meet these requirements. The manhole shall be manufactured in an off white color based resin provided formulations are agreed by Purchaser and Manufacturer.

B. Other Materials: Materials other than those specified under base materials may be used as part of the profile construction. For example: As a coretube to support the shape of the profile during processing provided these materials are compatible with the base PE material. Examples of suitable materials include PE and Polypropylene:

C. Rework Materials: Clean rework material of the type described in Section 2.1.1 or Section 2.1.2 and generated from the manufacturer's own production, may be used provided the material is of the same cell classification as the base PE material and allows the manufacturing of manhole risers that meets all the requirements of this specification.

D. Rubber gaskets shall comply in all respects with the physical requirements specified in the non- pressure requirements of ASTM Specification F-477. They shall be molded or produced from an extruded shape approved by the manufacturer and spliced into circular form.

E. Lubricant: The lubricant used for assembly shall have no detrimental effect on the gasket or on the pipe.

2.02 MANHOLE FABRICATION

A. The manhole shall be fabricated to meet the design requirements of ASTM F-1759, "Standard Practice for Design of High-Density Polyethylene (HDPE) Manholes for Subsurface Applications" based on soil and installation information supplied by the Purchaser or the Engineer.

B. Riser Shaft: The riser shaft shall be manufactured in accordance with ASTM F-894, shall be of solid wall in construction only, and shall be specified by the Standard Inside-Diameter Dimension Ratio (SIDR) or the Inside- Dimension Ratio (IDR). The riser SIDR or IDR shall be of a sufficient wall thickness that the manhole meets the requirements of Section 3.1.1.

C. Joints: Where required, the manhole riser shall be manufactured with an integrally wound bell and spigot joint, an extrusion welded joint, or a fused joint. Joining shall be accomplished in accordance with the manufacturer's recommendations.

2.03 SHOP DRAWINGS

A. Upon request complete shop drawings of the manholes shall be submitted to the Engineer for approval.

B. Fitting Dimensions: Fittings such as couplings, wyes, tees, adaptors, etc. for use in laying Spirolite® HDPE gravity sewer pipe shall have laying length dimensions as recommended by the manufacturer.

2.04 WORKMANSHIP

A. The riser and stubout pipes shall be homogeneous throughout and free from visible cracks, holes, foreign inclusions or other injurious defects.

2.05 PIPE SIZE

A. PE Pipe and manholes shall be produced by the same manufacturer.

B. Acceptable manhole manufacturers are:

1. Spirolite by ISCO
2. U.S. Composite Pipe, Inc.
3. Sewer Shield Composite, LLC.
4. Or approved equal.

PART 3 – EXECUTION

3.01 INSPECTION REQUIREMENTS

A. Notification: If inspection is specified by the purchaser, the manufacturer shall notify the purchaser in advance of the date, time and place of testing of the pipe in order that the purchaser may be represented at the test.

B. Access: The inspector shall have free access to the inspection area of the manufacturer's plant. The manufacturer shall make available to the inspector, without charge, all reasonable facilities for determining whether the pipe meets the requirements of this specification.

C. Certification: As the basis of the acceptance of the material, the manufacturer will furnish a certificate of conformance to these specifications upon request. When prior agreement is being made in writing between the purchaser and the manufacturer, the manufacturer will furnish other conformance certification in the form of affidavit of conformance, test results, or copies of test reports.

3.02 INSTALLATION AND DELIVERY

A. Unloading: Manholes can be unloaded from the truck by using a boom and sling arrangement. Manholes shall be handled per the Manufacturer's written recommendations. The Manufacturer will provide lifting lugs to assist with handling unless otherwise agreed to by the Manufacturer and Purchaser.

B. Installation: Achieve stable and permanent support under and around the manhole. Install the manhole in a dry trench. Place sufficient crushed stone or other Class I material to provide a stable foundation. The thickness of the foundation layer shall be a minimum of 8 inches. Compact the foundation material to 95% Standard Proctor density. Alternatively, the manhole can be set on a properly designed reinforced concrete slab on a stable foundation.

C. Backfilling: The embedment surrounding the manhole shall extend to at least 3.5 feet or to the trench wall, whichever is the greater distance, for manholes placed in stable insitu soils. In unstable soil, the embedment shall extend to a distance equal to at least one manhole diameter (but not less than 3.5 feet) or to the trench wall, whichever is the greater distance. Embedment shall be placed from the invert to the top of the manhole. The embedment shall consist of Class I or II material compacted to at least

Section 4
Scope of Work and Technical Specifications
SECTION 33 05 73-4 POLYETHYLENE MANHOLES

90% Standard Proctor density in 12" lifts. Place backfill evenly around the manhole to prevent moving the manhole out of alignment.

D. Concrete Anchors: Where required to prevent flotation, concrete anchors shall be constructed as shown in the Engineer's design drawings.

E. Concrete Tops: When vehicular loads are present, a concrete top shall be constructed as shown in the Engineer's design drawings.

F. Manhole Entry: Manholes present confined space and fall hazards. All entrants shall follow applicable OSHA confined space entry procedures and use a fall protection device for all entries.

3.03 DELIVERY

A. Manholes and fittings shall, unless otherwise specified, be prepared for standard commercial shipment.

END OF SECTION

SECTION 33 10 00

WATER UTILITIES

PART 1 GENERAL

1.01 RELATED DOCUMENTS:

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

B. Related work specified elsewhere includes:

1. Section 31 20 00 - "Earthwork"

1.02 SUMMARY:

A. This Section includes water service piping system, meter, vaults, valves, and appurtenances from the existing on-site utility source of potable water to a point 5 feet outside the building, and as indicated on the Drawings, and in this Section of the Project Manual.

B. Note that the Contractor shall furnish and install connection, water meter, etc., acceptable to the utility company and call on the utility company to approve the meter and inspect the installation prior to covering.

C. All fees and charges for water service, meters, taps, permits, impact fees, etc., if any, shall be paid by the Contractor from their contract amount.

D. The extent of water service piping system, fire hydrants, etc., is indicated on the Drawings, in this Section, other referenced Sections of the Project Manual, and as otherwise required by authorities having jurisdiction.

1. All water pipe which run under roads, streets, driveways, and other vehicular paving shall be sleeved in AWWA C151 ductile iron sleeves.

E. Utility Compliance: Comply with Mobile County Water Authority regulations and standards pertaining to sanitary sewerage systems.

1. Where conflicts or discrepancies occur with the plans or these specifications, Mobile County Authority regulations and standards shall govern.

1.03 SUBMITTALS:

A. General: Submit the following in accordance with conditions of Contract and Division 1 Specification Sections

1. Product data for water service piping and fire protection pipe and specialties.

2. Shop drawings for vaults, junction boxes, valve boxes, manholes, meters, backflow preventers, and other similar water service equipment.

PART 2 PRODUCTS

2.01 PIPE AND PIPE FITTINGS - GENERAL:

A. General: Pipe, valves, fittings and installation in R.O.W. and on site shall comply with requirements of this Section, other referenced Sections of the Project Manual, the Drawings, and the Fulton County Department of Public Works.

1. Pipe, fittings, hydrants and valves shall be as specified herein, subject to acceptance by the Fulton County Department of Public Works, unless other specific materials acceptable to the Fulton County Department of Public Works are indicated on the Drawings.

2. PVC piping and fittings smaller than 4" shall be C900 PVC, Class 200 plastic pipe, Schedule 40, or Type K Copper; and pipe 4" and larger, below paving and fire lines shall be ductile iron, of type(s) acceptable to the Mobile County Water Authority, unless other specific materials acceptable to the Mobile County Water Authority are indicated on the Drawings.

3. PVC water piping and fittings 4" and larger shall be C900, Class 250 plastic pipe of type acceptable to local utility company, unless other specific materials acceptable to utility company are indicated on the Drawings.

4. Ductile iron pipe for fire lines, pipe below paving and where indicated shall meet ANSI A21.51, Grade 60-42-10, and special thickness pressure class 50, (For 6" Pipe this is the same 0.25" wall thickness as Class 350) ductile iron, of type(s) acceptable to local utility company, unless other specific materials acceptable to utility company are indicated on the Drawings.

5. Note that all water pipe which run under roads, streets, driveways, and other vehicular paving shall be either ductile iron or shall be sleeved in ductile iron sleeves.

6. Copper pipe where indicated, provide Soft Copper Tube, ASTM B 88-62, Type K hard drawn, water tube, annealed temper.

- a. Copper, Solder-Joint Fittings: AWWA C800-6 and 66. Corp stops shall be Ford Angle Inverted Key Valve AV21-444 or equal, curb stops shall be ¾" Ford B-41-233W COMP x FIP or equal, and service saddles shall be dresser style 194 or equal. Furnish only wrought-copper fittings if indicated.

B. PVC Plastic, Schedule 40/80 PVC with pressure-rated fittings: Conform to ASTM D 1785 standard specifications for PVC plastic pipe.

- C. PVC Plastic, Water Pipe: AWWA C900, Class 200. Include elastomeric seal according to ASTM F477.
- D. Ductile Iron Fittings: AWWA C110, ductile-iron; or AWWA C153, ductile-iron, compact type, and specifically designed for joining PVC pipe; Include elastomeric seals according to ASTM F 477 or as otherwise required for joining plastic pipe specified
- E. Plastic Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended in writing by piping system manufacturer, unless otherwise indicated.
- F. Where copper pipe is indicated, provide Soft Copper Tube, ASTM B 88, Type K, water tube, annealed temper.
 - 1. Copper, Solder-Joint Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint pressure type. Furnish only wrought-copper fittings if indicated.
- G. DuctileIron, PushonJoint Pipe: AWWA C151 and ANSI C150, C151, A21.50, and A21.15 respectively, Class 350 as approved by the Mobile County Water Authority, tar coated outside, with cement lining and seal coat according to AWWA C104. Include rubber compression gasket according to AWWA C111.
 - 1. DuctileIron, PushonJoint Fittings: AWWA C110, ductileiron; or AWWA C153, ductileiron, compact type. Include cementmortar lining and seal coat according to AWWA C104 and rubber compression gaskets according to AWWA C111 (ANSI 21.11) and according to ASTM D-3139.
 - 2. Joining Materials: AWWA C111 rubber gaskets and lubricant according to ASTM F477 requirements.
- H. DuctileIron, MechanicalJoint Pipe: AWWA C151, with cementmortar lining and seal coat according to AWWA C104. Include gland, rubber gasket, and bolts and nuts according to AWWA C111.
 - 1. DuctileIron, MechanicalJoint Fittings: AWWA C110, ductileiron; or AWWA C153, ductileiron, compact type. Include cementmortar lining and seal coat according to AWWA C104 and glands, rubber gaskets, and bolts and nuts according to AWWA C111.
 - 2. Joining Materials: AWWA C111 ductileiron or grayiron glands, highstrength steel bolts and nuts, and rubber gaskets.
- I. PE Encasement for DuctileIron Piping: ASTM A 674 or AWWA C105, PE film, 0.008inch (0.20mm) minimum thickness, tube or sheet.
- J. Pipe Sleeves: Provide pipe sleeves at least one size larger than water service piping required below existing concrete and paving, and as follows.

Section 4
Scope of Work and Technical Specifications
SECTION 33 10 00-4 WATER UTILITIES

1. Below Concrete, Entry Pads, and Paving Subject to Only Pedestrian Traffic, and for Future Irrigation: Schedule 40/80 PVC.
 2. Below Concrete, Equipment Pads, Dumpster Pads, Valley Gutters, Curbs and Gutters, Paving Subject to Vehicular Traffic, and Where Indicated: Ductile Iron, as specified above herein this Section.
- K. Identification for Underground Plastic Pipe:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Allen Systems, Inc.; Reef Industries, Inc.
 - b. Brady (W.H.) Co.; Signmark Div.
 - c. Calpico, Inc.
 - d. Carlton Industries, Inc.
 - e. EMED Co., Inc.
 - f. Seton Name Plate Co.
 2. Plastic Underground Warning Tapes: Polyethylene plastic tape with metallic core, 6 inches wide by 4 mils thick, solid blue in color with continuously printed caption in blue letters "CAUTION WATER LINE BURIED BELOW."
- L. Domestic Water Meter – Provide in accordance with Mobile County Water Authority specifications.
1. Meter box and cover shall be traffic-bearing in all paved areas.
- M. Tapping Sleeve and Valve:
1. Tapping sleeves and valves shall be Mueller, mechanical joint, 250 psi or equal.
 2. Tapping sleeves shall have 24"x24"x8" concrete pad in undisturbed soil with solid blocking to support tapping valves.
- N. Valves:
1. Unless otherwise specified, all gate valves up to 12" shall be resilient seat, and all gate valves larger than 12" shall be butterfly type. All valves larger than 12" shall receive approval from the County before installation.
 2. Acceptable manufacturers of gate valves are American-Darling, Dresser M&H, or equal.
- O. Valve Accessories:

1. All buried valves shall be furnished with cast iron, screw type; extendable valve boxes marked "WATER". Acceptable manufacturers are Mueller, M&H Valve, or equal.
2. Valve boxes shall be mounted plumb in an 18" round concrete valve pad and centered over the operating nut.
3. One concrete valve marker shall be furnished and set at each line valve. The marker shall be made of 3,000 psi concrete with four #4 reinforcing bars. The size shall be four feet long by 4" on each side.

P. Hydrants

1. Fire Hydrants shall meet AWWA C-502-80 as well as the local authorities having jurisdiction.
2. Hydrants shall be manufactured by Mueller or an approved equal.
3. Hydrants shall be equipped with tamper proof caps that will work with County operating wrenches to prevent unauthorized use of water.
4. Hydrants shall be warranted by the manufacturer against defects in materials or workmanship for at least 10 years from the date of manufacture.

PART 3 EXECUTION:

3.01 INSTALLATION:

- A. Comply with requirements of Division 22, the International Plumbing Code, Drawings, the Fulton County Department of Public Works and requirements of other authorities having jurisdiction.
- B. Comply with requirements of the State Health Department, the local Health Department, and authorities having jurisdiction.

3.02 DEPTH OF COVER:

- A. Provide minimum cover of 48-inches for all water bearing piping.

3.03 INSTALLATION OF IDENTIFICATION:

- A. Install continuous plastic underground warning tape during backfilling of trench for underground water service piping. Locate 6 to 8 inches below finished grade, directly over piping.

3.04 CLEANING:

- A. Clean and disinfect water distribution piping as follows, or as required by utility company, Code, and authorities having jurisdiction:

Section 4
Scope of Work and Technical Specifications
SECTION 33 10 00-6 WATER UTILITIES

1. Purge all new water distribution piping systems and parts of existing systems that have been altered, extended, or repaired, prior to use.
2. Use the purging and disinfecting procedure prescribed by the authority having jurisdiction or, in case a method is not prescribed by that authority, use the procedure described in AWWA C651, or as described below:
 - a. Fill the system or part thereof with a water/chlorine solution containing at least 50 parts per million of chlorine. Isolate (valve off) the system or part thereof and allow to stand for 24 hours.
 - b. Drain the system or part thereof of the previous solution and refill with a water/chlorine solution containing at least 200 parts per million of chlorine and isolate and allow to stand for 3 hours.
 - c. Following the allowed standing time, flush the system with clean, potable water until chlorine does not remain in the water coming from the system.
 - d. Submit water samples in sterile bottles to the authority having jurisdiction. Repeat the procedure if the biological examination made by the authority shows evidence of contamination.
- B. Prepare reports for all purging and disinfecting activities and submit for review and along with each set of "Record Documents".

END OF SECTION

SECTION 33 11 15

VALVES AND APPERTENANCES

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. The work covered by this section includes furnishing all labor, equipment, and materials required to furnish and install all metal valves, including operators, boxes, and accessories as specified herein, shown on the Drawings, or required for proper completion of the work under these Contract Documents.
- B. The Contractor's attention is called to the fact that all valves, especially in the smaller sizes, are not necessarily shown completely on the Drawings. However, the Contractor shall furnish and install all valves indicated or required for proper operation of the equipment or services requiring such valves.
- C. The equipment shall include, but not be limited to, the following:
 - 1. Gate valves
 - 2. Eccentric Plug Valves
 - 3. Check Valves
 - 4. Ball Valves
 - 5. Pressure Indicators
 - 6. Yard hydrants
 - 7. Hose Bibbs
 - 8. Manual Valve Operators
 - 9. Extension Stems
 - 10. Valve Boxes
 - 11. T-Handle Operating Wrench
 - 12. Combination Sewage Air Release and Vacuum Valve
 - 13. Emergency Eye Wash

1.02 SUBMITTALS

- A. Complete shop drawings and engineering data shall be submitted to the Engineer in accordance with the requirements of Section 01 33 00.

B. Submit complete operation and maintenance data on the valves in accordance with the requirements of Section 01 78 23.

1.03 DESCRIPTION OF SYSTEMS

A. All of the equipment and materials specified herein are intended to be standard for use in controlling the flow of sewage, sludges, water, air or chemicals, depending on the applications.

1.04 QUALIFICATIONS

A. All of the types of valves and appurtenances shall be products of well established reputable firms who are fully experienced, reputable and qualified in the manufacture of the particular equipment to be furnished. The equipment shall be designed, constructed and installed in accordance with the best practices and methods and shall comply with these Specifications as applicable.

1.05 TOOLS

A. Special tools, if required for normal operation and maintenance, shall be supplied with the equipment.

PART 2 - PRODUCTS

2.01 GENERAL

A. All castings, regardless of material, shall be free from surface defects, swells, lumps, blisters, sandholes, or other imperfections.

B. All valves shall have the name of the manufacturer, rated working pressure, and size of the valve cast upon the body or bonnet in raised letters. Alternately, the name of the valve manufacturer, rated working pressure, and size may be stamped on a stainless steel identification plate permanently attached to the valve body or bonnet. Valves specified to conform to AWWA requirements shall have the letters "AWWA" cast upon the valve body or bonnet in raised letters.

C. Valves and operating mechanisms shall be of the proper size and dimensions to fit the pipe connections thereto and shall be installed in the position and within the space shown on the Drawings.

D. Unless otherwise specified, the direction of rotation of the operator to open the valve shall be to the left (counterclockwise). Each valve body or operator shall have cast thereon the word OPEN and an arrow indicating the direction to open.

E. A union or coupling shall be provided within 2 feet on each side of a threaded end valve unless the valve can be otherwise easily removed from the piping.

F. All exposed bolts and nuts on buried or submerged valves and operators shall be brass or stainless steel for corrosion resistance. Exposed bolts and nuts on exposed

valves and operators shall be of corrosion-resistant materials or shall be zinc or cadmium plated.

G. Valves and operators shall be of the proper size to fit the pipe connections and shall fit in the position and space as shown on the Drawings.

H. Valve operators shall be of sufficient size and capacity to seat, unseat, and operate the valve under the maximum specified differential pressure. Where no maximum differential pressure is specified, the operator shall be designed for a differential pressure equal to the maximum working pressure of the valve. Additional allowances shall be made for the lubricating and/or scale forming tendencies of the fluid.

2.02 GATE VALVES

A. Unless otherwise specified, all gate valves used in wastewater applications shall be of the single disc, double-seated, solid tapered wedge type. Iron body gate valves for potable water lines shall be of the double disc type. Valves shall have non-rising stems and shall be capable of being repacked under pressure when valve is fully open.

B. Gate valves 2-1/2 inches in size and smaller shall be bronze body; bronze fitted valves, and shall have 150-pound, cast bronze body, union bonnet, Teflon-impregnated asbestos packing, and threaded ends per ANSI B2.1. Bronze shall conform to ASTM B 62. Brass for nuts and gland shall conform to ASTM B 16. Valve discs shall be reversible. Bronze gate valves shall be Stockham Fig. B-130, Nibco Fig. T-136, or equal. For use in copper plumbing, gate valves shall be furnished with solder ends per ANSI B16.18.

C. Gate valves 3 inches in size and larger in water and wastewater shall be iron body, bronze mounted valves conforming in all respects to the applicable material and dimensional requirements of AWWA C500. Minimum working pressures shall be 200 psi for valves 12 inches in size and smaller and 150 psi for valves 16 inches and larger. Gate valves shall have an O-ring or self-adjusting chevron packing stem seal, and 125 - pound, flanged ends per ANSI B16.1, except for valves to be buried underground, which shall have mechanical joint ends per ANSI A21.11 (AWWA CLII). Body seat rings shall be ASTM B 62 bronze and shall be screwed into the body so as to be field replaceable. Disc faces and all moving parts shall be bronze or bronze mounted. Cast iron for body and bonnet shall conform to ASTM A 126; Grade B. Iron body gate valves with solid wedge discs shall be M & H (Dresser) Fig. 2067, Transverse City Fig. A248, or equal. Iron body gate valves with double discs shall be M & H (Dresser) Fig. 67, Mueller Fig. A-2380, or equal.

D. Gate valves shall be furnished with nut, wrench, chain, or handwheel operators as shown on the Drawings. Unless otherwise shown or specified, valves shall have operators as specified in Part 2.12 of this Section. Extension stems, and valve boxes and covers shall be furnished where shown or required.

2.03 ECCENTRIC PLUG VALVES

A. General

1. Plug valves shall be non-lubricated, resilient-seated, eccentric valves.
2. Pressure ratings shall be 175 psi on valve sizes through 12-inch and 150 psi for 14-inch and larger.
3. Valve pressure ratings, body flanges and wall thicknesses shall be in full conformance with ANSI B16.1, latest revision.
4. Valves shall seal leak-tight against full rated pressure in both directions.
5. Valve seats shall be tested to provide leak tight shut-off to 175 psi for valves through twelve (12) inches with pressure in either direction.
6. In addition, every valve shall be given a certified hydrostatic shell test and seat test, with the plug open to a pressure twice that of the pressure ratings specified above to demonstrate overall pressure integrity of the valve body. Test reports shall be available upon request by the Construction Manager.
7. Plug valves shall conform to the latest revision of ANSI/AWWA C517-05.
8. All materials shall be new.
9. Valves and operators shall have seals on all shafts and gaskets on valve actuator covers to prevent the entry of water. Actuator mounting brackets shall be totally enclosed and shall have gasket seals.
10. Plug valve and connecting pipe shall have the capability to be pigged without the use of special equipment.
11. A valve key for plug valves shall be provided to the Owner for each force main.

B. Body

1. Bodies and covers shall be Cast Iron ASTM A126 Class B or Ductile Iron ASTM A536 Grade 65-45-12.
2. At a minimum, valves measuring 4 inches to 12 inches in diameter shall have 175 psig bodies, and valves measuring 14 inches and greater in diameter shall have 150 psig bodies.
3. Ports shall be rectangular and 100% port.
4. For specific installation locations where the Total Dynamic Head (TDH) plus the surge pressure exceeds the minimum pressure ratings above, Class 250 flat face flanged ends and a 400 psi (for 3-inch to 12-inch valves) or 300 psi (for 14-inch and greater valves) valve body shall be provided.

C. Plug

1. Shall be solid one-piece, Cast-Iron ASTM A126 Class B or Ductile Iron ASTM A536 Grade 65-45-12.
 - a. Two-piece plugs or plugs with internal cavities shall NOT be acceptable.
2. The plug shall have a cylindrical seating surface eccentrically offset from the center of the shaft.
3. Valves shall be furnished with resilient elastomer faced plugs, suitable for use with wastewater.
 - a. Plug facing shall be composed of either EPDM or Neoprene.
 - b. Plug facings composed of natural rubber, Viton, or Nitrile shall NOT be acceptable.
4. Plug shall not contact the seat until at least 90% closed.
5. Spherical shaped plugs are not acceptable.

D. Seats

1. Valve seats shall be in accordance with AWWA C517, latest revisions.
2. Valve Seats on the body shall be 1/8" thick welded overlay of not less than 95% pure nickel.
 - a. Seat shall be at least 1/2-inch wide, 1/8-inch thick through entire width and raised.
 - b. The raised surface shall be completely covered with nickel to ensure that the resilient plug face contacts only the nickel seat.
3. Alternatively, valve seats shall be replaceable with 316 stainless steel seats.
4. Seats composed of thermosetting epoxy or fusion bonded nylon shall NOT be acceptable.
5. Screwed-in seats shall NOT be acceptable.

E. Bearings

1. Radial shaft bearings shall be permanently lubricated, sleeve-type, sintered, oil-impregnated bearings:
 - a. Type 316 stainless steel for sizes 4-inch to 18-inch.
 - b. ASTM A-743, Grade CF-8M for sizes 20-inch to 36-inch.

- c. Bronze in accordance with ASTM B-127.
 - d. Non-metallic radial shaft bearings shall NOT be acceptable.
- 2. Thrust bearings/washers shall be composed of Type 316 stainless steel, Teflon, Nylon 11, or Nylatron.
- F. Shaft Seals
 - 1. Adjustable packing shall be Acrylonitrile-Butadiene (NBR) multiple V-ring type, with a packing gland follower.
 - 2. Packing gland shall permit inspection, adjustment or complete replacement of packing without disturbing any part of the valve or actuator assembly, except the gland follower.
 - 3. Shaft seals shall be self-adjusting.
 - 4. Non-adjustable packing or packing requiring actuator removal to replace the packing shall not be acceptable.
 - 5. All shaft seal hardware shall be 316 stainless steel.
- G. End Connections
 - 1. End connections shall meet or exceed the latest revisions of AWWA C517 and other applicable standards.
 - 2. All buried valves shall have mechanical joint ends conforming to ANSI/AWWA C111/A21.11.
 - 3. All exposed valves measuring 4 inches in diameter and larger shall have Class 125 flat face flanged ends, at a minimum, conforming to ANSI B16.1 or ANSI/AWWA C110/A21.10.
- H. Interior Valve Lining
 - 1. All interior ferrous surfaces of the plug valve that will have contact with wastewater, except the valve seating surfaces, shall be coated with a factory applied, fusion bonded or thermosetting epoxy coating in accordance with AWWA C550, latest revision.
 - 2. Coating shall be holiday-free with a minimum thickness of twelve (12) mils DFT.
 - 3. Surfaces shall be clean, dry and free from rust, oil and grease before coating.

2.04 CHECK VALVES

- A. Unless otherwise shown or specified, check valves shall be of the swing type suitable for use in either horizontal or vertical piping. Disc shall swing entirely clear of the path of flow when in the open position. All internal parts shall be readily accessible and easily replaced in the field.
- B. Check valves shall be iron body, bronze-mounted valves conforming to AWWA C508. Valves shall have 125-pound cast iron body, bolted and gasketed cover, stainless steel or brass hinge pin, renewable bronze seats and disc, outside lever and adjustable weight, and 125-pound flanged ends per ANSI B16.1. Cast iron for body and cap shall conform to ASTM A 126, Grade B. Bronze for disc and seats shall conform to ASTM B62. Check valves shall be outside lever with side oil dampener for 8" and larger. Check valves shall be Val-Matic series 7900, APCO series 6000/6000A, or approved equal

2.05 BALL VALVES

- A. Ball valves 2 1/2" and below shall be quarter turn stainless steel valves. The body and body cap shall be constructed of A351-CF8M-stainless steel and withstand a working pressure of up to 1000 psi. The ball shall be 316 stainless steel with a 316 stainless steel stem. The ball seat, the stem seal, and stem baring shall all be constructed of PTFE.
- B. The valve operator/handle shall be constructed Stainless steel with stainless steel fasteners. The operator/handle shall have a locking option supplied with the valve
- C. Valve manufacturers shall be Jamesbury, Apollo, Sith-Cooper, or approved equal.

2.06 PRESSURE INDICATORS

- A. Bourdon tube or bellows as required by the pressure range. Phenolic case gauge with 4 1/2" dial. Dial shall have white face with black lettering. Provide unit with blowout protection. Provide non-freeze models for all outdoor locations.
- B. Fluid shall be 120 deg F (Maximum)
- C. The gauge will have an acrylic lens, bourdon tube and socket made of 316 stainless steel. The accuracy shall be ± 0.5 percent (Grade 2A).
- D. Gauge process connection size/location shall be 1/2" and a bottom connection.
- E. Diaphragm seal shall be provided with flushing connection. The diaphragm type shall be fully welded with a upper housing material of 316 stainless steel. Wetted parts for water shall be 316 stainless steel, for gaseous chlorine service, Hastelloy C, Monel, or as otherwise recommended by the diaphragm seal manufacturer for gaseous chlorine service.

F. Upper connection size shall be 1/2" NPT, Lower connection size shall be 1/2" NPT.

G. Diaphragm Material for water service shall be 316 stainless steel. For gaseous chlorine service, diaphragm shall be Teflon, Viton, or as otherwise recommended by the diaphragm seal manufacturer for gaseous chlorine service.

H. Acceptable manufacturer: Ashcroft, U.S. Gauge, or Engineered Approved equal.

2.07 YARD HYDRANTS

A. Yard hydrants shall have 2-in. hub inlet and 2-1/8-in. valve of the compression type closing with line pressure, and shall be manufactured by Simmons 800 series Freeze Proof, or approved equal. The hydrant shall have one 3/4-in. hose nozzle with National Standard hose thread and shall open left or counterclockwise. Furnish six (6) operating wrenches Mueller A-24089.

2.08 HOSE BIBS

A. Hose bibbs shall be brass, polished chromium plated, as manufactured by Chicago Faucet Company. Potable water bibbs shall be No. 952, 2 inch with vacuum breaker as noted on the Drawings. Non-potable water bibbs shall be No. 387, with lock-shield cap and removable tee handle. Provide heavy brass hook 6'-6" above floor level and provide for a brass chain to store handle on hook. Provide permanent, brass name tags located above the bibbs which shall state either "POTABLE" or "NON-POTABLE, DO NOT DRINK" as required. Letters shall be approximately 3/4 inch high.

2.09 MANUAL VALVE OPERATORS

A. Unless otherwise shown or specified, all valves shall be furnished with manual operators as follows:

1. Gate valves, buried - extension stem and valve box with standard operating nut.
2. Gate valves, submerged or located in deep vault - extension stem with floor-stand and hand wheel operator.

B. Operating nuts for buried or submerged valves shall be standard 2-inch square nuts and shall conform to AWWA C500, Section 19. Extension stems, valve boxes, and stem guides shall be furnished where shown, specified, or required for proper operation.

C. Rotary manual operators for above ground service shall be of the worm and worm gear or of the traveling nut type. Rotary operators shall have a heavy-duty, weatherproof cast iron or steel housing with gasketed, removable cover and shall be equipped with a mechanical dial or slot type position indicator and a suitable handwheel. Manual operators shall be totally enclosed and sealed to prevent the entrance of rain, dirt, and corrosive atmospheres. Traveling nut operators shall have a grease lubricated

alloy steel screw stem, brass nut, and self-lubricating bronze bushings. Worm gear operators shall have hardened, grease lubricated alloy steel worms and bronze worm gears. All exterior bolts and fasteners shall be bronze or stainless steel for corrosion resistance. The valve shall open with counterclockwise rotation of the handwheel.

D. Manual rotary operators for buried or submerged service shall conform with the requirements of Item C above except the operator shall be totally enclosed and completely sealed to prevent the entrance of water and dirt. Buried or submerged operators shall be finished on the outside with a bituminous or other approved coating. Rotary operators for buried or submerged service shall be capable of withstanding 300 ft-lbs. of torque on the operating nut or handwheel. A corrosion resistant, dial type valve position indicator shall be provided at the operating nut on the extension stem of buried operators to provide a remote indication of valve position.

E. All manual rotary operators shall be capable of seating or unseating the valve disc under the most adverse conditions in the particular application with not more than an 80-pound pull on the handwheel or lever. Valve operators shall be capable of holding the valve in any position between fully open and fully closed without creeping or fluttering. Operators shall be provided with adjustable, mechanical, stop-limiting devices to prevent over-travel of the valve disc in the open and closed position. Manual rotary and lever operators shall comply with all applicable requirements of AWWA C504, Sections 11.1, 11.2, and 11.3.

2.10 EXTENSION STEMS

A. Extension stems shall be solid steel not smaller than the stem of the valve or galvanized steel pipe having an inside diameter not smaller than the outside diameter of the valve or valve operator stem. Extension stems shall connect to the valve by a flexible, socket coupling. All couplings shall be pinned, keyed, or socket type.

B. Each extension stem for buried valves shall extend to within 6 inches of the top of the valve box or floor box and shall be provided with spacers which will center the stem in the valve box. A standard wrench nut shall be provided on the top of the extension stem. Extension stems for rising stem valves shall be stainless steel or carbon steel with bronze or stainless steel sleeves. Sleeves shall be of sufficient length and location to extend through each stem guide throughout the full vertical stem travel. Extension stems for submerged service shall be stainless steel or bronze.

C. Adjustable stem guides of the wall bracket type shall be provided as shown on the Drawings. Stem guide shall be of bronze-bushed, cast iron construction adjustable in two directions. Stem guides shall be installed so the unsupported length of the extension stem does not exceed 10 feet or an L/r of 200.. Stem guide shall be Model F5660 as manufactured by Clow Corporation, Bensenville, Illinois, equal Rodney Hunt Company, Orange, Massachusetts, or equal.

2.11 VALVE BOXES

- A. All buried valves shall be provided with 3-piece, cast iron, extension sleeve type, valve boxes suitable for the depth of cover as shown on the Drawings.
- B. Valve boxes shall not be less than 5 inches in diameter, shall have a minimum thickness of 3/16-inch at any point, and shall be provided with suitable cast iron bases and covers. Covers shall have cast thereon an appropriate name designating the service for which the valve is intended ("W" for water, "S" for drain or waste lines). Covers in roadways shall be of the deep locking type.
- C. All parts of valve boxes, bases, and covers shall be heavily coated with a suitable bituminous finish.
- D. Valves and boxes shall be set plumb. Each valve box shall be placed directly over the valve it serves with the top of the box flush with the finished grade.

2.12 T-HANDLE OPERATING WRENCH

- A. The Contractor shall furnish one T-handle, steel valve operating wrenches with sockets compatible with standard 2-inch square valve operating nuts.
- B. The operating wrenches shall be at least 72 inches in length.

2.13 COMBINATION SEWAGE AIR RELEASE AND VACUUM VALVE

- A. Manufacturers
 - 1. Vent-O-Mat Series RGX.
 - 2. Vent-Tech by International Valve
 - 3. Engineer approved equal.
- B. Materials
 - 1. Provide Air Release and Vacuum Relief Valves consisting of a compact tubular all stainless steel fabricated body, hollow direct acting float, and solid large orifice float in H.D.P.E.- stainless steel nozzle and woven dirt inhibitor screen, nitrile rubber seals and natural rubber seat.
 - 2. Include an integral anti-surge orifice mechanism, which operates automatically to limit surge pressure rise or shock induced by closure to less than 2 times the valve rated working pressure. Provide an intake orifice area equal to the nominal size of the valve (i.e., a 6" valve shall have a 6" intake orifice).
 - 3. Provide large orifice sealing with the flat face of the control float seating against a nitrile rubber "O" ring housed in a dovetail groove circumferentially surrounding the orifice. Control discharge of pressurized air by the seating and unseating of a small orifice nozzle on a natural rubber seal affixed into the control

float. Prevent damage to the rubber seal using a flat seating land surrounding the orifice.

4. The valve construction shall be proportioned with regard to material strength characteristics, so that deformation, leaking or damage of any kind does not occur by submission to twice the designed working pressure. Provide flanged ends conforming ANSI Class 250 or ANSI Class 300 Standards for the valve inlet connection. Fasten flanged ends with ASTM A193, Grade B8M, 316 stainless steel, heavy hex bolts and ASTM A194, Grade 8M, 316 stainless steel, heavy hex nuts inserted for alignment to the specified size of, nuts, washers, and gaskets.

C. Operation

1. Prior to the ingress of liquid into the valve chamber, as when the pipeline is being filled, and when sewage/effluent approach velocities are relative to a transient pressure rise, on valve closure, of < 2-times valve rated pressure, vent air through the large orifice.

2. At higher sewage/effluent velocities, which have a potential to induce transient pressure rises greater than 2-times valve rated pressure on valve closure the automatically discharge air/gas through the anti-shock orifice and reduce sewage/effluent approach velocity, so that on closure a maximum transient pressure rise of less than 2-times valve rated pressure is realized.

3. Valves shall not exhibit leaks or weeping of liquid past the large orifice seal at operating pressures of 7.3 psi to twice (2) the rated working pressure.

4. When the valve is closed, discharge accumulated air/gas through the small orifice at any pressures within a specified design range, 7.3 psi to 250 psi. No leakage is allowed in the absence of air.

5. Valves shall react immediately to pipeline drainage or liquid column separation by the full opening of the large orifice so as to allow unobstructed air intake at the lowest possible negative internal pipeline pressure.

2.14 EMERGENCY EYE WASH

A. Eyewash station to be Halo Stainless Steel Eye/Face wash and bowl, with foot activation and freeze proof valve. Bradley Model S19214SS or engineer approved equal

PART 3 - EXECUTION

3.01 FACTORY TESTS

A. All valves shall be tested at the point of manufacture for proper and unobstructed operation and for leakage and adequacy of design.

- B. Iron body gate valves shall be tested in accordance with AWWA C500, Section 29.
- C. Iron body check valves shall be tested in accordance with AWWA C508, Section 5.
- D. All other valves shall be given an operation test, a leakage test at rated pressure differential, and a hydrostatic test at two times rated pressure. During the hydrostatic test, there shall be no leakage through the metal, the end joints, or the shaft or stem seal, nor shall any part be permanently deformed. During the leakage test, leakage shall not exceed that permitted by ANSI B16.104, Class IV, for metal seated valves and Class VI for resiliently seated valves.

3.02 INSTALLATION

- A. All valves shall be installed in strict conformance with the Drawings and approved shop drawings and manufacturer's instructions. All valves and appurtenances shall be true to alignment and rigidly supported. Any damage to the above items shall be repaired to the satisfaction of the Engineer before they are installed
- B. Swing check valves shall be installed only in a horizontal position. Lever shall be free to operate without obstruction.
- C. All underground valves shall be installed using a concrete valve box with cast iron frame and cover or in a cast iron valve box as specified herein.
- D. Valves shall be installed in such a way that operators and packing are easily accessible. Valves with field replaceable seats shall be installed with sufficient clearance to permit removal of valve bonnet and stem without removing valve from the line.
- E. Install all floor boxes, brackets, extension rods, guides, the various types of operators and appurtenances as shown on the Drawings that are in masonry floors or walls, and install concrete inserts for hangers and supports as soon as forms are erected and before concrete is poured. Before setting these items, the Contractor shall check all plans and figures which have a direct bearing on their location and he shall be responsible for the proper location of these valves and appurtenances during the construction of the structures.
- F. Pipe for use with flexible couplings shall have plain ends as specified in the respective pipe Sections in Division 15.
- G. Buried flanged or mechanical joints shall be made with cadmium plated bolts. All exposed bolts shall be made with cadmium plated bolts. All exposed bolts and nuts shall be heavily coated with two (2) coats of bituminous paint comparable to Inertol No. 66 Special Heavy.
- H. Yard hydrants shall be installed in accordance with manufacturer's recommendation and applicable requirements of fire hydrants above.

Section 4
Scope of Work and Technical Specifications
SECTION 33 11 15-13 VALVES AND APPURTENANCES

I. Prior to assembly of split couplings, the grooves as well as other parts shall be thoroughly cleaned. The ends of the pipes and outside of the gaskets shall be moderately coated with petroleum jelly, cup grease, soft soap or graphite paste, and the gasket shall be slipped over one pipe end. After the other pipe has been brought to the correct position, the gasket shall be centered properly over the pipe ends with the lips against the pipes. The housing section then shall be placed. After the bolts have been inserted, the nuts shall be tightened until the housing sections are firmly in contact, metal-to-metal, without excessive bolt tension. Special care shall be taken in assembly of couplings in lines to be cleaned by hot water to provide the proper end clearance.

J. Prior to the installation of sleeve-type couplings, the pipe ends shall be cleaned thoroughly for a distance of 8-in. Soapy water may be used as a gasket lubricant. A follower and gasket, in that order, shall be slipped over each pipe to a distance of about 6-in. from the end, and the middle ring shall be placed on the already laid pipe end until it is properly centered over the joint. The other pipe end shall be inserted into the middle ring and brought to proper position in relation to the pipe already laid. The gaskets and followers shall then be pressed evenly and firmly into the middle ring flares. After the bolts have been inserted and all nuts have been made up fingertight, diametrically opposite nuts shall be progressively and uniformly tightened all around the joint, preferable by use of a torque wrench of the appropriate size and torque for the bolts.

3.03 SHOP PAINTING

A. Ferrous surfaces of valves and appurtenance shall receive a coating of rust-inhibitive primer as specified in Division 9. All pipe connection openings shall be capped to prevent the entry of foreign matter prior to installation.

3.04 FIELD PAINTING

A. All metal valves and appurtenances specified herein and exposed to view will be painted as part of the work in Division 9

3.05 FIELD INSPECTION AND TESTING

A. Following installation, all valves shall be tested by the Contractor under the anticipated operating conditions. The ability of the valves to operate properly without leakage, binding, sticking, fluttering, or excessive operating torque shall be demonstrated to the satisfaction of the Engineer. The Contractor shall at his own expense adjust and/or replace any valve as necessary to assure satisfactory operation.

B. Following installation and testing, all ferrous and non-machined surfaces of exposed valves, operators, floorstands, and stem guides shall be field primed and painted AS specified herein.

END OF SECTION

SECTION 33 30 00

SEWER AND ACCESSORIES

PART 1 – GENERAL

1.01. SCOPE

A. This Section describes products to be incorporated into sewers and accessories and requirements for the installation and use of these items. Furnish all products and perform all labor necessary to fulfill the requirements of these Specifications.

B. General: Supply all products and perform all work in accordance with applicable American Society for Testing and Material (ASTM), American Water Works Association (AWWA), American National Standards Institute (ANSI), or other recognized standards. Latest revisions of all standards are applicable.

1.02. QUALIFICATIONS

A. If requested by the Owner, submit evidence that manufacturers have consistently produced products of satisfactory quality and performance for a period of at least ten years.

1.03. SUBMITTALS

A. Complete product data and engineering data including shop drawings shall be submitted to the Owner in accordance with the requirements of Section 01 33 00, Section 01 33 23, and Section 33 30 65 of these Specifications.

B. When requested, the Contractor shall furnish the Owner with lists, in duplicate, of all pieces of pipe and fittings received on the Project, including copies of shipping documents from the manufacturer and/or supplier.

C. Said lists shall indicate the serial or mark number, weight, class, length, size, and description of each typical piece received.

D. The Contractor shall submit, in conjunction with the construction progress schedule, a schedule of deliveries for materials. The Contractor shall coordinate material shipments with the Owner and the material suppliers.

1.04. TRANSPORTATION AND HANDLING

A. The Contractor shall maintain communication with the material suppliers and the Owner as necessary, to keep informed as to scheduled shipment, and upon delivery of materials, the Contractor shall proceed without delay to unload such materials.

B. Unloading: Furnish equipment and facilities for unloading, handling, distributing and storing pipe, fittings, valves and accessories. Make equipment available at all times

for use in unloading. Do not drop or dump materials. Any materials dropped or dumped will be subject to rejection without additional justification.

C. Handling: Handle pipe, fittings, valves and accessories carefully to prevent shock or damage. Handle pipe by rolling on skids, forklift, or front loader. Do not use material damaged in handling. Slings, hooks or pipe tongs shall be padded and used in such a manner as to prevent damage to the exterior coatings or internal lining of the pipe.

D. Lined pipe shall be handled and transported with such care as to prevent damage to linings.

E. Upon receipt of materials from the manufacturer, the Contractor shall make an inspection of such materials.

F. Check and certify the bill of lading, noting any discrepancies.

G. Obtain a proper memorandum signed by the agent of the carrier for any shortage in the shipment or for any damaged materials received.

H. All bills of lading and any memorandum for shortage or damage of material in the shipment shall be promptly submitted to the Owner.

I. The Contractor shall be responsible for distribution of all materials as required to complete the Work.

J. Materials delivered to the Contractor shall be in the custody of the Contractor from the time of receipt by the Contractor of such materials from the carrier until final acceptance of the completed Work.

K. The Contractor shall be responsible for any loss or damage to materials.

1.05. STORAGE AND PROTECTION

A. Store all pipe which cannot be distributed along the route. Make arrangements for the use of suitable storage areas. Inform Owner and Owner of the location, street address, of the storage area.

B. Stored materials shall be kept safe from damage. The interior of all pipe, fittings, valves and other appurtenances shall be kept free from dirt or foreign matter at all times. Valves shall be drained and stored in a manner that will protect them from damage by freezing.

C. Pipe shall not be stacked higher than the limits recommended by the manufacturer.

D. The bottom tier shall be kept off the ground on timbers, rails or concrete. Pipe in tiers shall be alternated: bell, plain end; bell, plain end. At least two rows of timbers shall be placed between tiers and chocks, affixed to each other in order to prevent

movement. The timbers shall be large enough to prevent contact between the pipes in adjacent tiers.

E. Store joint gaskets in a cool location, out of direct sunlight. Gaskets shall not come in contact with petroleum products. Gaskets shall be used on a first in, first out basis.

F. Mechanical joint bolts shall be handled and stored in such a manner that will ensure proper use with respect to types and sizes.

G. All tools, materials, machinery and equipment required for the Work may be stored in a compact, neat, stock-piled manner adjacent to the work site, in a suitable location, and in such a manner as to cause the least inconvenience to the affected property owners, ensure traffic safety, and so as not to endanger the general public in any way.

H. All active, existing fire hydrants must be kept unobstructed and accessible at all times.

I. All water and gas valves, and underground power and telephone manholes must be left uncovered by such storing of materials.

1.06. QUALITY ASSURANCE

A. Product manufacturers shall provide the Owner with written certification that all products furnished comply with all applicable provisions of these Specifications. All materials which fail to conform to these Specifications shall be rejected.

B. If ordered by the Owner, each pipe manufacturer shall furnish the services of a competent factory representative to supervise and/or inspect the installation of pipe. This service will be furnished for a minimum of five days during initial pipe installation.

C. After delivery to the site, any materials which have been damaged in transit or are unsuitable for use in the Work shall be rejected and removed from the site.

PART 2 – PRODUCTS

2.01. GENERAL

A. For sewer installations with no live load and not along stream banks, the standard pipe shall be DR 17 HDPE in ductile iron pipe size (DIPS) for pipe sizes 8-inch through 48-inch with maximum bury depth of 20 feet.

B. For sewer installations with HS20/25 live loads, or with bury depth greater than 20 feet and not along stream banks, the standard pipe shall be DR 17 HDPE in ductile iron pipe size (DIPS) for pipe sizes 8-inch through 30-inch.

C. For force mains, regardless of bury depth, live load requirements and not along riverbanks, the standard pipe shall be DR 11 HDPE in ductile iron pipe size (DIPS) for pipe sizes 8-inch through 30-inch.

D. For sewer installations with no live loads and located along stream banks, the standard pipe shall be DR 17 HDPE in ductile iron pipe size (DIPS) for pipe sizes 8-inch through 48-inch and maximum bury depth of 20 feet.

2.02. DUCTILE IRON SEWER PIPE (DIP)

A. See Specification Section 33 33 00, Ductile Iron Pipe.

2.03. PVC SEWER PIPE

A. See Specification Section 33 32 00, PVC Pipe and Fittings.

2.04. HDPE SEWER PIPE

A. See Specification Section 33 31 00, HDPE Pipe and Fittings.

2.05. VALVES

A. Isolation valves for sewer force mains shall be eccentric plug valves.

B. See Specification Section 33 11 15, Valves and Appurtenances.

2.06. VALVE BOXES (VB) AND EXTENSION STEMS

A. All buried valves shall be equipped with valve boxes and covers.

1. The valve boxes shall be cast-iron two-piece screw type with drop covers. Valve boxes shall have a 5 ¼ inch inside diameter.

2. Valve box covers shall weigh a minimum of 13 pounds.

3. The valve boxes shall be adjustable to 6 inches up or down from the nominal required cover over the pipe.

4. Valve boxes shall be of sufficient length that bottom flange of the lower belled portion of the box is below the valve operating nut.

5. Ductile or cast-iron extensions shall be provided as necessary.

6. Covers shall have "SEWER VALVE" or "SEWER" cast into them.

7. Valve boxes shall be manufactured in the United States.

B. All valve boxes shall have a concrete collar, minimum 9 inches thick.

1. The collar shall be square or round and sized 24 inches square or 24 inches in diameter.

2. Precast collars may be used, provided that they are grouted in place to the valve box.
3. The box is to be flush with finished grade.
4. The edge of the valve box is to be ½-inch above the edge of the concrete collar.

C. Where the depth of cover is more than 5-feet, the Contractor shall provide suitable, permanently installed valve stem extensions and guides which have been approved by the Owner prior to fabrication and placement.

1. All valves shall be furnished with Type 316 stainless steel extension stems, as necessary, to bring the operating nut to within 6 inches of the top of the valve box.
2. Connection to the valve shall be with a wrench nut coupling and a set screw to secure the coupling to the valve's operating nut.
3. The coupling and square wrench nut shall be welded or pinned to the extension stem and shall have a centering ring.
4. Extension stems shall be minimum 1-inch diameter.
5. Extension stems shall be equal to Trumbull Industries, M & H Valve, or Penn-Troy Manufacturing/Troy Valve.

2.07. VALVE MARKERS (VM)

A. The Contractor shall provide a concrete valve marker as detailed on the Drawings for each valve installed outside paved areas.

1. The markers shall be Class A concrete of DOT specifications, 4 inches square by 5 feet long, and shall be of the same construction as that of highway right-of-way markers.
2. The words "SEWER VALVE" shall be cast vertically into the marker beginning 2 inches from the top of the marker.
2. There shall also be a 1-¼ inch brass plug cast into the marker 1 inch below the letter "E" of the word "VALVE", which shall be stamped in the field by the Contractor, after installation, with the distance, in feet, from the valve marker to the valve box.
4. The markers shall be installed as close to the right-of-way line opposite the valve as is possible, with the brass plug facing the valve.
5. The marker shall be located so as to avoid damage by traffic.

6. The top of the marker shall generally be set 24 inches above finished grade. The marker may be somewhat lower in areas where it may be considered obtrusive, such as lawns, however, at no time shall the marker be installed at less than 18" above finished grade.
7. Valve markers shall be in accordance with County standards.
8. In addition to concrete valve marker where street curbs are installed a saw cut ½ inch deep "V" notch on top of curb adjacent to water valve location is required.

2.08. PRECAST CONCRETE SECTIONS

- A. Precast concrete sections shall meet the requirements of ASTM C478 and ASTM C76, latest revision, Class II, Wall B, Type II Portland cement.
- B. The minimum compressive strength of the concrete in precast sections shall be 4,000 psi.
- C. Reinforcing steel shall conform to ASTM A615, including supplementary requirements, and shall be Grade 60 except that bars to be welded shall be Grade 40 or ASTM A706.
- D. Pre-cast concrete sections shall have a minimum 28-day cure time before delivery to the site.
- E. The minimum wall thickness shall be one twelfth of the inside diameter of the base, riser or the largest cone diameter, or 8 inches minimum, whichever is larger. Additionally, the wall thickness shall be sufficient for the proper installation of the rubber boots.
- F. The minimum inside diameter of manholes shall be 48 inches with an opening of 24 inches at the top of the cone.
- G. Transition slabs which convert bases larger than four feet in diameter to four-foot diameter risers shall be designed by the manhole manufacturer to carry the live and dead loads exerted on the slab.
- H. Seal joints between precast sections by means of rubber O ring gaskets or flexible butyl rubber sealant.
 1. Butyl rubber sealants shall meet the requirements of AASHTO M 198. Sealant shall be preformed type with a minimum nominal diameter of 1 inch.
 2. Butyl rubber sealant shall be equal to Kent Seal No. 2 or Concrete Sealants CS202.
- I. In flood plains and locations vulnerable to high rates of inflow and infiltration, manholes shall be lined on the inside with a protective liner approved by the Owner.

J. Drop manholes, manholes with a force main discharge connection and any other manholes that are susceptible to large amounts of hydrogen sulfide shall be lined on the inside with a protective liner approved by the Owner.

K. The manhole table shall have a flow channel made to conform in shape and carrying capacity to that of the sewers.

L. Eccentric manhole cones are required for manhole frame and covers.

2.09. GRADE RINGS:

A. Composite Manhole Ring.

B. EJ Infra-Riser or approved equal.

C. Material: Composite of recycled rubber, nylon fiber and polyurethane prepolymer.

D. Density: 64.2 lbs/cu. ft., ASTM D3574, Test A.

E. Durometer Hardness: 77A +/- 5 points, ASTM D2240.

F. Tensile Strength: 304 psi (not less than 145 psi), ASTM D412.

2.10. BRICK AND MORTAR:

A. Brick shall be whole and hard burned, conforming to ASTM C32 Grade MS.

B. Mortar shall be made of one part Portland cement and two parts clean sharp sand.

C. Cement shall be Type 1 and shall conform to ASTM C150. Sand shall meet ASTM C144.

2.11. RUBBER BOOTS:

A. All pipes entering a manhole must be sealed by a rubber boot

B. Provide preformed rubber boots and fasteners equal to A-Lok, Z-Lok, Kor N Seal or Press Seal Gasket Corporation.

C. Boots may be mechanically attached to the manhole or cast into the walls of the manhole.

2.12. CASTINGS:

A. The manhole cover shall be factory imprinted to read: FULTON COUNTY SEWER

B. Cast Iron Castings - Paved Areas (Non-bolted):

1. Cast iron manhole frames, covers and steps shall meet the requirements of ASTM A 48 for Class 30 gray iron and all applicable local standards. All

castings shall be tough, close grained, smooth, and free from blow holes, blisters, shrinkage, strains, cracks, cold shots and other imperfections.

2. No casting will be accepted which weighs less than 95 percent of the design weight.
3. Shop drawings must indicate the design weight and provide sufficient dimensions to permit checking.
4. All castings shall be thoroughly cleaned in the shop and given two coats of approved bituminous paint before rusting begins.
5. Manhole frames and covers shall be as shown on the Standard Details.
6. All frames and covers shall have machined horizontal bearing surfaces.
7. All manholes located in paved areas shall have standard frames and covers except where specifically shown otherwise on the Drawings.
8. Only solid manhole covers may be used for sanitary sewers.

C. Cast Iron Castings - Paved Areas (Bolt Down):

1. Cast iron manhole frames, covers and steps shall meet the requirements of ASTM A 48 for Class 30 gray iron and all applicable local standards. All castings shall be tough, close grained, smooth, and free from blow holes, blisters, shrinkage, strains, cracks, cold shots and other imperfections.
2. No casting will be accepted which weighs less than 95 percent of the design weight.
3. Shop drawings must indicate the design weight and provide sufficient dimensions to permit checking.
4. All castings shall be thoroughly cleaned in the shop and given two coats of approved bituminous paint before rusting begins.
5. Manhole frames and covers shall be as shown on the Standard Details.
6. All frames and covers shall have machined horizontal bearing surfaces.
7. All manholes located in paved areas shall have standard frames and covers except where specifically shown otherwise on the Drawings.
8. Watertight covers in paved areas shall be bolt down type and shall be equipped with four 1/2-inch stainless steel bolts and a 1/8-inch red rubber or rubber O ring gasket.
9. Covers shall be rotatable and interchangeable.

10. Bolt holes shall be bored through so that debris entering the bolt hole will fall into the manhole.
11. Bolt holes shall have the full 360-degree circle within the cover's radius when bored through the cover.
12. Only solid manhole covers may be used for sanitary sewers.

D. Cast Iron Castings - Unpaved Areas

1. For all manholes located in unpaved areas, manhole cover and frame shall be manufactured from ductile iron in accordance with ISO 1083.
2. Covers and frames shall be hinged and incorporate a 90-degree blocking system to prevent accidental closure. The hinge box shall include a self-cleaning, dual wiper infiltration plug.
3. Covers shall be one man operable using standard tools and shall be capable of withstanding a test load of 120,000 lbs.
4. Frames shall be circular with a 24" clear opening and shall include a 360° mechanically attached, C-shaped elastomer seating gasket for infiltration control and traffic shock.
5. Covers and frames must have at least five years of successful history in a minimum of five thousand installations and be manufactured by an ISO 9000 certified manufacturer.
6. The frame depth shall not exceed 4 inches, and the flange shall incorporate bedding slots, bolt holes and lifting eyes.
7. All components shall be black coated. Frame weight: 73 lbs. Cover weight: 122 lbs. Total weight 195 lbs.

E. Composite Castings

1. All composite moldings shall consist of a thermosetting resin matrix blended and/or combined with reinforcing fiber rovings, short fiber filaments, or equivalent nonmetallic reinforcing structure(s).
 - a. The thermosetting resin matrix shall be a polyester, vinyl ester, or a blend of these.
 - b. The moldings shall be true to pattern in form and dimension and free from cracks, pores, knit-lines, or other defects in locations affecting their strength and value for the service intended.
 - c. Before the moldings are removed from the molding operation, they shall be thoroughly deflashed and cleaned at the parting lines, holes, notches and all exposed edges.

2. Composite frames must have a wall thickness of at least 0.75 inches in sections exposed to traffic and potential traffic wheel impact.
3. If using a lock, bolt, or latch, these must be independent of the method used to open the cover to ensure the cover can be opened in the event of lock failure.
4. Molding Process
 - a. Covers and frames shall be compression molded under high pressures (>0.5 tons/sq inch of x-y surface area) and high temperatures (>200 degrees F).
 - b. Metal reinforcements or metal hinges molded within the composite shall not be permitted. Small non-stress bearing pieces of metal may be encapsulated.
 - c. Composite covers and frames shall be molded in the USA.
5. Testing and performance requirements
 - a. Testing shall be performed in accordance with the following inspection criteria unless otherwise specified.
 - 1) The manufacturer/supplier shall be responsible for carrying out all of the required tests and inspections.
 - 2) All testing shall be conducted in the United States.
 - 3) The manufacturer/supplier shall maintain complete records of all such tests and inspections.
 - 4) All testing shall be paid for by the manufacturer/supplier.
 - b. All covers shall be capable of withstanding a minimum traffic load of 40,000 lbs, tested in accordance with AASHTO M-306
 - 1) The Supplier of covers shall submit a test report from an accredited independent testing laboratory. The test report shall document a successful proof load test of 40,000 lbs. for 60 seconds using a 9-inch x 9-inch plate.
 - 2) There shall be no cracks or permanent deformation greater than 1/8 inch.
 - 3) The test report shall fully disclose the AASHTO M-306 test procedures and type of test equipment used and be illustrated with pictures showing the test plate, equipment used and pictures of the top and bottom of the lid.

Section 4
Scope of Work and Technical Specifications
SECTION 33 30 00-11 SEWER AND ACCESSORIES

- c. Load test:
 - 1) A load of 40,000 lbs shall be concentrated on a 9"x 9" block with rubber or fiber backing pad for one minute.
 - 2) During the load testing process, visible cracks or delamination will be cause for rejection (popping noises during this test are normal for composites and do not indicate failure).
 - 3) When load is removed, Permanent Set (Deflection) of more than 1/8 inch measured at center of load area will be cause for rejection.
 - 4) All testing shall be conducted on a NIST calibrated and Certified load test machine.
- d. Ultraviolet resistance:
 - 1) ASTM G 154 Cycle I for 1000 hrs.
 - 2) Specimens shall be tested for ultimate flexural strength (ASTM D790), retaining at least 75% of control values for load and deflection at failure.
- e. Coefficient of Friction:
 - 1) Shall be greater than 0.6 when tested in accordance to ASTM C 1028.
- f. Notched Izod Impact:
 - 1) Composite raw material impact results shall be greater than 5 ft.-lbs/inch when tested in accordance to ASTM D256.
- 6. Components for locking systems below the cover exposed to the sewer environment shall be made of noncorrosive materials such as nonmagnetic, 316 stainless steel or a polymer.
- 7. Covers shall be the types and shall be imprinted as shown on the plans or standard details.
- 8. Markings
 - a. Covers and Frames shall have the following molded into the substrate of the cover:
 - 1) Name (or Abbreviation) Molder
 - 2) Country of Origin
 - 3) Molding Date

4) Indication that Material is Non-metallic

9. The covers shall be black in color and have the words SANITARY SEWER molded into the lid in 1- $\frac{3}{4}$ inch raised letters.
10. The covers shall be secured to the frames with four type 316 socket head cap screws. The cap screws shall be coated with a resin-bonded, thermally cured, dry-film lubricant, black in color.
11. The coating shall be 1 mil thick and have a coefficient of friction of 0.05 - 0.10. Cap screws shall be retained to cover by type 316 stainless tooth-lock washers.
12. The frames shall be molded with four stainless threaded inserts to receive the coated stainless steel cap screws. The frame shall have a groove for a neoprene gasket.
13. All covers shall be capable of withstanding a fatigue analysis in accordance with EN 124-1: 2015 for a C250 rating.
 - a. The Supplier shall submit a test report from an independent testing laboratory which has been accredited by the American Association for Laboratory Accreditation.
 - b. The test report shall document no cracks being present after subjected to 100,000 cycles of 20,682 lbs. (92KN), applied by a 9-inch x 9-inch square plate.
14. All covers shall be capable of passing a water infiltration test in accordance with FACTA Specification for Fabricated Access Covers current edition.
 - a. The Supplier of covers shall submit a test report from an accredited independent testing laboratory.
 - b. The cover shall be tested in a specially designed fixture where it is face-down with 3.94 inches of water above it for 24 hrs.
 - c. After the test period, leakage shall not exceed 0.169 oz/minute.
15. Warranty
 - a. Material Warranty: A written guarantee of 20 years submitted to the County for the specific project shall be provided by the Manufacturer against any defects of the cover and frame material.
 - b. Workmanship Warranty: The Contractor shall guarantee his work for a warranty period of 3 years from the date of final acceptance and shall cover the cost of replacing the cover and frame and freight to project

site should the cover and frame have any defects in material or workmanship.

c. If repairs are made, the Contractor/Manufacturer shall warrant the repaired work for the periods specified above for material and workmanship in addition to the original warranty period required by the Contract.

d. Unless otherwise specified, the warranty periods shall begin after the Certificate of Acceptance is issued for the Contract.

16. Frames and covers shall be manufactured by Composite Access Products (CAP) or approved equal.

2.13. MISCELLANEOUS ACCESSORIES

A. Manhole Riser Rings

1. All final grade adjustment of manhole cover, and frame assemblies shall be completed with riser rings. The contractor shall utilize flat and sloping units to match the required slope and or grade of the structure.

2. All adjustments for matching road grade shall be made utilizing a molded indexed slope ring.

3. The complete riser ring system utilizing shall consist of the riser rings, sealed to the manhole structure, to the cover and frame, and to one another by means of an approved butyl sealant.

4. The manhole adjusting rings shall be molded from high-density polyethylene as defined in ASTM Specification D-4976.

5. The adjustment rings shall be molded from 100% recycled material.

6. The plastic rings shall be manufactured utilizing the injection molding process as defined by SPE (Society of Plastic Engineers).

7. The adjustment rings shall be tested to assure compliance with impact and loading requirements per the ASSHTO Standard Specification for Highway Bridges.

8. Installation shall be per manufacturer's recommendations only.

9. The annular space between the individual rings and cone basin and the rings and cover frame shall be sealed per manufacturer's instruction utilized with ASTM C990 approved butyl sealant.

10. Warranty

- a. **Material Warranty:** A written guarantee of 30 years submitted to the County for the specific project shall be provided by the Manufacturer against any defects of the riser ring material.
- b. **Workmanship Warranty:** The Contractor shall guarantee his work for a warranty period of 3 years from the date of final acceptance and shall cover the cost of replacing the riser rings and freight to project site should the riser rings have any defects in material or workmanship.
- c. If repairs are made, the Contractor/Manufacturer shall warrant the repaired work for the periods as specified above for material and workmanship in addition to the original warranty period required by the Contract.
- d. Unless otherwise specified, the warranty periods shall begin after the Certificate of Acceptance is issued for the Contract.

11. All riser rings shall be manufactured by LADTECH, Inc. or approved equal.

B. Flexible Adapter Couplings:

- 1. Couplings for pipe sizes 15 inches in diameter and less shall be elastomeric plastic sleeves designed to connect pipes of dissimilar materials. Adapters shall provide a positive seal against infiltration and exfiltration and remain leak-proof and root-proof up to 4.3 psi. The adapter manufacturer shall provide all stainless-steel clamps and required accessories.
- 2. Couplings shall be products of Fernco and shall be installed in accordance with the manufacturer's recommendations.

2.14. ELECTRONIC MARKERS

- A. Electronic markers shall be buried with utilities to serve as a locating device.
- B. Electronic markers shall be the "Ball" type for a depth up to 4 feet and the "Full Range" type for depths greater than 4 feet.
- C. Each marker shall be color coded in accordance with APWA standards and produce an industry specific frequency.
- D. Each marker shall contain a passive antenna that requires no internal power source.
- E. Markers shall be of water-resistant polyethylene shells and impervious to minerals, chemicals and underground temperature extremes.

F. Electronic markers shall be compatible with 3M Dynatel 1420 EMS-iD Marker Locator. Contractor shall supply one Marker Locator for use during installation and shall turn over Locator to County upon project completion.

G. Markers shall be equal to 3M EMS 1424 XR/ID for wastewater service.

2.15. CONCRETE

A. Concrete shall have a compressive strength of not less than 3000 psi with not less than 5.5 bags of cement per cubic yard and a slump between 3 and 5 inches.

B. For job mixed concrete, submit the concrete mix design for approval by the Owner.

C. Ready mixed concrete shall be mixed and transported in accordance with ASTM C94.

D. Reinforcing steel shall conform to the requirements of ASTM A615, Grade 60.

2.16. RETAINER GLANDS

A. All restrained ductile iron pipe and fittings shall be manufactured restrained joint as specified in Section 33 33 00. Retainer glands shall only be installed on MJ valves and where allowed by Owner.

B. Retainer glands shall be provided at all mechanical joints, including fittings, valves, hydrants and other locations as shown on the Drawings.

C. Anchorage: Where retainer glands are installed or allowed by Owner, the valves, plugs, caps, tees and bends deflecting 11 ¼ degrees or more shall be provided with one of the following two forms of restraint:

1. Retainer glands plus concrete thrust blocking (3,000 psi concrete thrust block sized to withstand line pressures of 300 psi and soil bearing pressures of 2,000 psf)

2. Retainer glands plus rodding to concrete thrust collar (3,000 psi concrete collar and tie rods sized to withstand line pressures of 300 psi and soil bearing pressures of 2,000 psf)

D. Retainer glands for ductile iron pipe shall be manufactured in the U.S.A and equal to:

1. Megalug Series 1100, as manufactured by EBAA Iron.
2. Uni-Flange Series 1400, as manufactured by Ford Meter Box Company,
3. Stargrip Series 3000, as manufactured by Star Pipe Products,
4. Sigma One LOK Series SLD as manufactured by Nappco-Sigma.

5. Or approved equal.

2.17. DETECTION TAPE

- A. Detection tape shall be composed of a solid aluminum foil encased in a protective plastic jacket.
- B. Tapes shall be color coded in accordance with APWA color codes with the following legends: "CAUTION WASTEWATER MAIN BURIED BELOW".
 - 1. Color is green for wastewater mains and the color may be solid or striped.
 - 2. Tape shall be permanently printed with no surface printing allowed.
 - 3. Tape width shall be a minimum of 2 inches when buried less than 10 inches below the surface.
 - 4. Tape width shall be a minimum of 3 inches when buried greater than 10 inches and less than 20 inches.
- C. Detection tape shall be equal to Lineguard Type III Detectable or Allen Systems Detectatape or approved equal.

2.18. SPECIAL COATINGS

- A. Applications
 - 1. Below grade (buried) or where little to no surface preparation can be performed on piping or structural steel.
- B. Coating Materials
 - 1. Petrolatum based mastic or wax based wrapping tapes
 - 2. Coating System Manufacturer
 - a. Carboline
 - 1) First Coat - Carbowrap Priming Paste
 - 2) Finish Coat - Tape A, B, or C (temp. dependent)
 - b. Denso
 - 1) First Coat - Denso Paste
 - 2) Finish Coat - Densyl Tape
 - c. Trenton
 - 1) First Coat - Waxtape Primer
 - 2) #1 Wax Tape

PART 3 – EXECUTION

3.01. EXISTING UTILITIES AND OBSTRUCTIONS

- A. The Drawings indicate utilities or obstructions that are known to exist according to the best information available to the Owner.
- B. The Contractor shall call the Utilities Protection Center (UPC) (800 282 7411) as required by Georgia law (O.C.G.A. §§ 25 9 1 through 25 9 13) and all utilities, agencies or departments that own and/or operate utilities in the vicinity of the construction work site, at least 72 hours (three business days) prior to construction, to verify the location of the existing utilities.
- C. Existing Utility Location: The following steps shall be exercised to avoid interruption of existing utility service.
 - 1. Provide the required notice to the utility owners and allow them to locate their facilities according to Georgia law.
 - 2. Field utility locations are valid for only ten days after original notice. The Contractor shall ensure, at the time of any excavation, that a valid utility location exists at the point of excavation.
 - 3. Expose the facility to verify its true location and grade for a distance of at least 200 feet in advance of pipeline construction to verify its true location and grade.
 - 4. Repair, or have repaired, any damage to utilities resulting from locating or exposing their true location.
 - 5. Avoid utility damage and interruption by protecting it with means or methods recommended by the utility owner.
 - 6. Maintain a log identifying when phone calls were made, who was called, area for which utility relocation was requested and work order number issued, if any.
 - 7. The Contractor shall provide the Owner an updated copy of the log biweekly, or more frequently if required.
- D. Conflict with Existing Utilities:
 - 1. Horizontal Conflict: Horizontal conflict shall be defined as when the actual horizontal separation between a utility, main, or service and the proposed sewer does not permit safe installation of the sewer by the use of sheeting, shoring, tying back, supporting, or temporarily suspending service of the parallel or crossing facility.

Section 4
Scope of Work and Technical Specifications
SECTION 33 30 00-18 SEWER AND ACCESSORIES

- a. The Contractor may change the proposed alignment of the sewer to avoid horizontal conflicts if the new alignment remains within the available rightofway or easement and complies with regulatory agency requirements after a written request to and subsequent approval by the Owner.
 - b. Where such relocation of the sewer is not approved by the Owner, the Contractor shall arrange to have the utility, main, or service relocated.
2. Vertical Conflict: Vertical conflict shall be defined as when the actual vertical separation between a utility, main, or service and the proposed sewer does not permit the crossing without immediate or potential future damage to the utility, main, service, or the sewer.
 - a. The Contractor may change the proposed grade of the sewer to avoid vertical conflicts if the changed grade provides minimum required capacity, maintains adequate cover and complies with regulatory agencies requirements, after written request to and subsequent approval by the Owner.
 - b. Where such relocation of the sewer is not approved by the Owner, the Contractor shall arrange to have the utility, main, or service relocated.
- E. Electronic Locator: Have available at all times an electronic pipe locator and a magnetic locator, in good working order, to aid in locating existing pipelines or other obstructions.
- F. Water, Sewer and Storm Drain Separation:
 1. Sewers shall be laid at least 10 feet laterally edge to edge from existing or proposed water mains.
 - a. Where the sewer crosses a water main, the top of sewer pipe must be at least 18 inches below the bottom of the water main.
 - b. Where 18 inches clear vertical separation cannot be maintained, the sewer pipe shall be mechanical joint DIP.
 - c. Where possible, a full joint of sewer pipe shall be centered over the water main. Any deviation shall be requested in writing to the Owner.
 2. Where sewer lines cross under storm drains, the sewer shall be laid such that the top of the sewer is at least 12 inches below the bottom of the storm drain. Where the vertical separation is less than 12 inches, the sewer pipe shall be mechanical joint DIP.
 3. No water main shall be permitted to pass through or come in contact with any part of a manhole.

4. There shall be a minimum 5 feet horizontal separation between parallel gravity and/or force mains

3.02. CONSTRUCTION ALONG HIGHWAYS, STREETS, AND ROADWAYS

- A. Install pipelines and appurtenances along highways, streets, and roadways in accordance with the applicable regulations of, and permits issued by, the Georgia Department of Transportation, Fulton County, and the City having jurisdiction, with reference to construction operations, safety, traffic control, road maintenance and repair.
- B. The Contractor shall prepare a Traffic Control Plan and submit the plan to the Owner at least 14 days prior to on-site work.
- C. The Traffic Control Plan shall include all anticipated lane closures, placement of traffic control devices, barricades, lights, flagmen etc. to clearly show how traffic flow and safety will be maintained throughout the Project.
- D. Traffic Control:
 1. The Contractor shall:
 - a. Provide, erect and maintain all necessary barricades, suitable and sufficient lights and other traffic control devices,
 - b. Provide qualified flagmen where necessary to direct traffic. Flagmen shall be certified by a Georgia DOT approved flagman training program.
 - c. Take all necessary precautions for the protection of the work and the safety of the public.
 2. Construction traffic control devices and their installation shall be in accordance with the current Manual on Uniform Traffic Control Devices for Streets and Highways.
 3. Placement and removal of construction traffic control devices shall be coordinated with the Georgia Department of Transportation, Fulton County and the City having jurisdiction, a minimum of 48 hours in advance of the activity.
 4. Placement of construction traffic control devices shall be scheduled ahead of associated construction activities.
 - a. Construction time in street right of way shall be conducted to minimize the length of time traffic is disrupted.
 - b. Construction traffic control devices shall be removed immediately following their useful purpose.
 - c. Traffic control devices used intermittently, such as "Flagmen Ahead", shall be removed and replaced when needed.

5. Existing traffic control devices within the construction work zone shall be protected from damage.

- a. Traffic control devices requiring temporary relocation shall be located as near as possible to their original vertical and horizontal locations.
- b. Original locations shall be measured from reference points and recorded in a log prior to relocation.
- c. Temporary locations shall provide the same visibility to affected traffic as the original location.
- d. Relocated traffic control devices shall be reinstalled in their original locations as soon as practical following construction.

6. Construction traffic control devices shall be maintained in good repair and shall be clean and visible to affected traffic for daytime and nighttime operation. Traffic control devices affected by the construction work zone shall be inspected daily.

7. Construction warning signs shall be black legend on an orange background. Regulatory signs shall be black legend on a white background.

- a. Construction sign panels shall meet the minimum reflective requirements of the Georgia Department of Transportation, Fulton County and the City having jurisdiction.
- b. Sign panels shall be of durable materials capable of maintaining their color, reflective character and legibility during the period of construction.

8. Channelization devices shall be positioned preceding an obstruction at a taper length as required by the current Manual on Uniform Traffic Control Devices for Streets and Highways, as appropriate for the speed limit at that location.

- a. Channelization devices shall be patrolled to ensure that they are maintained in the proper position throughout their period of use.

E. Construction Operations:

- 1. Perform all work along highways, streets and roadways to minimize interference with traffic.
- 2. Stripping: Where the pipeline is laid along road right of way, strip and stockpile all sod, topsoil and other material suitable for right of way restoration.
- 3. Trenching, Laying and Backfilling: Do not open the trench any further ahead of pipe laying operations than is necessary. Backfill and remove excess

material immediately behind laying operations. Complete excavation and backfill for any portion of the trench in the same day.

4. Shaping: Reshape damaged slopes, side ditches, and ditch lines immediately after completing backfilling operations. Replace topsoil, sod and any other materials removed from shoulders.

5. Construction operations shall include cleanup and utility exploration.

F. Excavated Materials: Do not place excavated material along highways, streets and roadways in a manner which obstructs traffic. Sweep all scattered excavated material off the pavement in a timely manner.

G. Drainage Structures: Keep all side ditches, culverts, cross drains, and other drainage structures clear of excavated material. Care shall be taken to provide positive drainage to avoid ponding or concentration of runoff.

H. Landscaping Features: Landscaping features shall include, but are not necessarily limited to: fences, property corners, cultivated trees and shrubbery, manmade improvements, subdivision and other signs within the right of way and easement. The Contractor shall take extreme care in moving landscape features and promptly reestablishing these features.

I. Maintaining Highways, Streets, Roadways and Driveways:

1. Maintain streets, highways, roadways and driveways in suitable condition for movement of traffic until completion and final acceptance of the Work.

2. During the time period between pavement removal and completing permanent pavement replacement, maintain highways, streets and roadways by the use of steel running plates.

a. The edges of running plates shall have asphalt placed around their periphery to minimize vehicular impact.

b. The backfill above the pipe shall be compacted, as specified elsewhere, up to the existing pavement surface to provide support for the steel running plates.

3. Furnish a road grader or front-end loader for maintaining highways, streets, and roadways. Make the grader or front-end loader available at all times.

4. Immediately repair all driveways that are cut or damaged. Maintain them in a suitable condition for use until completion and final acceptance of the Work.

3.03. PIPE DISTRIBUTION

A. Pipe shall be distributed and placed in such a manner that will not interfere with traffic.

- B. Pipe may not be strung along the project within existing highway rights-of-way, unless specifically directed to do so by the Owner, and only then after receiving permission from the road authority which has jurisdiction.
- C. No pipe shall be strung further along the route than 500 feet beyond the area in which the Contractor is actually working without written permission from the Owner.
- D. The Owner reserves the right to reduce this distance to a maximum distance of 200 feet in residential and commercial areas based on the effects of the distribution to the adjacent property owners.
- E. No street or roadway may be closed for unloading of pipe without first obtaining permission from the proper authorities.
- F. The Contractor shall furnish and maintain proper warning signs and obstruction lights for the protection of traffic along highways, streets and roadways upon which pipe is distributed.
- G. No distributed pipe shall be placed inside drainage ditches.
- H. Distributed pipe shall be placed as far as possible from the roadway pavement, but no closer than five feet from the roadway pavement, as measured edge to edge.

3.04. LOCATION AND GRADE

- A. The Drawings show the alignment and grade of the sewer and the position of manholes and other appurtenances. The slope shown on the profile is the slope of the invert of the pipe.
- B. Prior to clearing and grubbing, construction staking shall be performed. The Owner will provide a temporary benchmark along the sewer main route and at all other locations where the alignment of the sewer changes significantly
- C. From the information on the Drawings and the survey points found on the Project site, the Contractor shall perform all surveys necessary for the establishment of the horizontal and vertical alignment of the sewer.
- D. Construction Staking
 - 1. The base lines for locating the principal components of the Work are shown on the Drawings.
 - a. Base lines shall be defined as the line to which the location of the sewer is referenced, including but not limited to, edge of pavement, road centerline, property line, right of way or survey line.
 - b. The Contractor shall be responsible for performing all survey work required for constructing the sewer, including the establishment of base lines and any detail surveys needed for construction.

Section 4
Scope of Work and Technical Specifications
SECTION 33 30 00-23 SEWER AND ACCESSORIES

1) This work shall include the staking out of permanent and temporary easements to ensure that the Contractor is not deviating from the designated easements.

2. The level of detail of survey required shall be that which the correct location of the sewer can be established for construction and verified by the Owner.

a. Where the location of components of the sewer is not dimensioned, the establishment on the location of these components shall be based upon scaling these locations from the Drawings with relation to readily identifiable landmarks such as survey reference points, power poles, manholes, etc.

E. Reference Points:

1. The Contractor shall take all precautions necessary, which includes, but is not necessarily limited to, installing reference points, in order to protect and preserve the centerline or baseline established by the Owner.

2. Reference points shall be placed, at or no more than three feet, from the outside of the construction easement or right of way.

a. The location of the reference points shall be recorded in a log with a copy provided to the Owner for use prior to his verifying reference point locations.

b. Distances between reference points and the manhole centerlines shall be accurately measured to the nearest 0.01 foot.

3. The Contractor shall give the Owner reasonable notice that reference points are set. The reference point locations must be verified by the Owner prior to commencing clearing and grubbing operations.

F. Cut Sheets:

1. Cut sheets shall be utilized for basis of payment and confirming that the profile is as shown on the Drawings.

2. Prior to beginning installation of any section of the gravity sewer, prepare cut sheets from field run ground elevations and submit them to the Owner for approval.

3. The survey, from which cut sheets are prepared, may be performed prior to or after clearing and grubbing operations. The surveyor shall obtain an elevation on each benchmark shown on the Drawings and provide this information to the Owner.

Section 4
Scope of Work and Technical Specifications
SECTION 33 30 00-24 SEWER AND ACCESSORIES

4. No installation of the sewer shall commence prior to approval of the cut sheets.
 5. Submittal of cut sheets shall be in accordance with Section 01 33 00 and Section 01 33 23 of these Specifications.
 6. Cut sheets shall provide the station (to the nearest 1 foot) and the elevation (to the nearest 0.1 foot) at maximum 100-foot intervals, plus at each change in slope of the ground and at each manhole centerline.
 7. The cut sheet shall also show the invert elevation of the sewer at the corresponding sewer station.
 8. From a straight-line interpolation of the data, the Contractor shall calculate and record the station of each point where there is a change in the cut brackets indicated on the Bid form.
 9. The Contractor shall calculate and record the length of the sewer between each change in cut bracket.
 10. The Contractor shall also indicate the pipe material and class as well as the type of bedding.
 11. The slope of the sewer shall also be indicated between manholes.
 12. At least one offset hub or temporary benchmark shall be provided at each manhole. Its elevation and the resulting cut from the hub to the manhole invert shall also be shown on the cut sheets.
- G. Multiple construction sites shall not be permitted without written authorization from the Owner for each site. As a minimum, cut sheets between construction sites shall be submitted and approved before multiple construction sites will be permitted.
- H. The Contractor shall be responsible for any damage done to reference points, base lines, center lines and temporary benchmarks, and shall be responsible for the cost of re-establishment of reference points, base lines, center lines and temporary benchmarks as a result of the operations.
- I. Construction Verification Survey allowance: The Construction Verification Survey cash allowance is solely for the use of the Owner for verification of the Contractor's reference points, centerlines and work performed.
- J. The presence of this cash allowance in no way relieves the Contractor of the responsibility of installing reference points, centerlines, temporary benchmarks, providing as-built drawings, or verifying that the work has been performed accurately.

3.05. LAYING AND JOINTING PIPE AND ACCESSORIES

Section 4
Scope of Work and Technical Specifications
SECTION 33 30 00-25 SEWER AND ACCESSORIES

- A. Force mains, valves and appurtenances shall be installed before the installation of the subbase course or paving or any other utilities except gravity sewer lines.
- B. Lay all pipe and fittings to accurately conform to the lines and grades established by the Engineer.
- C. Pipe Installation:
 - 1. Proper implements, tools and facilities shall be provided for the safe performance of the Work.
 - a. All pipe, fittings and valves shall be lowered carefully into the trench by means of slings, ropes or other suitable tools or equipment in such a manner as to prevent damage to sewer materials and protective coatings and linings.
 - b. Under no circumstances shall sewer materials be dropped or dumped into the trench.
 - 2. All pipe, fittings, valves and other appurtenances shall be examined carefully for damage and other defects immediately before installation. Defective materials shall be marked and held for inspection by the Owner, who may prescribe corrective repairs or reject the materials.
 - 3. All lumps, blisters and excess coating shall be removed from the socket and plain ends of each pipe, and the outside of the plain end and the inside of the bell shall be wiped clean and dry and free from dirt, sand, grit or any foreign materials before the pipe is laid. No pipe which contains dirt shall be laid.
 - 4. Foreign material shall be prevented from entering the pipe while it is being placed in the trench. No debris, tools, clothing or other materials shall be left in the pipe at any time.
 - 5. As each length of pipe is placed in the trench, the joint shall be assembled and the pipe brought to correct line and grade. The pipe shall be secured in place with approved backfill material.
 - 6. Pipe laying shall commence at the lowest manhole unless otherwise directed and proceed upstream without interruption. Pipe shall be laid so that the spigot ends (if any) point in the direction of flow to prevent bedding material from entering the joint.
 - 7. Applying pressure to the top of the pipe, such as with a backhoe bucket, to lower the pipe to the proper elevation or grade shall not be permitted.
 - 8. Provide electronic marker for all force mains.

Section 4
Scope of Work and Technical Specifications
SECTION 33 30 00-26 SEWER AND ACCESSORIES

- a. Electronic markers shall be installed at an interval of every 100 linear feet and as needed to establish a change in direction or as directed by the Owner.
 - b. Electronic marker shall be equal to 3M Dynatel 1423 XR/ID and shall be compatible with 3M Dynatel 1420 EMS-ID Marker Locator System.
- D. Alignment and Gradient:
 - 1. Lay pipe straight in alignment and gradient or follow true curves, where shown on the Drawings, as nearly as practicable. Do not deflect any joint more than the maximum deflection recommended by the manufacturer.
 - 2. Maintain a transit, level and accessories on the job to lay out angles and ensure that deflection allowances are not exceeded.
 - 3. The Contractor shall check the invert elevation at each manhole and the pipe invert elevation at least three times daily, start, mid-day and end of day. Elevations shall be checked more frequently if more than 100 feet of pipe is installed in a day or if the pipe is being constructed at minimum slope.
 - 4. The Contractor shall check the horizontal alignment of the sewer at the same schedule as for invert elevations.
- E. Expediting of Work: Excavate, lay the pipe, and backfill as closely together as possible as determined by the Owner.
- F. Do not leave unjointed pipe in the trench overnight. Cover the exposed end of the installed pipe each day at the close of work and at all other times when work is not in progress.
- G. Backfill and compact the trench as soon as possible after laying and jointing is completed.
- H. If necessary to backfill over the end of an uncompleted pipe or accessory, close the end with a suitable plug, either pushon, mechanical joint, restrained joint or as approved by the Owner.
- I. Joint Assembly:
 - 1. Joints shall be assembled in accordance with the manufacturer's recommendations,
 - 2. Suitable means shall be used to force the spigot end of the pipe into the bell without damage to the pipe and its jointing materials and without disturbing the previously laid pipe and joints.

Section 4
Scope of Work and Technical Specifications
SECTION 33 30 00-27 SEWER AND ACCESSORIES

3. The Contractor shall inspect each pipe joint within 1,000 feet on either side of main line valves to ensure 100 percent seating of the pipe spigot, except as noted otherwise.

4. Each restrained joint shall be inspected by the Contractor to ensure that it has been "homed" 100 percent.

5. The Contractor shall internally inspect each pipe joint to ensure proper assembly for pipe 24 inches in diameter and larger after the pipe has been brought to final alignment.

J. Cutting Pipe:

1. Whenever a pipe requires cutting to fit the line or bring it to the required location, the work shall be performed in a manner so as to leave a smooth end at right angles to the axis of the pipe. Jointing of a field cut pipe shall be made in accordance with the manufacturers' instructions.

2. Only push on or mechanical joint pipe shall be cut.

3. Cut ductile iron pipe using an abrasive wheel saw.

4. Cut PVC and HDPE pipes using a suitable saw as recommended by the pipe manufacture.

5. Remove all burrs and smooth the end before jointing.

6. The Contractor shall cut the pipe and bevel the end, as necessary, to provide the correct length of pipe necessary for installing the fittings, valves, accessories and closure pieces in the correct location.

K. Lining Repair: Repair linings and recoat spigot ends of cut pipe with lining and bituminous coating as herein before specified in of this Section and as specified below:

L. Remove all burrs and areas of loose lining materials by sanding or scraping to bare metal.

M. Remove oil and lubricants used during field cutting.

N. Lining shall be stripped back a minimum of 1 inch from the spigot end into well adhered lined areas.

O. Roughen 1 to 2 inches of good lining with a rough grade (40 grit) emery paper, rasp or small chisel, to allow an overlap between new and existing lining.

P. Apply lining repair material in the number of coats required to match the thickness requirements as herein before specified in this Section and in accordance with the manufacturer's recommendations.

Q. The open end of uncompleted pipelines shall be provided with a temporary stopper carefully fitted so as to keep dirt, animals, and other substances from entering. This stopper shall be maintained in position at all times when pipe laying is not actually in progress.

R. Polyethylene Encasement: Installation shall be in accordance with AWWA C105 and the manufacturer's instructions. All ends shall be securely closed with tape and all damaged areas shall be completely repaired to the satisfaction of the Owner.

3.06. VALVE AND FITTING INSTALLATION

A. All valves shall be set accurately and carefully to the lines and grades given on the Drawings, or as directed, and shall be joined to the pipe utilizing such approved joints as herein before specified.

B. Prior to installation, valves shall be inspected for direction of opening, number of turns to open, freedom of operation, tightness of pressure containing bolting and test plugs, cleanliness of valve ports and especially seating surfaces, handling damage and cracks.

C. Defective valves shall be corrected or held for inspection by the Owner. Valves shall be closed before being installed.

D. Valves, fittings, plugs and caps shall be set and joined to the pipe in the manner specified in this Section for cleaning, laying and joining pipe, except that 12 inch and larger valves shall be provided with special support, such as treated timbers, crushed stone, concrete pads or a sufficiently tamped trench bottom so that the pipe will not be required to support the weight of the valve.

E. Valves shall be installed in the closed position.

F. A valve box shall be provided on each underground valve.

G. They shall be carefully set, centered exactly over the operating nut and truly plumbed.

H. The valve box shall not be in direct contact with the bonnet of the valve and shall be supported in such a manner as not to transmit shock, stress, or load directly to the valve.

I. The bottom flange of the lower belled portion of the box shall be placed below the valve operating nut.

J. This flange shall be set on brick, so arranged that the weight of the valve box and superimposed loads will bear on the base and not on the valve or pipe.

K. Extension stems shall be installed where depth of bury places the operating nut in excess of 24 inches beneath finished grade so as to set the top of the operating nut 24 inches below finished grade.

L. The valve box cover shall be flush with the surface of the finished area or such other level as directed by the Owner.

M. In no case shall valves be used to bring misaligned pipe into alignment during installation. Pipe shall be supported in such a manner as to prevent stress on the valve.

N. A valve marker shall be provided for each underground valve.

O. Unless otherwise detailed on the Drawings or directed by the Owner, valve markers shall be installed 6 inches inside the right-of-way or easement and buried to a depth of 30-inches.

P. In addition to a concrete valve marker where street curbs are installed, a saw cut ½" deep "V" notch on top of curb adjacent to the water valve location is required.

Q. A precast concrete vault shall be installed for 24-inch valves and larger.

3.07. SPECIAL COATINGS

A. Surface Preparation

1. Remove loose scale, rust, dirt, excessive moisture, or frost from the surface in accordance with SSPC SP-2 (Hand Tool Cleaning).

B. Application

1. All surfaces shall be hand rubbed or brushed with a priming paste recommended by the CSM. Sharp projections such as threads, irregular contours, or badly pitted areas shall receive a liberal amount of priming paste to ensure maximum protection of metal throughout.

2. On irregularly shaped surfaces, i.e., nuts, bolts, flanges, valves, etc., the Contractor shall use either of the following systems recommended by the CSM.

a. Apply recommended mastic by hand in sufficient quantity to build an even contour over entire surface. The Contractor shall pay particular attention to ensure that folds and air pockets within the mastic layer are thoroughly pressed out prior to subsequent application of tape. OR

b. An extra layer of tape shall be cut and carefully molded around sharp projections, nuts, bolts, etc., before final application of tape, in order to meet specified system thickness.

3. Tape shall be spirally wrapped with a 55 percent overlap and sufficient tension and pressure to provide continuous adhesion without stretching the tape. Edges of tape must be continuously smoothed and sealed by hand during wrapping. On vertical applications, contractor shall begin at bottom and proceed upward creating a weatherboard overlap.

4. System Thickness

- a. Smooth contours shall have a minimum thickness of 50 mils while nuts, bolts, and sharp projections shall be 100 mils.

5. Tape

- a. Number and types of tape wraps shall be in accordance with the CSM's written instructions.

3.08. MANHOLE AND PRECAST CONCRETE PRODUCT CONSTRUCTION

A. Construct manholes at locations and as shown on the Drawings.

B. Precast Concrete: Handle sections carefully to prevent cracking or chipping. Provide uniform bedding of the bottom section to prevent uneven loading. Install gaskets and joint sealants in accordance with manufacturer's recommendations to produce a watertight structure.

C. All manholes shall have a minimum of 12 inches #57 stone bedding.

D. Grade Rings:

1. Apply a continuous strip, 5/16 inch – 3/8 inch thick, of polyurethane joint sealer/adhesive on the top surface of the concrete structure or brick course. Place on a diameter 1 inch smaller than the outside or inside diameter of the adjustment riser.
2. Position the riser in place, ensuring it is centered over the top surface of the concrete structure or brick course of the manhole structure.
3. Apply a second continuous strip 5/16 inch – 3/8 inch thick of polyurethane joint sealer/adhesive on the top surface of the riser 1" smaller than the outside or inside diameter of the frame.
4. Center the frame of the manhole over the structure opening. Place bottom of frame onto adjustment riser. Press down, applying firm pressure to the frame to create a tight seal with the sealant and adjustment riser.

E. Brick: Bed the bottom and sides of every brick in mortar. Apply a smooth coat of mortar, 3/4 inch thick, on the inside and outside of manhole.

F. Pipe Connections: Seal the connection between the pipe and the manhole as follows:

1. Pipe 30 Inch Diameter and Less: Connect pipe to precast concrete manholes by a rubber boot provided in a cored or precast hole of the proper diameter.
2. Pipe 36 Inch Diameter and Larger: Construct manhole collars as shown on the Drawings after the pipe has been sealed into the manhole.

3. If rubber boots are damaged, replace Type I boots with a new boot and repair Type II boots by constructing a manhole collar.

4. If preformed openings must be enlarged or altered, or if new openings must be made in the field, minimize the amount of material removed to provide closely matched surfaces for grouting.

G. Inverts: Form channels as shown on the Drawings, rounded, and troweled smooth. Maintain consistent grade through the invert.

1. Inverts shall be constructed with the same radius as the effluent pipe.

2. Invert walls shall be constructed to a height corresponding to the spring-line of the influent and effluent pipes with smooth rounded walls.

3. All inverts must be grouted 360 degrees around rubber boots.

4. Inverts formed with a half pipe are NOT allowed.

H. Top Elevations:

1. Where manholes are constructed in paved areas the top surface of the frame and cover shall conform to the crown and grade of the existing adjacent pavement.

2. Adjustment to final grade in paved areas shall be provided by means of brick coursing not to exceed four (4) common brick (12 inches maximum) in height with Portland cement joints.

3. Where manholes are constructed in non-pavement areas the frame shall be factory cast into the concrete cone. The top surface of the frame and cover shall have bolt-down lids with a watertight gasket.

4. Manholes in wooded or unmaintained areas shall be a minimum of 24 inches above ground level unless otherwise shown on the Drawings or directed by the Owner.

5. Manholes in maintained grassy areas may be flush with the ground.

6. Manholes on sloped ground in un-maintained areas shall be a minimum of 24 inches above ground level on the uphill side of the manhole unless otherwise shown on the Drawings or directed by the Owner.

I. Drop Connections: Manholes requiring drop connections are shown on the Drawings

1. Construct drop connections of mechanical joint Class 350 DIP and diameter size as the upstream sewer and in accordance with the details shown on the Drawings.

2. All outside 90-degree elbows shall have a thrust block poured below the elbow.

J. Frames and Covers:

1. The cast iron frame for the manhole cover shall be set at the required elevation and properly anchored to the masonry
2. Unless frame and cover are at grade, the frame shall be cast into the cone section.

K. Seal all manhole joints and lift holes, both inside and out, with grout. Between precast sections, this is in addition to joint sealant.

L. Invert Elevations: The invert elevations shown on the Drawings shall be for the invert at the centerline of the precast concrete manhole. Prior to setting the laser or other vertical alignment control system for the sewer upstream of the manhole, the Contractor shall verify the elevation of the sewer installed at the manhole. Should the elevation differ from that shown on the Drawings, the Contractor shall take the following corrective action:

1. If the sewer is laid at negative grade, the Contractor shall remove and reinstall the sewer at the correct grade at no additional cost to the Owner.
2. If the sewer is laid at a grade less than that shown on the Drawings, thus reducing the sewer's capacity, the Owner may require the sewer to be removed and re-laid at the correct grade at no additional cost to the Owner. As a minimum, the grade to the next upstream manhole shall be adjusted such that the next upstream manhole shall be set at the correct elevation.
3. If the sewer is laid at a grade greater than that shown on the Drawings, and if the Contractor can show that there are no conflicts with upstream existing utilities or obstructions, the Contractor shall adjust the grade of the next upstream manhole such that the next upstream manhole shall be set at the correct elevation.
 - a. If such an adjustment, in the Owner's opinion, is substantial, the grade adjustment shall be spread over multiple sections of the sewer.
 - b. If such an adjustment, in the Owner's opinion, significantly reduces the sewer's capacity, the Owner may require the Contractor to remove and relay that portion of the sewer laid at the improper grade.

M. Doghouse Manholes

1. For doghouse manholes, the existing pipe shall not be cut without authorization of the Owner.

2. The Owner must be present when existing pipe is cut for the doghouse or cut-in manholes.

N. Manholes shall be constructed such that their walls are plumb.

O. Manhole Cores

1. The Contractor shall be responsible for performing manhole cores.
2. The core must not be backfilled until approved by the Owner.
3. Failure, for any reason, to have the Owner approve the core will cause all work to be halted until the cored manhole is excavated and the rubber boot exposed.
4. Cores for future development or future tie-ins are only allowed when installed with a rubber boot, one full joint of 6-inch ductile iron, HDPE or PVC pipe, based on bury depth conditions, and a mechanical joint plug.
5. A miscored manhole section shall be replaced unless a variance has been approved by the Owner. A miscore is defined as:
 - a. Cored into the barrel section joint.
 - b. Cored into the poured table.
 - c. Offset or misdirection of core.
6. A minimum of 12 inches separation is required between all manhole cores.

P. Pre-Cast Barrel

1. All lift holes shall be fully sealed with grout and troweled smooth inside and out.
2. All joints shall be grouted inside and out.

3.09. THRUST RESTRAINT

A. Thrust Collars: Collars shall be constructed as shown on the Drawings. Concrete and reinforcing steel shall meet the requirements specified in Article 2.14 of this Section. The welded-on collar shall be attached to the pipe by the pipe manufacturer.

B. Concrete Collars: Construct collars as shown on the Drawings. Concrete and reinforcing steel shall meet the requirements specified in Division 3 of these Specifications.

3.10. INSPECTION AND TESTING FOR GRAVITY SEWER

- A. The Owner will make periodic job site visits without advance notice to the Contractor. However, it is the responsibility of the Contractor to contact the Owner during each phase of the installation for inspections and/or re-inspections.
- B. The Owner will visually inspect the project for acceptable system installation such as invert work, gravel, pipe type, grout, etc.
- C. Final approval of a project will not be granted by the Owner until all inspections are conducted with no defects noted and all appropriate documents have been received and accepted by the Owner.
- D. Clean and test lines before requesting final acceptance. Where any obstruction is met, clean the sewers by means of rods, swabs, or other instruments. When requested by the Owner, flush out lines and manholes before final inspection.
- E. Alignment: Pipelines shall be straight and show a uniform grade between manholes. Correct any discrepancies discovered during inspection.
- F. Pipe joints for sewers 30 inches in diameter and larger shall be air tested individually. The joint tester assembly shall be placed over the joint and shall pressurize the joint area to 4 psi. The pressure shall not drop more than 2 psi in 10 seconds. The joint tester assembly shall be equal to Cherne Industries, Inc.
- G. Watertightness: All sewers constructed shall be tested for watertightness to the maximum extent feasible. Infiltration tests and exfiltration tests shall be performed on all new sewers constructed as indicated below, except for those new sewers constructed which have active services tied into it as the pipe is being installed. In such cases the watertightness of the sewers less than or equal to 24-inches shall be based on a visual inspection, and for sewers 30-inches and larger based on the individual joint test as specified herein. All visible leaks, including those found via television inspection, shall be repaired.
1. Infiltration Tests:
 - a. Install suitable weirs in manholes selected by the Owner to determine the leakage of ground water into the sewer. The maximum length of line for each infiltration test shall be 3,000 feet.
 - b. Measure leakage only when all visible leaks have been repaired, and the ground water is two feet above the top of the pipe.
 - c. Install weir for a minimum of four hours before measuring flow.
 - d. If leakage in any section of the sewer line exceeds 100 gpd/inch diameter/mile, locate and repair leaks. Repair methods must be approved by the Owner.
 - e. After repairs are completed, retest for leakage.

Section 4
Scope of Work and Technical Specifications
SECTION 33 30 00-35 SEWER AND ACCESSORIES

- f. Furnish, install, and remove the necessary weirs, plugs, and bulkheads required to perform the leakage tests.
 - g. Weirs shall be V-notch type equal to Pollard (800) 437-1146.
2. Exfiltration Tests: Use when groundwater is less than two feet above the top of the pipe.
- a. Low-Pressure Air Test: Only sewer diameters less than or equal to 24 inches.
 - b. Prior to air testing, the section of sewer between manholes shall be thoroughly cleaned and wetted.
 - c. Immediately after cleaning or while the pipe is water soaked, the sewer shall be tested with low pressure air.
 - d. At the Contractor's option, sewers may be tested in lengths between manholes or in short sections (25 feet or less) using inflatable balls pulled through the line from manhole to manhole.
 - e. Air shall be slowly supplied to the plugged sewer section until internal air pressure reaches approximately 4.0 psi. After this pressure is reached and the pressure allowed to stabilize (approximately two to five minutes), the pressure may be reduced to 3.5 psi before starting the test.
 - f. If a 1.0 psi drop does not occur within the test time, then the line has passed the test.
 - g. If the pressure drops more than 1.0 psi during the test time, the line is presumed to have failed the test, and the Contractor will be required to locate the failure, make necessary repairs, and retest the line.
 - h. Minimum test time for various pipe sizes and types is as follows:

Nominal Pipe Size, inches	T (Time Min/100) Feet
	DIP, PVC ¹
6	5.7
8	7.6
10	9.4
12	11.3
15	14.2
18	17.0
21	19.8
24	22.8

¹ Source: ASTM F1417

3. Required test equipment, including inflatable balls, braces, air hose, air source, timer, rotameter as applicable, cut off valves, pressure reducing valve, 0

15 psi pressure gauge, 0 5 psi pressure gauge with gradations in 0.1 psi and accuracy of + two percent, shall be provided by the Contractor. Testing equipment shall be equal to Cherne Air Loc Testing Systems.

4. Low Pressure Air Testing:

- a. At the option of the Owner, low pressure air testing may be performed in lieu of infiltration/exfiltration test.
- b. Testing shall be performed in accordance with Uni-Bell PVC Pipe Association Publication UNI-B 06 - "Recommended Low-Pressure Air Testing of Installed Sewer Pipe."

5. The Contractor shall keep records of all tests made. Copy of such records will be given to the Owner. Such records shall show date, line number and stations, operator, and such other pertinent information as required by the Owner.

6. The Contractor is cautioned to observe proper safety precautions in performance of the air testing. It is imperative that plugs be properly secured and that care be exercised in their removal. Every precaution shall be taken to avoid the possibility of over pressurizing the sewer line.

H. Deflection Test:

1. Test PVC gravity sewer for excessive deflection by passing a mandrel through the pipe. Deflection of the pipe shall not exceed the following:

Nominal Pipe Diameter (inches)	Maximum Allowable Deflection
< 12	5%
15 to 30	4%
> 30	3%

2. The mandrel size shall be based upon the maximum possible inside diameter for the type of pipe being tested, taking into account the allowable manufacturing tolerances of the pipe.

- a. The mandrel shall have an odd number of legs, or vanes, with a quantity of such equal to or greater than nine. The legs of the mandrel shall be permanently attached to the mandrel.
- b. A mandrel with variable sizes shall not be allowed.
- c. The mandrel shall be constructed of steel, aluminum or other material approved by the Owner, and shall have sufficient rigidity so the legs of the mandrel will not deform when pulling through a pipe.
- d. The mandrel dimensions shall be checked by the Owner before use by the Contractor.

3. Excavate and install properly any section of pipe not passing this test. Retest until results are satisfactory.
4. This test shall be performed twice:
 - a. Once within the first 30 days of installation, and
 - b. Once during final inspection, but no sooner than 30 days after pavement and backfill is done, at the completion of the contract.
- I. Closed Circuit Television: The interior of the gravity sewers shall be subjected to a post-installation televised inspection.
- J. The audio/video tape shall provide an audio description to what is being viewed; provide a continuous running footage indicator between manholes and be prepared in the presence of the Owner.
- K. Prior to Final Acceptance the Owner shall be provided with one copy of the TV inspection report and a video file showing the entire length of gravity sewer being tested.
- L. The report shall contain the condition of pipe, type of pipe, depth, location of services, length, type joint, roundness and distance between manholes.
- M. Any pipe found to be cracked, leaking, misaligned, bellied or otherwise defective shall be removed and replaced.
- N. Manholes: Prior to testing manholes for watertightness, all lift holes shall be plugged with a non-shrink grout, all joints between precast sections shall be properly sealed and all pipe openings shall be temporarily plugged and properly braced.
 1. Vacuum Tests: The manhole, after proper preparation as noted above, shall be vacuum tested prior to backfilling.
 - a. The test head shall be placed at the inside of the top of the cone section and the compression head inflated to 40 psi to affect a seal between the vacuum base and the manhole structure.
 - b. Connect the vacuum pump to the outlet port with the valve open. A vacuum of 10 inches of mercury shall be drawn and the vacuum pump shut off.
 - c. With the valves closed the time in seconds shall be measured for the vacuum to drop to 9 inches.
 - d. The manhole shall pass if the time in seconds is greater than that specified in the table below.
 - e. If the manhole fails the initial test, necessary repairs shall be made with non-shrink grout while the vacuum is still being drawn.

- f. Retesting shall proceed until a satisfactory test is obtained. Vacuum testing equipment shall be equal to that manufactured by P.A. Glazier, Inc.

Minimum Test Times for Various Manhole Diameters and Depths			
	Diameter (feet)		
Depth (feet)	4	5	6
8	20	28	33
10	25	33	41
12	30	39	49
14	35	48	57
18	40	52	67
18	45	59	73
20	50	65	81
22	55	72	89
24	59	78	97
26	64	85	105
28	69	91	113
30	74	98	121

3.11. INSPECTION AND TESTING FOR FORCE MAIN

- A. Prior to acceptance of the force main, the Contractor shall test the force main in accordance with the requirements of these Specifications.
- B. Force mains shall be subjected to a minimum test pressure equal to 150 percent of the total dynamic head or 100 psi, whichever is greater, for a minimum of two hours. The test shall be performed using potable water.
1. Use of a fire Hydrant requires a fire hydrant meter to be rented from the local water authority.
- C. The entire force main pressure test must be witnessed and approved by the Owner or his representative. The test shall be performed from the check valve to the discharge manhole. No leakage will be allowed.
- D. To schedule a test, the Contractor shall notify the Owner at a minimum of 48 hours in advance.
- E. The Owner will determine the test pressure and gauge location.
- F. Contractor shall remove, valve off, or otherwise protect any equipment that might be damaged by the pressures used in the test. All piping shall be securely anchored prior to the test.
- G. Pipe laid in trenches shall be backfilled. Joints, fittings and valves may be left exposed to be examined during the test.

H. Before applying the test pressure, all air shall be expelled from the pipe through installed air release valves. If combination air release valves are not available at high points, Contractor shall make necessary taps and insert plugs after the test has been completed. Prior approval must be obtained from Fulton County before making the taps.

I. The approval of the force main installation and pressure test by the Owner shall become a part of the overall pump station/force main system approval.

J. Contractor shall bear the complete cost of the test including temporary plugging and blocking, water usage and the repair of all leaks.

K. If a section of the force main fails the pressure test Contractor will be required to pay a re-inspection fee as determined by the Owner prior to each additional retest required.

3.12. PROTECTION AND RESTORATION OF WORK AREA

A. General:

1. Return all items and all areas disturbed, directly or indirectly by work under these Specifications, to their original condition or better, as quickly as possible after work is started.
2. The Contractor shall plan, coordinate, and prosecute the work such that disruption to personal property and business is held to a practical minimum.
3. All construction areas abutting lawns and yards of residential or commercial property shall be restored promptly.
 - a. Backfilling of underground facilities, ditches, and disturbed areas shall be accomplished on a daily basis as work is completed.
 - b. Finishing, dressing, and grassing shall be accomplished immediately thereafter, as a continuous operation within each area being constructed and with emphasis placed on completing each individual yard or business frontage.
 - c. Care shall be taken to provide positive drainage to avoid ponding or concentration of runoff.
4. Handwork, including raking and smoothing, shall be required to ensure that the removal of roots, sticks, rocks, and other debris is removed in order to provide a neat and pleasing appearance.
5. The Owner shall be authorized to stop all work by the Contractor when restoration and cleanup are unsatisfactory and to require appropriate remedial measures.

- B. ManMade Improvements: Protect, or remove and replace with the Owner's approval, all fences, walkways, mailboxes, pipelines, drain culverts, power and telephone lines and cables, property pins and other improvements that may be encountered in the work. Fences crossing easements shall be gated.
- C. Cultivated Growth: Do not disturb cultivated trees or shrubbery unless approved by the Owner. Any such trees or shrubbery which must be removed shall be heeled in and replanted under the direction of an experienced nurseryman.
- D. Cutting of Trees: Do not cut trees for the performance of the Work except as absolutely necessary.
- E. Protect trees that remain in the vicinity of the work from damage from equipment.
- F. Do not store spoil from excavation against the trunks. Remove excavated material stored over the root system of trees within 30 days to allow proper natural watering of the root system.
- G. Repair any damaged tree over 3 inches in diameter, not to be removed, under the direction of an experienced nurseryman.
- H. All trees and brush that require removal shall be promptly and completely removed from the work area and disposed of by the Contractor.
- I. No stumps, wood piles, or trash piles will be permitted on the work site. The Contractor may chip and grind vegetation and spread over the disturbed area if approved by the County.
- J. Disposal of Rubbish: Dispose of all materials cleared and grubbed during the construction of the project in accordance with the applicable codes and rules of the appropriate county, state and federal regulatory agencies.
- K. Swamps and Other Wetlands:
1. The Contractor shall not construct permanent roadbeds, berms, drainage structures or any other structures which alter the original topographic features within the easement.
 2. All temporary construction or alterations to the original topography shall incorporate measures to prevent erosion into the surrounding swamp or wetland.
 3. All areas within the easement shall be returned to their original topographic condition as soon as possible after work is completed in the area. All materials of construction and other non-native materials shall be disposed of by the Contractor.
 4. The Contractor shall provide temporary culverts or other drainage structures, as necessary, to permit the free migration of water between portions of a swamp, wetland or stream which may be temporarily divided by construction.

Section 4
Scope of Work and Technical Specifications
SECTION 33 30 00-41 SEWER AND ACCESSORIES

5. The Contractor shall not spread, discharge or dump any fuel oil, gasoline, pesticide, or any other pollutant to adjacent swamps or wetlands.

END OF SECTION

Section 4
Scope of Work and Technical Specifications
SECTION 33 31 00-1 HIGH DENSITY POLYETHYLENE (HDPE) PIPE AND FITTINGS

SECTION 33 31 00

HIGH DENSITY POLYETHYLENE (HDPE) PIPE AND FITTINGS

PART 1 – GENERAL

1.01. SUMMARY

A. Section Includes:

1. High density polyethylene (HDPE) pipe and fittings.
2. Fusion joints.
3. Testing.

B. Pipe Description

1. Pipe Supplier shall furnish high density polyethylene (HDPE) pipe and fittings conforming to all applicable standards and procedures as referenced in this Specification, and meeting all applicable testing and material properties as described by the applicable standards referenced in this specification or as required within this specification.

1.02. GENERAL.

- A.** For gravity sewer installations with no live load, located below grade and along stream and riverbanks, the standard pipe shall be HDPE Ductile Iron Pipe Size (DIPS) DR17 for diameters 8-inch to 48-inch and depths 3 feet to 11 feet.

1.03. QUALITY ASSURANCE

A. References:

1. This section contains references to the following documents. They are a part of this section to the extent referenced in this specification. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly.
2. In the event of a conflict between the requirements of this section and those of the referenced documents, the requirements of this specification shall prevail.
3. Unless otherwise specified, references to documents shall mean the latest published edition of the referenced document in effect at the time of construction.
4. If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no

Section 4
Scope of Work and Technical Specifications
SECTION 33 31 00-2 HIGH DENSITY POLYETHYLENE (HDPE) PIPE AND FITTINGS

replacement documents, the last version of the document before it was discontinued.

5. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

6. It is incumbent upon the Contractor to have a working familiarity with the following ASTM Standards:

Reference	Title
ANSI/AWWA C901	Polyethylene (PE) Pressure Pipe and Tubing, $\frac{3}{4}$ -in. (19 mm) through 3 in. (76 mm), for Water Service
ANSI/AWWA C906	Polyethylene (PE) Pressure Pipe and Fittings, 4 in. through 65 in. (100 mm through 1,650 mm), for Waterworks
ASTM C923	Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals
AWWA M55	PE Pipe—Design and Installation
ASTM D1603	Standard Test Method for Carbon Black in Olefin Plastics
ASTM D2321	Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
ASTM D2774	Standard Practice for Underground Installation of Thermoplastic Pressure Piping
ASTM D3035	Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter
ASTM D3261	Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing
ASTM D3350	Standard Specification for Polyethylene Plastics Pipe and Fittings Materials
ASTM D4218	Standard Test Method for Determination of Carbon Black Content in Polyethylene Compounds by the Muffle-Furnace Technique
ASTM F585	Standard Guide for Insertion of Flexible Polyethylene Pipe into Existing Sewers
ASTM F714	Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Outside Diameter
ASTM F1055	Standard Specification for Electrofusion Type Polyethylene Fittings for Outside Diameter Controlled Polyethylene and Crosslinked Polyethylene (PEX) Pipe and Tubing
ASTM F1290	Standard Practice for Electrofusion Joining Polyolefin Pipe and Fittings
ASTM F1417	Standard Practice for Installation Acceptance of Plastic Non-Pressure Sewer Lines Using Low-Pressure Air

Section 4

Scope of Work and Technical Specifications

SECTION 33 31 00-3 HIGH DENSITY POLYETHYLENE (HDPE) PIPE AND FITTINGS

ASTM F1962	Standard Guide for Use of Maxi-Horizontal Directional Drilling for Placement of Polyethylene Pipe or Conduit Under Obstacles, Including River Crossings
ASTM F2164	Standard Practice for Field Leak Testing of Polyethylene (PE) and Crosslinked Polyethylene (PEX) Pressure Piping Systems Using Hydrostatic Pressure
ASTM F2206	Standard Specification for Fabricated Fittings of Butt-Fused Polyethylene (PE)
ASTM F2620	Standard Practice for Heat Fusion Joining of Polyethylene Pipe and Fittings
ASTM F2786	Standard Practice for Field Leak Testing of Polyethylene (PE) Pressure Piping Systems Using Gaseous Testing Media Under Pressure (Pneumatic Leak Testing)
NSF/ANSI 61	Drinking Water System Components—Health Effects
PPI TR-4	PPI Listing of Hydrostatic Design Basis (HDB), Strength Design Basis (SDB), Pressure Design Basis (PDB) and Minimum Required Strength (MRS) Ratings for Thermoplastic Piping Materials or Pipe
PPI TR-46	Guidelines for Use of Mini-Horizontal Directional Drilling for Placement of High-Density Polyethylene Pipe

B. Manufacturer Requirements

1. High density polyethylene (HDPE) pipe and fittings shall be manufactured in accordance with the following standards:
 - a. ASTM D3035 – ½ in through 24-in pipe
 - b. ASTM F714 – 3-in through 54-in pipe
 - c. AWWA C901 – ¾-in. (19 mm) through 3 in. (76 mm) pipe and tubing
 - d. AWWA C906 – 4 in. (100 mm) through 65 in. (1,650 mm) pipe and fabricated fittings
 - e. ASTM D3261 – butt fusion fittings, saddles and flange adapters
 - f. ASTM F1055 – electrofusion couplings and saddles.
 - g. ASTM F2206 – fabricated fittings

C. Fusion Technician Requirements

1. Each Fusion Technician shall be separately qualified to make each type of fusion joint. Fusion joint types are butt fusion, saddle fusion and electrofusion.
 - a. Qualification to make one type of fusion joint shall not qualify a Fusion Technician to make a different type of fusion joint.
2. Each Fusion Technician making butt fusion joints shall be qualified to make butt fusion joints in accordance with ASTM F2620.

Section 4
Scope of Work and Technical Specifications
SECTION 33 31 00-4 HIGH DENSITY POLYETHYLENE (HDPE) PIPE AND FITTINGS

- a. Qualification shall have occurred not more than 12 months before performing fusion joining on site in accordance with this Specification.
 - b. Qualification shall be a documented demonstration of proficiency by making joints in accordance with ASTM F2620 that are proved to be satisfactory by destructive testing in accordance with ASTM F2620.
 3. Each Fusion Technician making saddle fusion joints shall be qualified to make saddle fusion joints in accordance with ASTM F2620.
 - a. Qualification shall have occurred not more than 12 months before performing on-site fusion joining in accordance with this specification.
 - b. Qualification shall be a documented demonstration of proficiency by making joints in accordance with ASTM F2620 that are proved to be satisfactory by destructive testing in accordance with ASTM F2620.
 4. Each Fusion Technician making electrofusion fitting joints shall be qualified to make electrofusion fitting joints in accordance with ASTM F1290 and the electrofusion fitting manufacturer's recommended procedure.
 - a. Qualification shall have occurred not more than 12 months before performing on-site fusion joining in accordance with this specification.
 - b. Qualification shall be a documented demonstration of proficiency by making joints in accordance with ASTM F1290 and the electrofusion fitting manufacturer's recommended procedure that are proved to be satisfactory by destructive testing in accordance with ASTM F1290 and the electrofusion fitting manufacturer's recommended procedure.
- D. Approved Suppliers
1. Pipe and fitting suppliers shall be approved by the Owner.
 - a. The following pipe manufacturers are approved:
 - 1) WL Plastics,
 - 2) Chevron
 - 3) Phillips 66 Dricsopipe
 - 4) Northern Pipe Products
 - 5) JM Eagle
 - 6) Or approved equal
 - b. The following fitting manufacturers are approved:
 - 1) WL Plastics,

Section 4
Scope of Work and Technical Specifications
SECTION 33 31 00-5 HIGH DENSITY POLYETHYLENE (HDPE) PIPE AND FITTINGS

- 2) Chevron
- 3) Phillips 66 Driscopipe
- 4) Northern Pipe Products
- 5) JM Eagle
- 6) Or approved equal

E. Contractor shall furnish samples and material tests for compliance with this specification from an independent laboratory to verify the required physical properties and characteristics of supplied materials in accordance with the applicable ASTM Specification.

1. A certificate shall be furnished by the manufacturer, upon request, for all material furnished under this specification.
2. Polyethylene plastic pipe and fittings that do not meet any of the requirements of this Specification will be rejected.
3. The Owner will pay for tests on pipe material which meets specification requirements. Contractor shall pay for failed tests and re-testing of failed materials

F. Warranty

1. Material Warranty
 - a. A written guarantee of 10 years submitted to the County for the specific project shall be provided by the Manufacturer against any defects of the pipe and fittings material.
 - b. A successful pressure test or pressure leak test prior to the expiration of the warranty period shall not relieve the supplier of warranty responsibility for the full warranty term.
2. Workmanship Warranty
 - a. The Contractor shall guarantee the Work is free from defects in material and workmanship for a period of 3 years from the final acceptance.
 - b. The warranty shall cover the costs to repair or replace items including, but not be limited to, all gravity sewers, force mains, manholes, appurtenances, trenches, roadways, landscaping, other areas disturbed by the construction of the project and freight to project site, should these items have any defects in material or workmanship.

Section 4
Scope of Work and Technical Specifications
SECTION 33 31 00-6 HIGH DENSITY POLYETHYLENE (HDPE) PIPE AND FITTINGS

c. In addition to the standard pipe warranty, the fusing contractor shall provide in writing a three-year warranty from the date of installation acceptance covering defects in fusion joining workmanship that requires remaking defective butt fusion, saddle fusion or electrofusion joints. The warranty shall also include freight to the project site, formation, installation and pressure testing.

d. A successful pressure test or pressure leak test prior to the expiration of the warranty period shall not relieve the installer of warranty responsibility for the full warranty term.

3. Deficiencies related to material and workmanship shall be repaired by Contractor to the satisfaction of the Owner.

4. No bell clamps or wrap around corsets are allowed as a means of repair on new pipelines.

5. The Contractor shall be responsible to cover all costs, including materials and labor, associated with these repairs.

6. If required, Contractor and pipe manufacturer representatives may participate in inspections to determine such deficiencies.

7. If repairs are made, the Contractor/Manufacturer shall warrant the repaired work for the periods specified above for material and workmanship in addition to the original warranty period required by the Contract.

8. The Contractor shall be responsible for repairs to any trench settlements caused by leaking pipe, fittings, etc. He shall promptly furnish and place fill to original grade.

9. Should any leaks or trench settlement occur under the new pavement, the Contractor will be held responsible for the cost of all repairs, including pavement replacement.

10. Within the guarantee period, where no loss of customer service or property damage is involved, the Contractor shall begin work on requested repairs or corrective measures within 24 hours following notification by Owner.

11. If property damage or loss of customer service is involved, the Contractor shall begin work with four (4) hours of notification from the Owner.

12. Unless otherwise specified, the warranty periods shall begin after the Certificate of Acceptance is issued for the Contract.

G. Submittals

Section 4
Scope of Work and Technical Specifications

SECTION 33 31 00-7 HIGH DENSITY POLYETHYLENE (HDPE) PIPE AND FITTINGS

1. Complete product data and engineering data shall be submitted to the Owner in accordance with the requirements of Section 01 33 23 of these Specifications.
2. The following information shall be submitted by pipe and fitting suppliers:
 - a. Name of the pipe manufacturer and a list of the piping and quantities to be provided by the manufacturer.
 - b. Name(s) of fitting manufacturer(s) and lists of fittings and quantities to be provided by manufacturer.
 - c. Pipe and fitting product data indicating conformance with this Specification, applicable standards, and warranty provisions, including written documentation regarding any intended variance from this specification and applicable standards.
 - d. Projected Initial and long-term deflection calculations based on site conditions.
 - 1) Deflection being defined as a decrease in the vertical diameter of a pipe.
 - 2) The value ΔY (%) is the average long-term vertical deflection of the pipe and is the final expected change in vertical diameter divided by the nominal pipe diameter, expressed as a percentage.
 - e. At the time of shipment, the supplier shall provide certified documentation of pipe and fitting conformance with this Specification and applicable pipe and fitting standards specified herein.
3. The following information shall be submitted by Fusion Providers.
 - a. Documentation that each Fusion Technician has met requirements for joining proficiency for each type of fusion joint performed by the Fusion Technician under this Specification.
 - b. Documentation of conformance with this Specification and applicable standards, including written documentation regarding any intended variance from this Specification and applicable standards.
 - 1) This will include fusion joint warranty information and recommended project specific fusion parameters, including criteria logged and recorded by data logger.
 - c. The following AS-RECORDED DATA is required from the Contractor and/or Fusion Provider:

Section 4
Scope of Work and Technical Specifications
SECTION 33 31 00-8 HIGH DENSITY POLYETHYLENE (HDPE) PIPE AND FITTINGS

- 1) Fusion reports for each fusion joint performed on the project, including joints that were rejected.
- 2) Submittals of the Fusion Technician's joint reports are required as requested by Owner.
- 3) Specific requirements of the Fusion Technician's joint report shall include:
 - a) Pipe or fitting size and DR or pressure class rating
 - b) Fusion equipment size and identification
 - c) Fusion Technician Identification
 - d) Job Identification Number
 - e) Fusion Number
 - f) Fusion joining parameters
 - g) Ambient Temperature

PART 2 – PRODUCTS

2.01. PIPE AND FITTINGS

A. General

1. All pipe and fittings shall be manufactured in ductile iron pipe sizes (DIPS) in accordance with the following Standards.
 - a. ANSI/AWWA C906 - "Polyethylene Pipe and Fittings, 4 in. (100 mm) through 63 in. (1,575 mm) for Water Distribution".
 - b. ASTM D3035 - "Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter".
 - c. ASTM F714 - "Standard Specification for Polyethylene (PE) Pipe (SDR-PR) Based on Outside Diameter".
 - d. ASTM F2619 - "Standard Specification for High Density Polyethylene (PE) Line Pipe".
 - e. ASTM F2206 - "Standard Specification for Fabricated Fittings of Butt-Fused Polyethylene (PE) Plastic Pipe, Fittings, Sheet Stock, Plate Stock or Block Stock".
 - f. ASTM D3261 - "Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing".

Section 4
Scope of Work and Technical Specifications
SECTION 33 31 00-9 HIGH DENSITY POLYETHYLENE (HDPE) PIPE AND FITTINGS

g. ASTM F1055 - "Standard Specification for Electrofusion Fittings for Outside Diameter Controlled Polyethylene Pipe and Tubing".

B. PE4710 Pipe and Fitting Material (Compound):

1. Pipe and fittings shall be made from the resin meeting the requirements of the PPI material designation PE 4710.
2. PE4710 material (compound) shall conform to material requirements specified in ASTM F714 for pipe and ASTM D3261 for fittings as applicable for the pipe or fitting.
3. PE4710 material (compound) shall meet the requirements of ASTM D3350 and shall meet or exceed a cell classification of 445574 per ASTM D3350.
4. PE4710 material (compound) shall have a hydrostatic design stress (HDS) rating for water at 73°F (23°C) of not less than 1600 psi that shall be listed in PPI TR-4 in the name of the pipe manufacturer.
5. PE4710 material (compound) shall have a hydrostatic design basis (HDB) rating at 140°F (60°C) of not less than 1000 psi that shall be listed in PPI TR-4 in the name of the pipe manufacturer for all force main, reclaimed water, and irrigation water service systems.
6. PE4710 pipe and fitting material (compound) in PE4710 pipe and fittings shall contain color and ultraviolet (UV) stabilizer meeting the requirements of Code C or E per ASTM D3350.
 - a. Code C material shall contain 2 to 3 percent carbon black to provide indefinite protection against UV degradation when material from the pipe is tested in accordance with ASTM D1603 or ASTM D4218.
 - b. Code E material used for coextruded OD color stripes or a coextruded ID color layer shall contain sufficient UV stabilizer to protect the pipe against UV degradation for at least 24 months of unprotected outdoor exposure.
 - c. Coextruded color PE compound material shall be PE4710 pipe material compound, varying only by color and UV stabilizer.
7. The pipe and fittings shall contain no recycled compound except for clean rework materials derived from pipe production by the same manufacturer.
8. Clean rework materials are acceptable as part of a blend with new material for the production of new pipe provided that the rework material is the same PE4710 material designation as the new material (compound) to which it is added.

Section 4
Scope of Work and Technical Specifications
SECTION 33 31 00-10 HIGH DENSITY POLYETHYLENE (HDPE) PIPE AND FITTINGS

9. Finished products containing rework material shall meet the requirements of this Specification.

C. PE4710 Pipe

1. HDPE pipes

a. Force mains shall be DR 11 with a minimum pressure class rating of 200 psi.

b. Gravity lines shall be DR 17 with a minimum pressure class rating of 200 psi.

2. HDPE pipe shall have plain ends for butt fusion.

3. The pipe shall be homogeneous throughout and free of visible cracks, holes, voids, foreign inclusions or other defects that may affect the wall integrity.

4. Permanent identification of piping service shall be provided by co-extruding longitudinal green, lavender or purple stripes into the pipe outside surface.

a. The striping material shall be the same material as the pipe material except for color.

b. Stripes printed or painted on the outside surface shall not be acceptable.

5. The nominal pipe diameter shall be specified on the Drawings. The DR (dimension ratio) and the pressure rating of the pipe shall be as noted on the Drawings.

6. HDPE pressure pipes may be deflected subject to approval by the Owner.

a. The following table shows maximum deflection based upon the allowable strain of the pipe wall.

b. Potential flow restrictions, surge and other non-trench stability and pipe strain issues may reduce the values shown here per the Owner's recommendations.

c. The bend radius multiplier determines the minimum radius of the pipe curvature and is calculated by multiplying the outside diameter of the pipe by the multiplier from the appropriate DR used.

d. Bending radius allowed by the manufacturer can vary. Verify the multiplier with the manufacturer. In no case shall the radius be less than 125% of the manufacturer's permitted multiplier

Section 4

Scope of Work and Technical Specifications

SECTION 33 31 00-11 HIGH DENSITY POLYETHYLENE (HDPE) PIPE AND FITTINGS

HDPE pipe Dimension Ratio (DR)	Allowable deflection	
(percent)	Bend Radius Multiplier	
32.5	8.1	50
26.0	6.5	45
21.0	5.2	40
19.0	4.7	37.5
17.0	4.2	32.5
15.5	3.9	30
13.5	3.4	27.5
11.0	2.7	25

7. Nominal straight lengths of 3-inch and larger pipe shall be 40 feet or 50 feet.
8. Nominal coil lengths of 4-inch and smaller pipe shall be 500 feet. Longer or shorter coils such as 800 feet for 4-inch pipe, 1000 feet for 3-inch pipe, or 2000 feet for 2-inch or smaller pipe shall be acceptable.
 - a. Pipe shall be black with a light reflective interior color to allow for easier/better viewing for television inspection.
9. Pipe Markings
 - a. Pipe shall be permanently marked using heated indent printing in accordance with ASTM F714 as applicable for the pipe size including:
 - 1) Nominal size and sizing system, such as DIOD
 - 2) SDR 11 or SDR 17
 - 3) Standard Designation, ASTM F714, material designation, and pressure rating or pressure class for water at 73°F.
 - 4) Marking the Standard Designation on the pipe shall serve as the manufacturer's certification that the pipe has been manufactured, sampled and tested and has been found to comply with the requirements of the Standard.
 - 5) The ASTM D3035 or ASTM F714 pipe pressure rating for water at 73°F shall be "PE4710 PRXXX" where XXX = pressure rating in psi
 - 6) The AWWA C901 pipe pressure class for water at 73°F shall be "PE4710 PCXXX" where XXX = pressure class in psi.
 - 7) The AWWA C906 pipe pressure class for water at 73°F shall be "PE3408 PCXXX" where XXX = pressure class in psi.

Section 4
Scope of Work and Technical Specifications
SECTION 33 31 00-12 HIGH DENSITY POLYETHYLENE (HDPE) PIPE AND FITTINGS

- b. Extrusion production-record code.
- c. Manufacturer's Trademark or trade name.

D. PE4710 Fittings

1. PE4710 butt fusion, saddle fusion, electrofusion and fabricated fittings shall be manufactured from PE4710 material (compound) in accordance with this Specification.
2. All fittings shall be tested in accordance with AWWA C906.
3. PE4710 fittings shall comply with the following Standards:
 - a. ASTM D3261 for molded butt fusion and saddle fusion fittings, flange adapters and MJ adapters.
 - b. ASTM F2206 for fabricated butt fusion fittings.
 - c. ASTM F1055 for electrofusion fittings.
4. PE4710 fittings shall comply with the marking requirements of the following Standards:
 - a. ASTM D3261 for molded butt and saddle fusion fittings, flange adapters and MJ adapters.
 - b. ASTM F2206 for fabricated butt fusion fittings
 - c. ASTM F1055 for electrofusion fittings.
5. Fabricated Fittings
 - a. Fittings shall be manufactured and tested in accordance with ASTM F2206 and so marked.
 - b. Fittings shall be made by heat fusion joining specially machined shapes cut from pipe, polyethylene sheet stock or molded fittings.
 - c. Fittings shall be rated for internal pressure service at least equal to the full-service pressure rating of the mating pipe.
 - d. Fittings shall be tested in accordance with AWWA C906.
6. PE4710 fittings shall have pressure class ratings not less than the pressure class rating of the pipe to which they are joined.
7. Plain end butt fused fittings shall be used when joining polyethylene materials.
8. Saddles fittings for connecting laterals to the sewer shall be electrofusion or strap-on sewer saddles.

Section 4

Scope of Work and Technical Specifications
SECTION 33 31 00-13 HIGH DENSITY POLYETHYLENE (HDPE) PIPE AND FITTINGS

a. Strap-on sewer saddles shall be used only where it is not possible to use electrofusion saddles.

b. The saddles shall be equipped for joining with a casketed hub, or plain outlet for mechanical couplings or electrofusion couplings joining.

9. Mechanical fittings shall be used only when joining polyethylene materials to different piping materials and approved by the Owner.

10. The fittings shall be homogeneous throughout and free of visible cracks, holes, voids, foreign inclusions or other defects that may affect the wall integrity.

2.02. FUSION JOINTS

A. Unless otherwise specified, PE4710 pipe and fittings shall be assembled in the field with butt fusion, saddle fusion or electrofusion joints in accordance with the following Standards:

1. ASTM F2620 and the pipe manufacturer's recommended procedure (WL Plastics WL101) shall be observed for butt fusion and saddle fusion joints.

2. ASTM F1290 and the electrofusion fitting manufacturer's recommended joining procedure shall be observed for electrofusion joints.

B. Field butt fusion, saddle fusion and electrofusion joints shall be made by Fusion Technicians that are qualified in accordance with this Specification to make the specific fusion joint type.

C. Field fusion joints shall be recorded and documented in accordance with this Specification.

2.03. CONNECTIONS AND FITTINGS FOR PRESSURE APPLICATIONS

A. General

1. Connections shall be defined in conjunction with the linking of project piping, as well as the tie-ins to other piping systems.

B. Mechanical Fittings

1. Mechanical fittings used with polyethylene pipe shall be specifically designed for, or tested and found to be acceptable for, use with polyethylene pipe.

2. Acceptable mechanical fittings for use with PE4710 pipe and fittings shall be mechanical fittings that are qualified by the mechanical fitting manufacturer for use with HDPE pipe and fittings.

3. Mechanical fittings for use with HDPE pipe shall provide restraint against longitudinal separation that is inherent to the design of the joint.

Section 4
Scope of Work and Technical Specifications
SECTION 33 31 00-14 HIGH DENSITY POLYETHYLENE (HDPE) PIPE AND FITTINGS

4. Mechanical joints that do not provide restraint against pull-out or push-off are prohibited.
5. Mechanical connections to non-HDPE devices and appurtenances shall be by bolted flange adapter or MJ adapter.
6. Flange adapter and MJ adapter connections shall be assembled, installed and tightened in accordance with flange adapter or MJ adapter manufacturer's instructions.
7. Flange bolt tightening shall be in accordance with PPI TN-38.
8. Where PE4710 pipe is connected to gasketed mechanical/flange joint fittings or appurtenances, the connection shall be made by butt fusing a PE4710 MJ/flange Adapter to the PE4710 pipe and connecting the PE4710 MJ/flange Adapter to the mechanical joint/flange fitting or appurtenance.

C. Gasketed, Push-On Fittings

1. Gasketed push-on fittings shall be fitted with external mechanical restraints that span across the joint and are assembled in accordance with restraint manufacturer's instructions.
 - a. Thrust blocking does not provide acceptable restraint and is prohibited.
 - b. Where plain-end PE4710 pipe is assembled with push-on fittings, the PE4710 pipe end shall be fitted with electrofusion restraints so that external mechanical restraint may be secured to the PE4710 pipe.

D. Sleeve-Type Couplings

1. Sleeve-type mechanical couplings shall be manufactured for use with HDPE pipe and shall be restrained as indicated on the Drawings and in these Specifications.
2. Unrestrained sleeve-type couplings are prohibited.

E. Expansion and Flexible Couplings

1. Expansion-type mechanical couplings are prohibited.

F. Connection Hardware

1. Bolts and nuts for buried service shall be made of non-corrosive, high-strength, low-alloy steel having the characteristics specified in ANSI/AWWA C111/A21.11, regardless of any other protective coating.

2.04. CONNECTIONS FOR NON-PRESSURE SEWER APPLICATIONS

A. General

Section 4
Scope of Work and Technical Specifications
SECTION 33 31 00-15 HIGH DENSITY POLYETHYLENE (HDPE) PIPE AND FITTINGS

1. The following connections are to be used in conjunction with tie-ins to other non-pressure sewer piping and structures and shall be as indicated on the Drawings.
- B. Sleeve-Type Couplings:
1. Sleeve-type mechanical couplings shall be manufactured for use with solid-wall non-pressure HDPE pipe and may be restrained or unrestrained as indicated on the Drawings and in these specifications.
- C. Connection Hardware
1. Bolts and nuts for buried service shall be made of non-corrosive high strength, low-alloy steel having the characteristics specified in ANSI/AWWA C111/A21, regardless of any other protective coating.
- D. Connection to Non-Pressure Manholes and Structures
1. Non-pressure PE4710 pipe and fittings shall be connected to manholes and other structures to provide a leak-free, properly graded flow into or out of the manhole or structure.
 2. Connections to existing manholes and structures shall be as specified and shown on the Drawings.
 - a. For a cored or drilled opening, provide a flexible, watertight connection that meets and/or exceeds ASTM C923.
 - b. For a knockout opening, provide a watertight connection (waterstop or other method) meeting the material requirements of ASTM C923 that is securely attached to the pipe with stainless steel bands or other means.
 - c. Grout opening in manhole wall with non-shrink grout. Pour concrete collar around pipe and outside manhole opening.
 3. Connections to a new manhole or structure shall be as specified and shown on the Drawings.
 - a. A flexible, watertight gasket per ASTM C923 shall be cast integrally with riser section(s) for all precast manhole and structures.
 - b. Drop connections shall be required where shown on Drawings.
 - c. Grout internal joint space with non-shrink grout.

PART 3 - EXECUTION

3.01. DELIVERY AND OFF-LOADING

- A. General

Section 4
Scope of Work and Technical Specifications
SECTION 33 31 00-16 HIGH DENSITY POLYETHYLENE (HDPE) PIPE AND FITTINGS

1. All piping shall be bundled or packaged for transportation by commercial carrier to the site.
2. Before off-loading, the pipe shall be inspected for damage.
 - a. Any pipe damaged in shipment shall be assessed and either accepted or rejected as directed by the Owner.
 - b. The pipe supplier shall be notified of rejected pipe within 7 days of delivery at the site.
 - c. Rejected pipe shall be quarantined for disposition.
3. Each pipe shipment shall be checked for quantity and proper pipe size, color and type.
4. Pipe shall be off-loaded and handled in accordance with the pipe manufacturer's instructions and AWWA M55.

3.02. HANDLING AND STORAGE

- A. Pipe lengths should be placed and stored on level ground. Pipe should be stored at the job site in the unit packaging provided by the manufacturer.
- B. The interior of the pipe, as well as all end surfaces, should be kept free from dirt and foreign matter.
- C. Pipe shall be handled and supported with the use of woven fiber pipe slings or approved equal.
 1. Care shall be exercised when handling the pipe so as not to cut, gouge, scratch or otherwise abrade the piping in any way.
 2. Use of hooks, chains, wire rope or any other handling device which creates the opportunity to damage the surface of the pipe is strictly prohibited.
- D. Covering or shading of PE4710 pipe and fittings against exposure to ultraviolet light from sunlight is not required.

3.03. FUSION PROCESS

- A. General
 1. Butt and saddle fusion of PE4710 pipe and fittings shall be in accordance with ASTM F2620 and the manufacturer's recommended joining procedure.
 2. Electrofusion of PE4710 pipe and fittings shall be performed in accordance with ASTM F1290 and the electrofusion fitting manufacturer's recommended procedure.

Section 4

Scope of Work and Technical Specifications
SECTION 33 31 00-17 HIGH DENSITY POLYETHYLENE (HDPE) PIPE AND FITTINGS

3. PE4710 pipe and fittings shall be fused by qualified fusion technicians, as documented by the fusion provider. Training records for qualified fusion technicians shall be available to Owner upon request.
4. As each fusion joint is constructed, pressure, time and temperature parameters shall be recorded and logged by an electronic monitoring device (data logger) affixed to the fusion machine. Joint data shall be submitted as part of the As-Recorded information, in accordance with this specification.
5. Butt fusion machines shall incorporate the following properties, including the following elements:
 - a. Heat Plate – Heat plates and the non-stick coatings on heating surfaces shall be in good condition without heating surface gouges or scratches. The non-stick coating shall be intact, clean and free of any contamination. Heater controls and temperature indicators shall function properly, and electrical cords and connections shall be in good condition. The heat plate shall maintain a uniform and consistent temperature on all areas of the heating surfaces on both sides of the heat plate.
 - b. Carriage – Carriage shall travel smoothly with no binding at less than 50 psi for hydraulic fusion machines. Clamps shall be in good condition with proper inserts for the pipe size being fused.
 - c. General Machine – Overview of machine body shall yield no obvious defects, missing parts, or potential safety issues during fusion.
 - d. Data Logger – The current version of the pipe supplier's recommended and compatible software shall be used. A protective case shall be utilized for the handheld wireless portion of the unit. Data logger operations and maintenance manual shall be with the unit at all times. If fusing for extended periods of time, an independent 110V power source shall be available to extend battery life.
6. Other equipment specifically required for fusion processes shall include the following:
 - a. Pipe rollers shall be used to support pipe to either side of the butt fusion machine and provide for vertical and lateral pipe alignment straight through the butt fusion machine.
 - b. A protective enclosure that provides for full machine motion of the clamps, heat plate, fusion assembly and carriage shall be provided for fusion in inclement and/or windy weather. Pipe ends shall be covered or blocked where open pipe ends could allow prevailing winds to blow through the pipe.

Section 4
Scope of Work and Technical Specifications
SECTION 33 31 00-18 HIGH DENSITY POLYETHYLENE (HDPE) PIPE AND FITTINGS

- c. Fusion machine operations and maintenance manual shall be kept with the fusion machine at all times.

B. Joint Recording

- 1. Each fusion joint shall be recorded and logged by an electronic monitoring device (data logger) connected to the fusion machine that shall register and/or record the parameters required by the manufacturer and these specifications. Data not logged by the data logger shall be logged manually and be included in the Fusion Technician's joint report.

- C. Any joint that extrudes more than 1/8-inch shall be trimmed to less than 1/8-inch before installation.

3.04. INSTALLATION

- A. Bedding for HDPE pipes shall be minimum Class "B" as specified in Section 31 23 00 of these Specifications.

- B. The PE4710 pressure pipe and fittings shall be installed such that PE4710 pipe curvature is not less than the minimum bending radius recommended by the pipe manufacturer.

- C. Direct burial installation of PE4710 pressure pipe shall be in accordance with ASTM D2774 and the pipe manufacturer's recommendations.

- D. Direct burial installation of PE4710 non-pressure pipe shall be in accordance with ASTM D2321 and the pipe manufacturer's recommendations.

- E. Installation of PE4710 pipe by horizontal directional drilling shall be in accordance with ASTM F1962 or PPI TR-46 and the pipe manufacturer's recommendations.

- F. Installation of PE4710 pipe by sliplining or insertion within a casing or host pipe shall be in accordance with ASTM F585 and the pipe manufacturer's recommendations.

- G. Tracer Wire – All PE4710 piping shall be installed with a continuous, insulated TW, THW, THWN, or HMWPE insulated copper, 10 gauge or thicker wire for pipeline location purposes by means of an electronic line tracer.

- 1. The wires shall be installed along the entire length of the pipe.
- 2. Sections of wire shall be spliced together using approved splice caps and waterproof seals. Twisting the wires together is not acceptable.

3.05. MAKING CONNECTIONS TO NON-PE4710 PIPING SYSTEMS

- A. Approximate locations for non-PE4710 piping systems are shown on the Drawings or detailed in the specifications. Prior to making connections into existing piping systems, the Contractor shall:

Section 4

Scope of Work and Technical Specifications

SECTION 33 31 00-19 HIGH DENSITY POLYETHYLENE (HDPE) PIPE AND FITTINGS

1. Verify the actual field location, size, piping material and service of non-PE4710 piping systems.
 2. Obtain all required non-PE4710 piping manufacturer(s) approved fittings (i.e., saddles, sleeve type couplings, flanges, tees, etc., as shown).
 3. Have installed all temporary pumps and/or pipes in accordance with established connection plans.
 4. Have pipe stoppers on hand, blind flanges or other devices to seal a valve or appurtenance that fails to seal properly.
 - a. When applied to pressure rated valves or appurtenances, all such devices shall be pressure rated equal to or greater than the pressure rating of the valve or appurtenance to which they are attached.
- B. Where PE4710 pipe connects in-line to unrestrained gasketed push-on piping, the end of the PE4710 pipe shall be anchored in-line within 10 feet of the connection to restrict longitudinal movement of the PE4710 pipe.
1. The PE4710 pipe shall be fitted with a PE4710 wall anchor or electrofusion flex restraints.
 2. The PE4710 wall anchor or electrofusion flex restraints shall be encased in reinforced concrete that is sufficient to withstand Poisson effect longitudinal loads in accordance with AWWA M55 In-Line Anchoring.
- C. Unless otherwise approved by the Owner, new piping systems shall be completely assembled and successfully tested prior to making connections to non-PE4710 piping systems.

3.06. PIPE SYSTEM CONNECTIONS

- A. Pipe connections shall be installed per applicable standards and regulations, as well as per the connection manufacturer's recommendations and as indicated on the Drawings.
- B. Pipe connections to structures shall be installed per applicable standards and regulations, as well as per the connection manufacturer's recommendations.

3.07. TRACER WIRE TESTING

- A. Upon completion of installation by direct burial, sliplining, directional boring or pipe bursting, the Contractor shall demonstrate that the tracer wire is continuous and unbroken through the entire run of the pipe.
 1. Demonstration shall include full signal conductivity (including splices) when energizing for the entire run in the presence of the Owner or Owner.

Section 4
Scope of Work and Technical Specifications

SECTION 33 31 00-20 HIGH DENSITY POLYETHYLENE (HDPE) PIPE AND FITTINGS

2. If the wire is broken, the Contractor shall repair or replace it. Pipeline installation will not be accepted until the tracer wire passes a continuity test.

3.08. TESTING

A. General

1. Testing shall comply with all local building codes, statutes, standards, local jurisdiction, and laws.
2. Segments of the pipe may be tested separately in accordance with standard testing procedure, as approved by the Owner and Owner.
3. No leakage shall be allowed.

B. Hydrostatic Leakage Testing for Pressure Piping

1. Hydrostatic leakage testing shall comply with ASTM F2164. Joint leakage and any defective materials and/or workmanship shall be repaired or replaced by the Contractor at no additional cost to the Owner.
2. Pneumatic (compressed air) leakage testing of PE4710 pressure piping is prohibited.

C. Leakage Testing For Non-Pressure Piping

1. Non-pressure piping such as sewers shall be tested for excessive leakage in accordance with ASTM F1417.
2. Joint leakage and any defective materials and/or workmanship shall be repaired or replaced by the Contractor at no additional cost to the Owner.

D. Circularity Tests

1. Where required by the Owner, pipes may be tested at ground surface for circularity before installation and welding commences.
2. Circularity will be checked by pulling a closed cylindrical mandrel through the polyethylene pipe.
3. The mandrel's outside dimension shall be sized to permit no more than 5.0 percent deflection.
4. The percent deflection shall be established from the base inside diameter of the pipe.
 - a. If the internal beading of the fused joints for the pipe is not required to be removed, the mandrel shall account for this clearance as well.
5. The mandrel shall be approved by the Owner prior to use.

Section 4
Scope of Work and Technical Specifications

SECTION 33 31 00-21 HIGH DENSITY POLYETHYLENE (HDPE) PIPE AND FITTINGS

6. The mandrel shall be at least three times the diameter of the pipe in length and not greater than inside diameter of pipe minus 2 millimeters.

7. Lines that permit safe entry may allow other deflection test options, such as direct measurements.

8. Pipes will be rejected which have greater than 5% deformation due to thermal softening.

3.09 INSPECTION

A. Furnish to Owner copies of the Manufacturer's Sworn Certificate of Inspection and Testing of all HDPE pipe and HDPE fittings provided on the Work.

B. All HDPE pipe and fittings will be subject to inspection and approval by Owner after delivery of material to the site. Do not use broken, cracked, misshaped, imperfectly coated, unsatisfactory, or otherwise damaged pipe or fittings.

C. Such inspection by Owner does not relieve the Contractor of full responsibility for the material installed.

END OF SECTION

SECTION 33 32 00

PVC PIPE AND FITTINGS

PART 1 – GENERAL

1.01 SCOPE

- A. This section specifies PVC pipe, PVC fittings and gaskets.
- B. General:
 - 1. Supply all products and perform all work in accordance with applicable American Society for Testing and Material (ASTM), American Water Works Association (AWWA), American National Standards Institute (ANSI) or other recognized standards. Latest revisions of all standards are applicable.
- C. This Specification designates general requirements for DR 25 gravity and DR 18 pressure unplasticized polyvinyl chloride (PVC) plastic pipe with integral bell and spigot joints for the conveyance of wastewater.

1.02 QUALIFICATIONS

- A. If requested by the Owner submit evidence that manufacturers have consistently produced products of satisfactory quality and performance for a period of at least two years.
- B. Acceptable manufacturers
 - 1. J. M. Eagle
 - 2. Approved equal

1.03 SUBMITTALS

- A. Complete product data and engineering data shall be submitted to the Owner in accordance with the requirements of Section 01 33 23 of these Specifications.
- B. The following information shall be submitted by pipe and fitting suppliers:
 - 1. Name of the pipe manufacturer and a list of the piping and quantities to be provided by the manufacturer.
 - 2. Name(s) of fitting manufacturer(s) and lists of fittings and quantities to be provided by manufacturer.
 - 3. Pipe and fitting product data indicating conformance with this Specification, applicable standards, and warranty provisions, including written documentation regarding any intended variance from this specification and applicable standards.

4. Projected Initial and long-term deflection calculations based on site conditions.
 - a. Deflection being defined as a decrease in the vertical diameter of a pipe.
 - b. The value ΔY (%) is the average long-term vertical deflection of the pipe and is the final expected change in vertical diameter divided by the nominal pipe diameter, expressed as a percentage.
5. At the time of shipment, the supplier shall provide certified documentation of pipe and fitting conformance with this Specification and applicable pipe and fitting standards specified herein.

1.04 QUALITY ASSURANCE

- A. Product manufacturers shall provide the Owner with written certification that all products furnished comply with all applicable provisions of these Specifications.
- B. If ordered by the Owner, the pipe manufacturer shall furnish the services of a competent factory representative to supervise and/or inspect the installation of pipe. This service will be furnished for a minimum of five days during initial pipe installation.
- C. Upon request by the Owner, the Contractor shall furnish samples for material tests by the Owner's independent laboratory demonstrating compliance with this Specification to verify the required physical properties and characteristics of supplied materials. The Owner shall pay for tests on pipe samples that meet specification requirements. Contractor shall pay for failed tests and re-testing of failed materials.
- D. Hydrostatic Proof Testing
 1. Each standard and random length of pipe is tested to two times the rated pressure of the pipe for a minimum of 5 seconds. The integral bell shall be tested with the pipe.
- E. Quick Burst Test
 1. Randomly selected samples tested in accordance with ANSI/UL 1285 shall withstand, without failure, the pressures listed below when applied for 60-70 seconds. This test is performed on pipe sizes less than 30".
- F. Flattening Test
 1. There shall be no evidence of splitting, cracking, or breaking when the pipe is tested as follows:
 - a. Specimens of pipe, a minimum of 6 in. (150 mm) long, shall be flattened between parallel plates in a suitable press until the distance between the plates is 40 percent of the OD of the pipe.

Section 4
Scope of Work and Technical Specifications
SECTION 33 32 00-3 PVC PIPE AND FITTINGS

- b. The rate of flattening shall be uniform and such that the compression is completed within 2 to 5 minutes. There shall be no evidence of splitting, cracking or breaking.

G. Drop Impact Test

1. A 6" length section of pipe shall be subjected to impact from a free-falling Tup.

- a. 20-lb Tup A and flat plate holder B for 4-inch to 15-inch".
- b. 20-lb or 30-lb Tup B and flat plate holder B for 18-inch to 36-inch
- c. In accordance with ASTM D2444, "Standard Practice for Determination of the Impact Resistance of Thermoplastic Pipe and Fittings by Means of a Tup (Falling Weight)".

PIPE SIZE (inch)	IMPACT (ft/lbs)
4	150
6 – 8	210
10 – 36	220

2. There shall be no visible evidence of shattering or splitting when energy is imposed.

TEST	AWWA C900				
	80 psi	100 psi	125 psi	165 psi	235 psi
SHORT TERM BURST TEST (psi) less than 30"	255	315	400	535	755
EXTRUSION QUALITY OF PVC PIPE BY ACETONE IMMERSION TEST METHOD ASTM D2152	20 min	20 min	20 min	20 min	20 min
FLATTENING TEST Tests extrusion quality and ductility under slow loading conditions (Flattening Capability)	40% of OD between the plates within 2 - 5 min	40% of OD between the plates within 2 - 5 min	40% of OD between the plates within 2 - 5 min	40% of OD between the plates within 2 - 5 min	40% of OD between the plates within 2 - 5 min
HYDROSTATIC PROOF TEST	160	200	250	330	470

(each piece) (psi)					

PART 2 – PRODUCTS

2.01 POLYVINYL CHLORIDE (PVC) PIPE

A. General

1. PVC pipe shall be utilized where shown on the Drawings, specified or directed by the Owner.
 - a. For gravity sewer installations with no live load located below ground and not along streams banks and rivers the standard pipe shall be DR 25 PVC for pipe sizes 8-inch to 14-inch and depths 3 feet to 8 feet.
 - b. For gravity sewer installations with live loads of HS20/25 or pipe located at a depth of greater than 8 feet and not along stream banks and rivers, the standard pipe shall be CIOD DR18 PVC (235 psi pressure class) for pipe sizes 8-inch to 60-inch.
 - c. For pressure pipe applications (force mains) regardless of depth and live load requirements and not along riverbanks and streams, the standard pipe and fittings shall be CIOD DR18 PVC (235 psi pressure class) for diameters 8-inch to 60-inch.
 - d. The pipe shall be colored green for in-ground identification as sewer pipe.

B. Materials

1. This pipe shall meet the requirements of AWWA Standard C900 “Polyvinyl Chloride (Pvc) Pressure Pipe and Fabricated Fittings, 4 In. through 60 In. (100 Mm Through 1,500 Mm)”.
 2. All pipe shall be made from quality PVC resin, compounded to provide physical and mechanical properties that equal or exceed cell class 12454 for pressure pipes and 12454 or 12364 for gravity pipes as defined in ASTM D1784.

C. Pipe

1. DR 25 Gravity pipes shall meet the requirements of the following Standards:
 - a. ASTM D3034-21, “Standard Specification for Type PSM Polyvinyl Chloride (PVC) Sewer Pipe and Fittings” for pipes 4-inch through 15-inch.

Section 4
Scope of Work and Technical Specifications
SECTION 33 32 00-5 PVC PIPE AND FITTINGS

- b. ASTM F679 "Standard Specification for Polyvinyl Chloride (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings", PS115, for pipes 18-inch through 48-inch.
- c. ASTM D2321-20, "Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications" for depths of cover up to twelve feet and for pipe diameters up to fifteen.
- d. Pipe joints shall be integral bell conforming to ASTM D3212-20, "Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals".
- e. Joint shall be tested in accordance with ASTM D3212 under 25 feet of head pressure and 22 inches Hg vacuum.

2. DR 18 pressure pipes shall meet the requirements of the following Standards:

- a. AWWA C900-16, "Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4-in. Through 60-in. (100 Mm through 1,500 Mm)".
- b. Pipe joints shall be integral bell conforming to ASTM D3139-19, "Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals".
- c. Pipe shall be of the 235-psi pressure class.
- d. The bell section shall be designed to be at least as hydrostatically strong as the pipe barrel and meet the requirements of AWWA C900 DR 18.

3. Gaskets for all pipes shall EPDM, NBR or SBR as selected by the Owner and shall conform to the requirements of ASTM F477-14(2021), "Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe".

- a. Gaskets shall be factory assembled and securely locked in place to prevent displacement during assembly.

4. Standard laying lengths shall be 20 feet for all sizes.

D. Fittings

- 1. For sizes 8 inch and less in diameter, fittings shall be molded in one piece with no solvent welded joints. Minimum socket depths shall be as specified in ASTM D 3034, Table 2.
- 2. For sizes 10 inch and larger in diameter, fittings shall be fabricated from pipe conforming to ASTM D 3034 using solvent welding.

3. No field fabrication of fittings will be allowed. All such fabrication shall be performed at the factory and the fittings shall be delivered ready for use.

E. Thrust Restraint

1. Provide restraint at all points where hydraulic thrust may develop.
2. Where specified or as directed, plugs, caps, tees, and bends deflecting 11¼ degrees or more shall be restrained.
3. Restrained joint pipe and fittings shall be restrained, at a minimum, to the restraint lengths specified on the Drawings with one (1) of the following methods:
 - a. Restrained joint pipe and fittings:
 - 1) Certa Lok as manufactured by Napco or approved equal.
 - b. Restrained harnesses:
 - 1) Series 1900 for DR 18 235 psi CIOD pipes as manufactured by EBBA Iron or approved equal.
 - 2) Series 2600 for CIOD fittings as manufactured by EBBA Iron or approved equal.
 - 3) Harness shall conform to the following:
 - a) The combination of the restraint(s) and fasteners shall have a pressure rating to the full pressure rating of the pipe.
 - b) The restraint shall have a two-to-one safety factor.
 - c) The restraint shall be manufactured of ductile iron conforming to ASTM A536.
 - d) The restraint devices shall be coated with MEGA-BOND.
 - c. Split Restraint
 - 1) Split Restraints shall be used for connecting to mechanical joints.
 - 2) Series 19MJ00 for DR 18 CIOD 235 psi pipes as manufactured by EBBA Iron or approved equal.

F. Joints

1. Joints for PVC pipe and fittings shall be of the integral bell and spigot type with a confined elastomeric gasket having the capability of absorbing expansion

and contraction without leakage, when tested in accordance with ASTM D 3212 for gravity pipes and ASTM D3139 for pressure pipes.

2. Gaskets shall meet the requirements of ASTM F477. The joint system shall be subject to the approval of the Owner and shall be identical for pipe and fittings.

3. Gaskets shall be factory assembled and securely locked in place to prevent displacement during assembly.

4. Provisions must be made for expansion and contraction at each joint with an elastomeric gasket.

G. Joint Tightness

1. Two sections of pipe shall be assembled in accordance with the manufacturer's recommendations.

H. Pipe Stiffness:

1. Minimum "pipe stiffness" at 5% deflection shall be 364 psi for SDR 18 and 129 psi for DR 25 pipes, when tested in accordance with ASTM D2412, "External Loading Properties of Plastic Pipe by Parallel-Plate Loading".

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install PVC pipes in accordance with the requirements of the following:

1. Section 33 30 00 – Sewer and Accessories, Part 3.
2. Manufacturer's written recommendations.
3. Supplemental and applicable information from Uni-Bell PVC Pipe Association:

a. Installation Guide for Gasketed-Joint PVC Pressure Pipe.

B. Bedding for PVC pipes shall be at a minimum Class "B" Bedding as specified in Section 31 23 00.

C. Tracer Wire – All PVC piping shall be installed with a continuous, insulated TW, THW, THWN, or HMWPE insulated copper, 10 gauge or thicker wire for pipeline location purposes by means of an electronic line tracer.

1. The wires shall be installed along the entire length of the pipe.
2. Sections of wire shall be spliced together using approved splice caps and waterproof seals. Twisting the wires together is not acceptable.

3.02 TRACER WIRE TESTING

A. Upon completion of installation by direct burial, sliplining, directional boring or pipe bursting, the Contractor shall demonstrate that the tracer wire is continuous and unbroken through the entire run of the pipe.

1. Demonstration shall include full signal conductivity (including splices) when energizing for the entire run in the presence of the Owner or Owner.
2. If the wire is broken, the Contractor shall repair or replace it. Pipeline installation will not be accepted until the tracer wire passes a continuity test.

3.03 TESTING

A. Testing shall be in accordance with the requirements of the following:

1. Section 33 30 00 – Sewer and Accessories, Part 3.
2. Supplemental and applicable information from Uni-Bell PVC Pipe Association:
 - a. Installation Guide for Gasketed-Joint PVC Pressure Pipe.
 - b. UNI-B 06 - "Recommended Low-Pressure Air Testing of Installed Sewer Pipe."
3. The Contractor shall conduct the tests in the presence of the Owner.
4. No leakage shall be allowed for sewer force mains.

B. Circularity Tests

1. Where required by the Owner, pipes may be tested at ground surface for circularity before installation and welding commences.
2. Circularity will be checked by pulling a closed cylindrical mandrel through the polyethylene pipe.
3. The mandrel's outside dimension shall be sized to permit no more than 5.0 percent deflection.
4. The percent deflection shall be established from the base inside diameter of the pipe.
5. The mandrel shall be approved by the Owner prior to use.
6. The mandrel shall be at least three times the diameter of the pipe in length and not greater than inside diameter of pipe minus 2 millimeters.
7. Lines that permit safe entry may allow other deflection test options, such as direct measurements.

8. Pipes will be rejected which have greater than 5% deformation due to thermal softening.

3.04 GUARANTEE

A. Material Warranty:

1. A written guarantee of 10 years submitted to the County for the specific project shall be provided by the Manufacturer against any defects of the pipe and fittings material.
2. A successful pressure test or pressure leak test prior to the expiration of the warranty period shall not relieve the supplier of warranty responsibility for the full warranty term.

B. Workmanship Warranty

1. The Contractor shall guarantee the Work is free from defects in material and workmanship for a period of 3 years from the final acceptance.
2. The warranty shall cover the costs to repair or replace items including, but not be limited to, all gravity sewers, force mains, manholes, appurtenances, trenches, roadways, landscaping, other areas disturbed by the construction of the project and freight to project site, should these items have any defects in material or workmanship.
3. In addition to the standard pipe warranty, where applicable, the fusing contractor shall provide in writing a three-year warranty from the date of installation acceptance covering defects in fusion joining workmanship that requires remaking defective butt fusion, saddle fusion or electrofusion joints. The warranty shall also include freight to the project site, formation, installation and pressure testing.
4. A successful pressure test or pressure leak test prior to the expiration of the warranty period shall not relieve the installer of warranty responsibility for the full warranty term.

C. Deficiencies related to material and workmanship shall be repaired by Contractor to the satisfaction of the Owner.

D. No bell clamps or wrap around corsets are allowed as a means of repair on new pipelines.

E. The Contractor shall be responsible to cover all costs, including materials and labor, associated with these repairs.

F. If required, Contractor and pipe manufacturer representatives may participate in inspections to determine such deficiencies.

Section 4
Scope of Work and Technical Specifications
SECTION 33 32 00-10 PVC PIPE AND FITTINGS

G. If repairs are made, the Contractor/Manufacturer shall warrant the repaired work for the periods specified above for material and workmanship in addition to the original warranty period required by the Contract.

H. The Contractor shall be responsible for repairs to any trench settlements caused by leaking pipe, fittings, etc. He shall promptly furnish and place fill to original grade.

I. Should any leaks or trench settlement occur under the new pavement, the Contractor will be held responsible for the cost of all repairs, including pavement replacement.

J. Within the guarantee period, where no loss of customer service or property damage is involved, the Contractor shall begin work on requested repairs or corrective measures within 24 hours following notification by Owner.

K. If property damage or loss of customer service is involved, the Contractor shall begin work with four (4) hours of notification from the Owner.

L. Unless otherwise specified, the warranty periods shall begin after the Certificate of Acceptance is issued for the Contract.

3.05 INSPECTION

A. Furnish to Owner copies of the Manufacturer's Sworn Certificate of Inspection and Testing of all PVC pipe and PVC fittings provided on the Work.

B. All PVC pipe and fittings will be subject to inspection and approval by the Owner after delivery of material to the site. Do not use broken, cracked, misshaped, imperfectly coated, unsatisfactory, or otherwise damaged pipe or fittings.

C. Such inspection by the Owner does not relieve the Contractor of full responsibility for the material installed.

END OF SECTION

SECTION 33 33 00

DUCTILE IRON PIPE AND FITTINGS

PART 1 – GENERAL

1.01 DESCRIPTION

A. Scope:

1. This section specifies ductile iron pipe, ductile fittings and gaskets.

B. Definition:

1. Where cast iron pipe is specified, the term and symbol shall mean ductile iron pipe.

1.02 REFERENCES

A. This section contains references to the following documents.

1. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly.
2. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.
3. Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids).
4. If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued.
5. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
ANSI B1.1	Unified Inch Screw Threads (UN, UNR, and UNJ Thread Forms)
ANSI B16.1	Cast Iron Pipe Flanges and Flanged Fittings Class 25, 125, 250, and 800
ANSI B16.5	Pipe Flanges and Flanged Fittings
ASTM A 193	High Tensile Alloy and Stainless-Steel Bolts

Section 4
Scope of Work and Technical Specifications
SECTION 33 33 00-2 DUCTILE IRON PIPE AND FITTINGS

ASTM A 194	Carbon Steel, Alloy Steel, and Stainless-Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both
ASTM A242	Standard Specification for High-Strength Low-Alloy Structural Steel
ASTM A307	Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength
ASTM A563	Standard Specification for Carbon and Alloy Steel Nuts (Inch and Metric)
ASTM A716	Ductile-Iron Culvert Pipe
ASTM A746	Standard Specification for Ductile Iron Gravity Sewer Pipe
ASTM B633	Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel
ASTM C150	Portland Cement
AWWA C104 (ANSI A21.4)	Cement-Mortar Lining for Ductile- Iron and Gray-Iron Pipe and Fittings for Water
AWWA C105 (ANSI A21.5)	American National Standard for Polyethylene Encasement for Ductile-Iron Pipe Systems
AWWA C110 (ANSI A21.10)	Ductile-Iron and Gray-Iron Fittings, 3 In. Through 48 In., for Water and Other Liquids
AWWA C111 (ANSI A21.11)	Rubber-Gasket Joints for Ductile- Iron and Gray-Iron Pressure Pipe and Fittings
AWWA C115 (ANSI A21.15)	Flanged Ductile-Iron and Gray-Iron Pipe with Threaded Flanges
AWWA C116 (ANSI A21.16-09)	Protective Fusion-Bonded Epoxy Coatings for the Interior and Exterior Surfaces of Ductile-Iron and Gray-Iron Fittings
AWWA C150 (ANSI A21.50)	Thickness Design of Ductile-Iron Pipe
AWWA C151 (ANSI A21.51)	Ductile-Iron Pipe, Centrifugally Cast, in Metal Molds or Sand-Lined Molds, for Water or Other Liquids
AWWA C153 (ANSI A21.53)	Ductile-Iron Compact Fittings, 3 In. Through 12 In. for Water and Other Liquids
AWWA C600	Installation of Ductile-Iron Water Mains and Their Appurtenances
AWWA C606	Grooved and Shouldered Type Joints

1.03 SUBMITTALS

A. The following information shall be provided in accordance with Section 01 33 00 and Section 01 33 23:

1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements.

Section 4
Scope of Work and Technical Specifications
SECTION 33 33 00-3 DUCTILE IRON PIPE AND FITTINGS

- a. Check marks shall denote full compliance with a paragraph as a whole.
 - b. If deviations from the specifications are indicated, and therefore requested by the Contractor, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation.
 - c. The Construction Manager shall be the final authority for determining acceptability of requested deviations.
 - d. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications.
2. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
- B. The following information shall be submitted by pipe and fitting suppliers
1. Name of the pipe manufacturer and a list of the piping and quantities to be provided by the manufacturer.
 2. Name(s) of fitting manufacturer(s) and lists of fittings and quantities to be provided by manufacturer.
 3. Pipe and fitting product data indicating conformance with this Specification, applicable standards, and warranty provisions, including written documentation regarding any intended variance from this specification and applicable standards.
 4. At the time of shipment, the supplier shall provide certified documentation of pipe and fitting conformance with this Specification and applicable pipe and fitting standards specified herein.

PART 2 – PRODUCTS

2.01 GENERAL

- A. Pipe design, materials and manufacture shall comply with the following documents:

Item	Document
Thickness design	AWWA C150

Section 4
Scope of Work and Technical Specifications
SECTION 33 33 00-4 DUCTILE IRON PIPE AND FITTINGS

Manufacturing requirements	
Water or other liquid	AWWA C151
Gravity sewer pipe	ASTM A746
Joints	
Rubber gasket	AWWA C111
Threaded flange	AWWA C115
Fittings	
Water or other liquid	AWWA C110/AWWA C153
Cement mortar lining	AWWA C104

B. All ductile iron pipe shall be marked in accordance with AWWA C151 and ductile iron fittings shall be marked in accordance with AWWA C110.

C. Acceptable Manufacturers

1. American Cast Iron Company
2. U.S. Pipe
3. Or approved equal

2.02 PIPE

A. All pipe shall be Class 50 (thickness class) for 16-inch and smaller, and Class 51 for 18-inch and larger, unless otherwise specified or shown on the Drawings.

B. Flanged pipe minimum wall thickness shall be equal to Special Class 53. Flanges shall be furnished by the pipe manufacturer.

C. All pipes shall have a minimum pressure rating as indicated in the following table and corresponding minimum wall thickness, unless otherwise specified or shown on the Drawings:

Diameter	Minimum Pressure Class
14" through 20"	350
24" and greater	300

D. Unless otherwise specified, pipe shall have nominal laying lengths of 18 or 20 feet.

E. All pipe shall be manufactured in the United States of America.

F. Certificates of conformance with the foregoing Specifications shall be furnished with each lot of pipe supplied.

2.03 GASKETS

A. Unless otherwise specified, gasket stock shall be a synthetic rubber compound in which the elastomer is nitrile or neoprene.

1. The compound shall contain not less than 50 percent by volume nitrile or neoprene and shall be free from factice, reclaimed rubber and other deleterious substances.

B. Gaskets for flanges shall be the full face type.

1. Thickness shall be 1/16 inch for pipe 10 inches and less in diameter and 1/8 inch for pipe 12 inches and larger in diameter.

C. Gaskets shall, in addition, comply with AWWA C111 for push-on and mechanical joints and with AWWA C606 for grooved end joints.

D. Sufficient lubricant shall be furnished with each order of pipe to provide a thin coating on both the gasket and the spigot-end of the pipe.

1. Lubricant shall be NSF 61 approved and shall have no deleterious effect on the rubber gasket.

2. Lubricant shall be of such consistency that it can be easily applied to the pipe in either hot or cold weather and shall satisfactorily adhere to either wet or dry pipe.

3. ONLY LUBRICANT FURNISHED WITH THE PIPE BY THE PIPE MANUFACTURER SHALL BE USED.

2.04 FITTINGS

A. Unless otherwise specified, fittings shall conform to AWWA C110 with a minimum rated working pressure of 250 psi.

B. Ends shall be flanged, restrained mechanical joint, restrained push-on, or grooved to suit the conditions specified.

C. The AWWA C153 compact ductile iron fittings in sizes 3 through 12 inches are an acceptable substitute for standard fittings unless otherwise specified.

D. In general, use flanged fittings with long radius elbows except where space limitations prohibit use of same.

E. Design of special flanged fittings, including wall castings, shall conform to dimensions and details as directed, indicated, or noted on the approved drawings.

F. Fittings shall be cement lined in accordance with AWWA C104 and shall be furnished with a bituminous outside coating.

G. In lieu of cement lining and bituminous coating, fittings may be provided with a fusion bonded coating and lining meeting the requirements of AWWA C116.

H. Galvanized pipe fittings and PVC pipe fittings shall not be used as any part of the Fulton County Sewer System, nor shall it be used to join any appurtenances to the System.

2.05 JOINTS

A. Unrestrained Joints:

1. Push-On Joints:

a. Unrestrained joints, where specified, shall be the rubber ring compression, push-on type joint suitable for buried services.

b. Acceptable unrestrained joints shall be:

1) Fastite Joint as manufactured by American Cast Iron Pipe Company

2) Tyton Joint as manufactured by U.S. Pipe

3) Or approved equal.

c. This joint is not permitted on fittings or specials, unless otherwise specified.

d. Unless otherwise specified, joints shall have a maximum allowable deflection up to 5 degrees at specified pressures.

e. Gaskets shall comply with Paragraph 2.03.

f. Joint assembly and field cut joints shall be made in strict conformance with AWWA C600 and manufacturer's recommendations.

2. Mechanical Joints:

a. Where specified, mechanical joints for above or below ground services shall meet the requirements of ANSI/AWWA A21.10/C110 and ANSI/AWWA A21.11/C111.

b. Mechanical joint glands shall be ductile iron.

c. Gaskets and bolts and nuts shall comply with paragraphs 2.03 and 2.05D, respectively.

B. Restrained Joints:

Section 4
Scope of Work and Technical Specifications
SECTION 33 33 00-7 DUCTILE IRON PIPE AND FITTINGS

1. General:
 - a. Unless otherwise specified, restrained joints shall be flanged or grooved end for exposed service and restrained push-on for buried services.
 - b. Restrained joint pipe (RJP) on supports shall have bolted joints and shall be specifically designed for clear spans of at least 36 feet.
2. Push-On Joints:
 - a. Restrained push-on joints shall be as specified in paragraph 2.05A, modified for restraint.
 - b. Acceptable restrained push on Joints
 - 1) Flex-Ring or Lok-Ring Joint as manufactured by American Cast Iron Pipe Company,
 - 2) TR Flex or HP Lok Joint as manufactured by US Pipe
 - 3) Clow "SUPER LOCK"
 - 4) Griffin "SNAP-LOK"
 - 5) Or approved equal.
 - c. Restraining gasket joints shall be assembled with American Fast-Grip gaskets or US Pipe FIELD LOK gaskets and may be used for pipe 12-Inches in diameter or less.
 - d. Restrained joints shall be capable of being deflected after full assembly.
 - e. Joint assembly shall be in strict conformance with AWWA C600 and manufacturer's recommendations.
 - f. No field welding for manufactured restrained joint pipe assembly will be permitted.
 - g. No field cuts of restrained pipe are permitted without prior approval of the Owner.
 - h. Where field cutting of restrained joint pipe is required, the joint shall be assembled with American Field Flex-Rings or US Pipe TR FLEX GRIPPER Rings.
3. Flange Joints:

Section 4
Scope of Work and Technical Specifications
SECTION 33 33 00-8 DUCTILE IRON PIPE AND FITTINGS

- a. Unless otherwise specified, flanges shall be ductile iron and shall be threaded-on flanges conforming to ANSI/AWWA A21.15/C115 or cast-on flanges conforming to ANSI/AWWA A21.10/C110.
 - b. Flanges shall be adequate for 250 psi working pressure.
 - c. Bolt circle and bolt holes shall match those of ANSI B16.1, Class 125 flanges and ANSI B16.5, Class 150 flanges.
 - d. Gaskets shall be as specified in Paragraph 2.03.
4. Thrust collars shall be welded on ductile iron body type or split retainer gland type, as shown on the Drawings or directed by the Owner, designed to withstand thrust due to 300 psi internal pressure on a dead end.
5. Anchorage:
 - a. All valves, caps, tees, bends deflecting 11 ¼ degrees or more and other fittings shall have two forms of restraint as one of the following:
 - 1) Manufactured restrained joint plus concrete blocking (3,000 psi concrete thrust block sized to withstand line pressures of 300 psi and soil bearing pressures of 2,000 psf)
 - 2) Manufactured restrained joint plus rodding to concrete thrust collar (3,000 psi concrete collar and tie rods sized to withstand line pressures of 300 psi and soil bearing pressures of 2,000 psf)
6. Mechanical Joints:
 - a. Where specified, restrained mechanical joints shall be the positive restraint type.
 - b. Retainer glands on a mechanical joint may be used as a restrained joint only where retainer glands are specifically shown on the drawings, where specifically specified or where specifically identified and allowed by the Owner.
 - 1) Retainer glands shall be Megalug Series 1100, as manufactured by EBAA Iron, or Uni-Flange Series 1400, as manufactured by Ford Meter Box Company.
 - c. Locked mechanical hydrant tees, bends and adapters are an acceptable substitute for anchoring fire hydrants and valves to the pipe main.
- C. Ball and Socket Flexible Joint Pipe:

Section 4
Scope of Work and Technical Specifications
SECTION 33 33 00-9 DUCTILE IRON PIPE AND FITTINGS

1. Ball and socket flexible joint pipe shall be the boltless type and shall allow a maximum joint deflection of 15 degrees.
2. Each joint shall be provided with a retainer lock to prevent rotation after assembly.
3. Joints shall be the Flex-Lok Joint as manufactured by American Cast Iron Pipe Company, USIFLEX as manufactured by U.S. Pipe, or equal.

D. Bolts and Nuts:

1. Provide the necessary bolts for connections. All bolts and nuts shall be threaded in accordance with ANSI B1.1, Coarse Thread Series, Class 2A external and 2B internal fit. All bolts and nuts shall be made in the U.S.A.
2. Bolts and nuts for mechanical joints shall be Tee Head Bolts and nuts of high strength low alloy steel in accordance with ASTM A 242 to the dimensions shown in AWWA C111/ANSI A21.11.
3. Flanged joints shall be bolted with through stud or tap bolts of required size as directed. Bolt length and diameter shall conform to ANSI/AWWA C115 for Class 125 flanges shown in ANSI/ASME B16.1.
4. Bolts for exposed service shall be zinc plated, cold pressed, steel machine bolts conforming to ASTM A 307, Grade B. Nuts for exposed service shall be zinc plated, heavy hex conforming to ASTM A 563. Zinc plating shall conform to ASTM B 633, Type II.
5. Bolts for submerged service shall be stainless steel machine bolts conforming to ASTM A 193, Grade B8M. Nuts shall be heavy hex, stainless-steel conforming to ASTM A 194, Grade 8M.
6. Corrosion-resistant bolts and nuts for use with ductile iron joints shall be Type 316 stainless steel

E. Tapping Saddles: Tapping saddles are not allowed.

F. Pipe outlets shall be welded on ductile iron pipe and shall be provided in lieu of tees or saddles on pipes with a diameter greater than or equal to 24-inches.

1. Outlets shall be plain end, push-on, mechanical or flanged joint, and shall meet the joint requirements stated in this Specification.
2. All welding, fabrication and outlet hole drilling shall be performed by the manufacturer of the parent pipe.

Section 4
Scope of Work and Technical Specifications
SECTION 33 33 00-10 DUCTILE IRON PIPE AND FITTINGS

3. Outlets shall be free of burrs. Sizes shall be as indicated on the Drawings.
4. The outlets and parent pipe shall be minimum Class 53 ductile iron pipe for parent pipe 54-inches and smaller.
5. For pipe larger than 54 inches, parent pipe shall be Pressure Class 350.
6. Each welded outlet shall be rated for 250 psi working pressure and hydrostatically tested at 500 psi.
7. The maximum outlet diameters shall not exceed those listed in the table below:

Parent Pipe Diameter, Inches	Maximum Outlet Diameter, Inches
24	16
30	20
36	24
42	30
48	30
54	30
60	30
64	30

2.06 PIPE COATING

- A. The exterior of ductile iron pipe and fittings shall be coated with a layer of arc-sprayed zinc per ISO 8179.
 1. The mass of the zinc applied shall be 200 g/m² of pipe surface area.
 2. A finishing layer of bituminous topcoat as specified in AWWA C151 shall be applied to pipe and fitting over the zinc.
 3. The coating system shall conform in every respect to ISO 8179-1 "Ductile iron pipes – External zinc-based coating - Part 1: Metallic zinc with finishing layer. Second edition 2004- 06-01."
- B. Where corrosive soils or soils with electrical currents are encountered that may, or in the judgment of the Owner, cause a deleterious effect on the piping system, the piping system shall be wrapped with polyethylene in accordance with the manufacturers recommendations to a minimum distance of 20 lineal feet beyond such conditions.
 1. All elements of the piping system shall be wrapped entirely in polyethylene tubing and secured with polyethylene tape to completely prevent the entrance of foreign matter.
 2. Such encasement shall be carried out in accordance with AWWA/ANSI C105/A21.5.

2.07 PIPE LINING

A. Cement Mortar Lining:

1. Pipe:

a. Cement mortar lining shall be to Standard thickness in accordance with ANSI/AWWA C104/A21.4.

2. Fittings:

a. Cement mortar lining shall be to Double thickness in accordance with ANSI/AWWA C104/A21.4.

3. Pipe and fittings shall be lined with 40 mil dry film thickness of Protecto 401 Ceramic Epoxy by Induron or equivalent. A seal coat over the ceramic lining is not required.

2.08 PRODUCT DATA

A. The following information shall be provided in accordance with Section 01 33 23:

1. Shop drawings.

2. Alignment drawings.

3. Certifications specified in the following documents:

a. ANSI A21.14, paragraph 14-4.2

b. ANSI A21.52, paragraph 52-4.2

c. ASTM A716, paragraph 4.2

d. AWWA C110, paragraph 10-5.3

e. AWWA C111, paragraph 11-7.1

f. AWWA C115, paragraph 15-4.2

g. AWWA C151, paragraph 51-5.2

h. AWWA C153, paragraph 53-6.3

i. AWWA C606, paragraph 4.1.1.1

PART 3 – EXECUTION

3.01 INSTALLATION

A. General:

Section 4
Scope of Work and Technical Specifications
SECTION 33 33 00-12 DUCTILE IRON PIPE AND FITTINGS

1. Piping runs specified on the Drawings shall be followed as closely as possible. Proposed deviations shall be submitted in accordance with Section 01 33 00.
2. Pipe shall be installed in accordance with AWWA C600.
3. Coatings and linings shall be inspected for damage during installation, and damage shall be repaired according to the coating manufacturer's recommendations.

B. Insulating Sections

1. Where a metallic nonferrous pipe or appurtenance is connected to ferrous pipe or appurtenance, an insulating section shall be provided.

C. Anchorage:

1. Anchorage shall be provided as specified. Calculations and drawings for proposed alternative anchorage shall be submitted in accordance with Section 01 33 00.

3.02 ACCEPTANCE TESTING

A. Gravity Sewer:

1. Infiltration and exfiltration tests as specified in Section 33 30 00.

B. Force Main

1. Hydrostatic pressure and leakage in accordance with Section 4 of AWWA C600 except that test pressures shall be as listed in Section 33 30 00 and no leakage will be allowed.

C. The Contractor shall conduct the tests in the presence of the Owner.

3.03 GUARANTEE

A. Material Warranty:

1. A written guarantee of 20 years submitted to the County for the specific project shall be provided by the Manufacturer against any defects of the pipe and fittings material.
2. A successful pressure test or pressure leak test prior to the expiration of the warranty period shall not relieve the supplier of warranty responsibility for the full warranty term.

B. Workmanship Warranty

1. The Contractor shall guarantee the Work is free from defects in material and workmanship for a period of 10 years from final acceptance.

Section 4
Scope of Work and Technical Specifications
SECTION 33 33 00-13 DUCTILE IRON PIPE AND FITTINGS

2. The warranty shall cover the costs to repair or replace items including, but not be limited to, all gravity sewers, force mains, manholes, appurtenances, trenches, roadways, landscaping, other areas disturbed by the construction of the project and freight to project site, should these items have any defects in material or workmanship.

3. A successful pressure test or pressure leak test prior to the expiration of the warranty period shall not relieve the installer of warranty responsibility for the full warranty term.

C. Deficiencies related to material and workmanship shall be repaired by the Contractor to the satisfaction of the Owner.

D. No bell clamps or wrap around corsets are allowed as a means of repair on new pipelines.

E. The Contractor shall be responsible to cover all costs, including materials and labor, associated with these repairs.

F. If required, Contractor and pipe manufacturer representatives may participate in inspections to determine such deficiencies.

G. If repairs are made, the Contractor/Manufacturer shall warrant the repaired work for the periods specified above for material and workmanship in addition to the original warranty period required by the Contract.

H. The Contractor shall be responsible for repairs to any trench settlements caused by leaking pipe, fittings, etc. He shall promptly furnish and place fill to original grade.

I. Should any leaks or trench settlement occur under the new pavement, the Contractor will be held responsible for the cost of all repairs, including pavement replacement.

J. Within the guarantee period, where no loss of customer service or property damage is involved, the Contractor shall begin work on requested repairs or corrective measures within 24 hours following notification by Owner.

K. If property damage or loss of customer service is involved, the Contractor shall begin work with four (4) hours of notification from the Owner.

L. Unless otherwise specified, the warranty periods shall begin after the Certificate of Acceptance is issued for the Contract.

3.04 INSPECTION

A. Furnish to Owner copies of the Manufacturer's Sworn Certificate of Inspection and Testing of all ductile iron pipe and ductile iron fittings provided on the Work.

Section 4
Scope of Work and Technical Specifications
SECTION 33 33 00-14 DUCTILE IRON PIPE AND FITTINGS

B. All ductile iron pipe and fittings will be subject to inspection and approval by Owner after delivery of material to the site. Do not use broken, cracked, misshaped, imperfectly coated, unsatisfactory or otherwise damaged pipe or fittings.

C. Such an inspection by the Owner does not relieve the Contractor of full responsibility for the material installed.

END OF SECTION

SECTION 33 41 13

REINFORCED CONCRETE PIPE FOR STORM DRAINS

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals necessary to install reinforced concrete pipe and fittings as shown on the drawings and required by the Specifications.

1.02 SHOP DRAWINGS

A. Submit shop drawings showing piping and drainage structure layout and details of reinforcement, joint and method of construction and installation of reinforced concrete pipe, specials, and fittings required.

1.03 RELATED WORK

- A. Section 31 23 00: Trench Excavation and Backfill
- B. Section 01 74 00: Cleaning and Waste Management
- C. Division 3: Concrete

PART 2 - PRODUCTS

2.01 REINFORCED CONCRETE PIPE

A. Except as otherwise specified within, pipe shall conform to ASTM Standard Specifications for Reinforced Concrete Culvert, Storm Drain and Sewer Pipe, Designation C76, Class III, Wall B. The tabulated reinforcement given in the tables in ASTM Standard C76 shall be the minimum required.

B. The pipe shall be capable of withstanding construction equipment loading which may be encountered during the progress of work. Any pipe damage during construction operations shall be promptly and satisfactorily repaired.

C. Non-air-entraining Portland cement conforming to ASTM Specification C150, Type I shall be used, except as otherwise approved in writing. The use of a non-bleeding, water-reducing, dispersing agent may be permitted subject to the specific approval. The use of any other admixture will not be permitted.

D. Fine aggregate shall consist of washed inert natural sand conforming to the requirements of ASTM Specification C33, except for gradation, with a maximum loss of 5% when subjected to 5 cycles of the soundness test using magnesium sulfate.

Section 4

Scope of Work and Technical Specifications
SECTION 33 41 13-2 REINFORCED CONCRETE PIPE FOR STORM DRAINS

E. Coarse aggregate shall consist of well-graded crushed stone or washed gravel conforming to the requirements of ASTM Specification C33, with a maximum loss of 5% when subjected to 5 cycles of the soundness test using magnesium sulfate.

F. The 28-day compressive strength of the concrete, as indicated by cores cut from the pipe shall be not less than 4,000 psi. The pipe interior shall comprise a continuous integral cement skin and shall be smooth and even, free from roughness, projections, indentations, offsets or irregularities. The concrete mass shall be dense and uniform. The average absorption shall not exceed 5.3%. Reinforcement shall be circular for all concrete pipe. Reinforcement in the bell and spigot shall be adequate to prevent damage to concrete during shipping, handling and installation. Cores indicating reinforcing steel having less than 85% bond shall be cause for rejection of the lot of pipes.

G. The pipe shall be clearly marked as required by ASTM C76. The markings may be at either end of the pipe for the convenience of the manufacturer, but for any one size shall always be at the same end of each pipe length. Pipe shall not be shipped until compressive strength of the concrete has attained 3,000 psi and not before 5 days after manufacture and/or repaired, whichever is the longer.

H. Pipes shall have a minimum laying length of approximately 8', except for closure and other special pieces. The length of the incoming and outgoing concrete pipe at each structure shall not exceed 4', except where the joint is cast flush with the exterior wall of the structure. Maximum laying length shall not exceed 16', but the installation of 16' lengths will depend upon the ability of the Contractor to handle such lengths of pipe. In deep sheeted trenches comply with trench width requirements, maintain the integrity of the sheeting and avoid disturbance to adjacent ground. If in the opinion of the Owner's Representative the use of 16' lengths is impracticable, shorter lengths shall be used.

I. The quality of all materials and the finished pipe shall be subject to inspection and approval of a representative of the Owner. Such inspection may be made at both places, and the pipe shall be subject to rejection at any time because of failure to meet any of the specification requirements, even though sample pipes may have been accepted as satisfactory at the place of manufacture. Pipe rejected after delivery shall be marked for identification and shall be removed from the job at once.

J. At the time of inspection, the pipe will be carefully examined for compliance with the appropriate ASTM and project specification, and inspected for general appearance, dimension, "scratch-strength", blisters, cracks, roughness, soundness, and other features. All pipes will be checked for soundness by being tapped and scratched over a reasonable portion of the area, at least once on every 20 sq. inches of pipe surface. The surface shall be dense and close-textured. Cores shall also serve as a basis for rejection of pipe, particularly if lamination or poor bond of reinforcement is apparent.

Section 4

Scope of Work and Technical Specifications
SECTION 33 41 13-3 REINFORCED CONCRETE PIPE FOR STORM DRAINS

K. The manufacturer shall inspect all pipe joints for out-of-roundness and pipe ends for squareness. The manufacturer shall furnish a notarized affidavit stating all pipes meet the requirements of ASTM C76, these specifications, and the joint design with respect to square ends and out-of-round joint surfaces.

L. Unsatisfactory or damaged pipe will be either permanently rejected or returned for minor repairs. Only that pipe actually conforming to the specifications and accepted will be listed for approval, shipment and payment. Approved pipe will be stamped or stenciled on the inside before it is shipped. All pipe which has been damaged after delivery will be rejected, and if such pipe already has been laid in the trench, it shall be acceptably repaired, if permitted, or removed and replaced.

M. Pits, blisters, rough spots breakage and other imperfections may be repaired, subject to the approval of the Owner's Representative, after demonstration by the manufacturer that strong permanent repairs result. Repairs shall be carefully inspected before final approval. Non-shrink cement mortar used for repairs shall have a minimum compressive strength of 6,000 psi at the end of 7 days and 7,000 psi at the end of 28 days, when tested in 3" cylinders store in the standard manner. Epoxy mortar may be utilized for repairs.

2.02 JOINTS FOR CONCRETE PIPE

A. Joints for concrete pipe shall be the tongue and groove or bell and spigot type of joint with provisions for using a round rubber "O-Ring" gasket in recess in the spigot end of the pipe. The bevel on the bell of the pipe shall be between 1-1/2 degree and 2-1/2 degree and the annular open spaced at the gasket when the joint is made up and pipes are centered in line shall not exceed 1/8". The faces of pipe in contact with the gasket shall be true, and free of irregularities. Joints for drainpipe may be made with mortar.

B. The round rubber "O-Ring" gaskets for either joint shall conform to ASTM C443 Specifications for joints for Circular Concrete Sewer and Culvert Pipe using rubber gaskets.

PART 3 - EXECUTION

3.01 LAYING REINFORCED CONCRETE PIPE FOR DRAINS

A. Bell and spigot pipe joints shall be made by caulking all around with twisted jute of proper size to give proper alignment of the pipe. Inner surfaces of abutting sections shall be flush and on a smooth grade. Brush and wet the jointing surfaces and fill the annular opening with mortar to a minimum depth of 2", sufficient to form a bead around the outside face of the bell.

B. Mortar for jointing shall consist of one part Portland cement and two parts sand, using a minimum amount of water-sufficient to make a workable mortar.

Section 4
Scope of Work and Technical Specifications

SECTION 33 41 13-4 REINFORCED CONCRETE PIPE FOR STORM DRAINS

C. Joints shall be immediately protected from freezing or excessive drying by covering them with earth, burlap or other approved material.

3.02 CLEANING

A. At the conclusion of the work, thoroughly clean all new pipelines by flushing with water or other means to remove all dirt, stones, pieces of wood or other material which may have entered during the construction period. Debris cleaned from the lines shall be removed from the lowest outlet. If, after this outlet cleaning, obstructions remain, they shall be removed.

END OF SECTION

SECTION 34 41 16

TRAFFIC CONTROL

PART 1 - GENERAL

1.01 SUMMARY

A. SECTION INCLUDES:

Section	Title
1.02	References
1.03	Work Included
1.04	Submittals
2.01	Materials
2.02	Worker Safety Apparel
2.03	Traffic Control Devices
3.01	Maintaining Traffic
3.02	Traffic Control

B. RELATED SECTIONS

The following listed sections do not purport to be all inclusive, as it is the Contractor's responsibility to do all the Work in accordance with the Contract Documents.

1. Submittals (01 33 00).
2. Demolition (02 22 21).
3. Clearing and Grubbing (31 11 10)
4. Trench Excavation and Backfill (31 23 00).
5. Erosion and Sedimentation Control (31 25 00).
6. Removing and Replacing Pavement (32 12 16)

1.02 REFERENCES

- A. Drawings and general provisions of the Contract, including general and supplementary conditions and Division 1 Specification Sections, apply to this section.

1.03 WORK INCLUDED

- A. The Contractor shall furnish all materials, equipment, and labor (including employment of off-duty City of South Fulton or City of Chattahoochee Hills Police

Officer(s)), necessary to maintain traffic control during construction. This Work shall consist of furnishing, installing, maintaining, and removing necessary traffic signs, pedestrian signs, barricades, lights, signals, cones, pavement markings, and other traffic control devices, and shall include flagging and other means for guidance and protection of vehicular, worker, and pedestrian traffic through the Work Zone. This Work shall include both maintaining existing devices and installing additional devices, as necessary, in construction work zones.

1.04 SUBMITTALS

- A. Submit for approval, in accordance with Section 01 33 00 SUBMITTAL PROCEDURES all working drawings and schedules of materials and methods proposed to be followed in the execution of the Work under this item.
- B. Submittals shall show in detail, the type, number, and location of all traffic control measures to be used in the execution of the Work.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Unless otherwise specified, all materials furnished for traffic control shall meet the requirements of the Georgia Department of Transportation Standard Specifications, Construction of Roads and Bridges, Sections 148 and 150, latest edition; Georgia Department of Transportation, Special Provision, Section 150-Traffic Control, latest edition; and the Manual on Uniform Traffic Control Devices (MUTCD), latest edition.

2.02 WORKER SAFETY APPAREL

- A. All workers within the right-of-way who are exposed to traffic or to work vehicles and construction equipment shall wear high-visibility safety apparel that meets the Performance Class for the risk exposure.

2.03 TRAFFIC CONTROL DEVICES

- A. All traffic control devices used during the execution of the Work shall meet the Standards utilized in the Manual on Uniform Traffic Control Devices (MUTCD), latest edition.

PART 3 - EXECUTION

3.01 MAINTAINING TRAFFIC

- A. All working operations of the Contractor, Subcontractors, and/or their agents or employees must be subordinated to the free and unobstructed use of the highway, and structures encountered in the prosecution of the Work under this item.
- B. The Contractor shall proceed with the Work in such manner as shall permit regular transaction of business by the property owner without delay or danger to life or

property, and shall place necessary barricades, warning signs, signals, lights, and if necessary, flaggers or Police Officer(s) for the protection of the traveling public.

C. Whenever it is necessary to cross, obstruct, or close roads, driveways, and walks, whether public or private, Contractor shall provide and maintain suitable and safe bridges, detours, or other temporary expedients for the accommodation of public and private travel, and shall give a minimum of twenty-four (24) hour notice to owner(s)/tenant(s) of private drives before interfering with them.

D. In making open-cut street crossings, Contractor shall not block more than one-half ($\frac{1}{2}$) of the street at a time. Whenever possible, Contractor shall widen the shoulder on the opposite side of the street to facilitate traffic flow.

3.02 TRAFFIC CONTROL

A. Contractor's proposed plan of operation shall supplement the approved traffic control plan as specified, as indicated on the Drawings, or as directed by the Engineer or Fulton County Department of Public Works.

B. All traffic control devices shall be in an acceptable condition when first installed on the Project and shall be maintained throughout the construction period. All unacceptable traffic control devices shall be replaced within twenty-four (24) hours.

C. In the execution of the Work, if it becomes necessary to remove any existing signs, markers, etc., they shall be removed, stored and reinstalled as directed by the Engineer or Fulton County Department of Public Works, to line and grade in the same condition as when removed.

D. All temporary traffic control devices shall be removed within seven (7) calendar days after completion of construction.

E. When necessary to provide a safe work zone for the Contractor and Fulton County Department of Public Works employees, off-duty Police Officer(s) may be utilized to assist in maintaining safe traffic control. Use of Police Officer(s) shall be used when safety necessary, in areas of high traffic volume, installation in roadways, road closures and lane closures, or in areas of low visibility. The Contractor shall contact the City of South Fulton Police Department at (470) 552-4311 or the City of Chattahoochee Hills Police Department at (770) 463-6576 to schedule an off-duty Police Officer(s). Arrangements for Police Officer(s) must be made a minimum of forty-eight (48) hours prior to the Work to allow time for Police Officer(s) to be scheduled. Depending on the situation, the Police Officer(s) onsite may request additional Police Officer(s), if needed.

END OF SECTION

SECTION 35 22 27

STAINLESS STEEL SLUICE AND SLIDE GATES

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. This section specifies sluice gates of stainless-steel construction for isolation of channels, tanks, or pipes. The Contractor shall assign unit responsibility as specified in paragraph 35 22 27, 1.02 C to the sluice gate manufacturer for the combined equipment consisting of sluice gate and operator.

B. Sluice gate types:

1. Type A: Sluice gates shall be of stainless-steel construction with sliding resilient seals, flat frames, and wall thimbles.

C. Operating Requirements

Size, Inches	Opening Direction	Bottom Seating	Frame Type	Operator Type	Mounting Surface
24x36	U	S	C	I	FMS
24x36	U	S	C	I	FMS
24x24	U	S	C	I	FMS

Contractor shall field verify exact type of sluice gate required prior to submittal.

*Abbreviations:

U = upward opening; D = downward opening; FB = flush bottom; S = standard; SC = self-contained (yoke-type); C = conventional FLG = Flanged, FMS = Flat mounting surface, See below for sections for Operator Type.

*Design heads are measured from gate centerline.

D. Component Sizing:

1. The sluice gate shall be sized to operate against a static head of 45ft.

E. Contractor Provisions:

1. The Contractor shall provide all labor, materials, equipment, and incidentals required to furnish and install slide gates, operating stems, and operating floor stands, complete and operational with all necessary accessories as shown on the Contract Drawings, as specified herein, or as required for complete operation.
2. The Contractor shall obtain all equipment specified in this Section from one manufacturer to ensure proper coordination and functionality. The manufacturer shall have responsibility for performance and compatibility of the

entire system. This does in no way relieve the Contractor for ultimate responsibility under this Contract for equipment, coordination, installation, operation and guarantee.

3. The Contract Drawings are for the purpose of guidance and to show functional features and required external connections. They do not necessarily show all components necessary to accomplish the desired results nor do they necessarily show all components required to interface with the equipment. The Contractor shall provide all parts, equipment, and devices necessary to meet the functional requirements of the system.

1.02 REFERENCES

A. This section contains references to the following documents. They are a part of this section as specified and modified. In case of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

1. American Society for Testing and Materials (ASTM):
2. AWWA
 - a. AWWA C561 – Stainless Steel Slide Gates
3. American National Standards Institute (ANSI)

1.03 SUBMITTALS

A. Shop drawings and product data shall be submitted in accordance with Section 01 33 00.

B. A copy of this specification section, with addendum updates includes, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate requested deviations from specifications requirements. If deviation from the specifications are indicated and therefore requested by the Contractor, the submittal shall be accompanied by a detailed, written justification for each deviation. Failure to include a copy of the marked-up specification sections, along with justification for any requested deviations to the specification requirements, with the submittal shall be cause for rejection of the entire submittal with no further consideration.

C. Fabrication drawings with full dimensions and weights.

D. Plan, cross section, and details showing proposed mounting for each size and application of gate. Certification that all components were designed based upon the maximum seating and unseating heads described herein.

E. Materials of construction

F. Installation diagrams showing location, arrangement, and size of all fasteners required for the equipment. Setting drawings, templates, and instructions for installation of frames, thimbles, etc.

PART 2 – PRODUCTS

2.01 ACCEPTABLE PRODUCTS

A. Stainless Steel Sluice Gates shall be WACO Environmental Products, Hydro Gate, Rodney Hunt, Waterman, or approved equal.

2.02 EQUIPMENT

A. Sluice Gates:

1. All slide gates shown on the plans and listed in the specifications shall conform in all respects to the latest version of AWWA C561, with the noted changes and additions: Materials used in construction of slide gates and appurtenances will be best suited for the application and will conform to the following specifications:

- a. Frame, Slide, Reinforcing Members and Self-contained Yoke (as required): Stainless Steel, ASTM A240/A240M, Type 304L or 316L.
- b. Stems and retainer bars: Stainless Steel, ASTM A276, Type 304 or 316.
- c. Fasteners: Stainless Steel, ASTM F593/F594, Alloy Group 1 or 2 (Type 304 or 316).
- d. Invert seals and compression load pad: Neoprene or EPDM, ASTM D2000, 60 Durometer.
- e. Side seal: Ultra High Molecular Weight (UHMW) Polymer, ASTM D4020.
- f. Top wedges: Stainless Steel, ASTM A351-CF8M, Type 304 or 316
- g. Pedestals, Wall Brackets and Stem Guide Brackets: Cast Iron, ASTM A126, Class B or Stainless Steel, ASTM A276, Type 304 or 316.
- h. Stem Guide Bushings: Silicon Bronze, ASTM B584, Alloy 873 or Ultra High Molecular Weight (UHMW) Polymer, ASTM D4020

B. Gate Frame

1. Gate frame shall be flat back, embedded or channel mount as shown in the Drawings. Spigot-back frames are not acceptable. The frame shall be an integral unit of brake form and structural shapes, rigidly assembled to form the waterway openings. Holes shall be provided for mounting on anchor bolts. Seats

Section 4
Scope of Work and Technical Specifications
SECTION 35 22 27-4 STAINLESS STEEL SLUICE AND SLIDE GATES

and seals shall be secured to the frame in a manner to ensure they will remain in place, free from distortion or loosening during the life of the gate. Seat contact pressure shall not exceed 600psi at the design head.

C. Gate Slide

1. Gate slides shall conform to the safety factors applied by the manufacturer, but shall, in no case, be less than 1/4 inch thick. Deflection under full head shall be limited to 1/720 of the span. The stem connector clips or stem block pocket shall be welded to the slide. Gates over 24" wide shall have adjustable top wedges to prevent deflection in the slide resulting from over closure.

D. Flush Bottom

1. Gates shall incorporate a flush-bottom seal that is mechanically fastened to the bottom frame invert member. The seal shall be of the materials shown in "Materials of Construction" provided by the manufacturer. Press fit seals are not acceptable.

E. Side Seals

1. UHMW seals shall be provided as specified in the Drawings. Seals shall be securely fastened to the frame with formed stainless steel retainers and shall be replaceable and adjustable without removing the gate from the installed position. A compression load pad shall be set behind the UHMW seal to allow for a self-adjusting seal system. The face of the UHMW guide that is in contact with the cover bar shall have a machined or extruded groove, to create a raised surface on each side, to allow for secondary adjustment of the seal clamp force.

F. Yoke

1. Self-contained gates shall be provided with a yoke designed to withstand the thrust of the operator. Yoke deflection shall not exceed 1/360 of the gate width or a maximum of 1/4 inch, whichever is less at maximum operating load. The yoke head channels shall be welded to the gate frame. The channels shall be sufficiently spaced to allow removal of the gate slide.

G. Gate Operation

1. The operating stem shall be of a size to safely withstand, without buckling or permanent distortion, the stresses induced by normal operating forces. In addition, the stem shall be designed to transmit in compression at least 2 times the rated output of the floor stand or bench stand with a 40-pound effort on the crank or handwheel. The threaded portion of the stem will have cold rolled threads of the double lead Acme type. Stainless Steel couplings, threaded and keyed to the stems, will join stems of more than one section. All threaded and keyed couplings of the same size will be interchangeable. Manually operated,

Section 4
Scope of Work and Technical Specifications
SECTION 35 22 27-5 STAINLESS STEEL SLUICE AND SLIDE GATES

rising stem type gates will be provided with an adjustable stop collar on the stem to prevent over-opening of the gate.

H. Stem Guides

1. Stem guides will be split collar bronze type, mounted on cast iron brackets to allow for installation after the stem is placed. They will be adjustable in two directions and will be spaced at sufficient intervals to adequately support the stem. The inside diameter of the guide shall be 1/8 inch to 1/4 inch larger than the outside diameter of the stem. Stem guide spacing will not exceed an L/r ratio of 200.

2.03 OPERATORS:

A. General:

1. Operators specified include hand-crank, handwheel, and T-wrench. Operators shall meet specifications, except as otherwise specified, and shall be designed to meet the operating requirements specified in paragraph 2.03 C, 1. A portable powered operator shall be provided as an accessory to crank- operated and handwheel-operated units. Plastic stem covers shall be provided as specified in, Section 2.03, A., 4.

2. Manually operated lifts shall be handwheel or geared crank type as shown in the Drawings. Lifts shall operate the gate with a maximum pull of 40 lb on the handwheel or crank. Handwheel or crank shall be located approximately 36 in. above grating or walkway. All lifts shall have thrust bearings, bronze lift nuts, and a bronze stop nut to limit the downward travel of the stem and slide. All geared lifts shall have cast or ductile iron housings and cast or fabricated pedestals. All lifts shall be rising stem type if possible. Lifts shall be grease lubricated and regreasable through grease zerks. Oil bath lifts are not acceptable. Gears and bearings shall be enclosed in weatherproof stainless-steel housings.

3. Gates 48 inches and wider and having widths greater than twice their height shall be provided with two operators connected by a tandem shaft for simultaneous operation.

4. A clear, polycarbonate plastic stem cover and indicator shall be provided on each slide gate operator. Stem indication shall be provided to denote gate level. A cast aluminum adapter shall be used to mount the cover to the lift or operator. The covers shall be capped, vented, and of sufficient length to allow full travel of the gate.

B. Type I:

1. Operator shall be the manual, geared, crank type. The operator shall be either pedestal or bench mounted as specified. Pedestal type floor stands shall

Section 4
Scope of Work and Technical Specifications
SECTION 35 22 27-6 STAINLESS STEEL SLUICE AND SLIDE GATES

be the offset type or the standard type with wall mounting bracket. The crank shall be 15 inches long and removable from the operator.

2. The geared floor or bench stand shall have a weatherproof, stainless-steel housing, with a bronze operating nut, mounted on a high-strength stainless steel pedestal baseplate. The operating nut shall be internally threaded with 29-degree acme threads corresponding to stem threading. Tapered roller bearing or ball bearings shall be located above and below the bronze operating nut to support the output thrust of the floor stand. The pinion shaft shall be mounted on tapered roller or needle bearings to resist axial and radial thrust. Mechanical seals shall be provided around the operating nut and the pinion shaft to prevent lubrication from leaving the unit and moisture from entering the sealed housing. The reduction gear case shall be precision machined and equipped with tapered roller or needle bearings and sealed about the reduction shafts.

3. Operators shall be self-locking at any position of stem travel. The input shaft shall be fitted with an AWWA nut.

C. Type II:

1. Operator shall be the manual handwheel type. The operator shall be either pedestal or bench mounted as specified. Pedestal type floor standards shall be the offset type or the standard type with wall mounting bracket. Pedestal or bench stands shall be stainless steel. The head of the pedestal or bench stand operator shall have a solid bronze internally threaded operating nut. The operator shall be mounted on anti-friction roller bearings. Handwheels shall be removable from the operator.

D. Type III:

1. Operator shall be the T-wrench type, including floor box, thrust bearings, and lift nut. Floor box shall be of fabricated steel, with galvanized steel hinged cover and embedded in the floor or mounted on a wall bracket as shown on the drawings. Floor box depth shall be such that the gate stem and operating nut does not protrude above the floor under any condition. Wall brackets shall be stainless steel or fabricated steel. Thrust bearings shall be roller or ball bearing type, replaceable and protected by seals. Accessible pressure type grease fitting shall be provided for bearing lubrication. Operating nuts shall be AWWA standard 2-inch square head nuts. T-wrenches shall be 4 feet long, aluminum, with socket to match the operating nut.

E. Portable Operators:

1. Operator shall be the portable, pneumatic/service air driven, tripod type suited for operation of Type 1 and 2 manual operators. The operator shall be mounted on an adjustable tripod base. The operator shall be equipped to drive the manual operators by means overload release clutch designed to release

Section 4
Scope of Work and Technical Specifications
SECTION 35 22 27-7 STAINLESS STEEL SLUICE AND SLIDE GATES

instantly upon reaching a preset torque. The operator shall be reversible and shall be suitable for operation with a maximum air demand of 20 scfm at 85 psig and shall be furnished with a 50-foot length of service air hose.

2.05 FINISHES

A. Shop Prep and Finishing

1. The gate manufacturer shall be responsible for shop prime and finish painting of all cast iron and steel accessories supplied under this contract. All coatings shall conform to VOC Emission Regulations in effect at the manufacturing location and at the project site to allow touch up or recoating to be performed with the same products.

B. Submerged Surfaces

1. Submerged surfaces shall be cleaned to SSPC SP10, dry, and grease-free prior to painting in conformance with the paint manufacturer's instructions. Non-submerged surfaces shall be cleaned to SSPC SP6.

C. Stainless Components

1. Stainless steel gates and accessories shall not be painted.

D. Accessories

1. All cast iron and steel accessories shall receive a primer and finished coat with a high-solids epoxy coat or approved equal for potable water use. Primer and finished coats shall be applied in the manufacturer's shop. Coating for all cast iron and steel accessories shall be Ameron Amerlock 400, medium gray color.

2.06 PRODUCT DATA

A. The following information shall be provided in accordance with Section 01 33 00.

1. Product information, calculations, charts, or graphs to verify that the product provided meets the requirements set forth in this specification.

2. Affidavits of compliance with accordance with .

3. Applicable operation and maintenance information as specified in Section 01730.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Unless otherwise specified, sluice gates shall be installed in accordance with the manufacturer's instructions.

3.02 TESTING

Section 4
Scope of Work and Technical Specifications
SECTION 35 22 27-8 STAINLESS STEEL SLUICE AND SLIDE GATES

A. Shop seat clearance and operating tests shall be performed per AWWA C561 including leakage tests.

3.03 OPERATIONAL AND MAINTENANCE MANUALS

A. Operational and maintenance manuals shall include all approved shop drawings associated with this Section, complete instructions for installation, and parts list for all components.

B. Include a list and frequency of specific maintenance activities.

END OF SECTION

SECTION 40 13 19

FIBERGLASS REINFORCED PLASTIC DUCTWORK

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. Furnish and install fiberglass reinforced plastic (FRP) duct, dampers and all appurtenances, complete and in place, all in accordance with the requirements of the Drawings.

1.02 REFERENCED SPECIFICATIONS, CODES, AND STANDARDS

A. Codes: All codes, as referenced herein, are specified in Section entitled "Reference Standards."

B. Standards

1. ASTM D 3567 Practice for Determining Dimensions of "Fiberglass" (Glass-Fiber Reinforced-Thermosetting-Resin) Pipe and Fittings.
2. ASTM C 582 Standard Specification for Contact - Molded Reinforced Thermosetting Plastic (RTP) Laminates for Corrosion -Resistant Equipment.
3. AWWA M-45 American Water Works Manual of Water Supply Practices "Fiberglass Pipe Design"
4. ASTM D 3982 "Standard Specification for Contact Molded "Fiberglass" Duct and Hoods" or NBS PS 15-69 "Custom Contact-Molded Reinforced Polyester Chemical-Resistant Process Equipment"
5. ASTM D 2992 "Standard Practice for Obtaining Hydrostatic Design Basis for Fiberglass Pipe and Fittings"
6. ASTM D 2310 "Standard Classification for Machine-Made "Fiberglass" Pipe

1.03 SUBMITTALS

A. Shop Drawings

1. See Section 01 33 00 – Submittal Procedures
2. Shop drawings to include product data and Samples
3. Fabrication drawings shall have details on Laminate Sequence used.

B. Additional Submittal Information

Section 4
Scope of Work and Technical Specifications
SECTION 40 13 19-2 FIBERGLASS REINFORCED PLASTIC DUCTWORK

1. The Contractor shall submit a copy of this specification with check-marks by each line to show full compliance or a note with attached supporting information noting any deviation for Engineer review.
2. A letter from the resin supplier stating that the material used for this project complies with the specification and meet all corrosion requirements.
3. Design calculations performed by the manufacturer and stamped by a Professional Engineer registered in the State of Georgia for record purposes.
4. Duct manufacturer shall submit certified test results in accordance with ASTM 2992. Engineer will confirm that supplier has completed ASTM 2992 testing.
5. Duct manufacturer shall submit sample coupons of proposed ductwork to Engineer which shall be representative of the ductwork (construction method and material used) to be supplied on this project.
 - a. Shop Drawings: Indicate system layout with location including critical dimensions, sizes, and duct hanger and support locations and detail of trapeze hangers.
 - b. Product Data:
 - 1) Design Data: Design of duct, supports and hangers must be coordinated as an entire system. Duct supplier shall coordinate the maximum allowable stress limits for each segment of duct with the duct support and hanger supplier to ensure that no component of either system is unduly stressed due to thermal expansion/contraction, wind, seismic and/or dead loads including soil loading for buried applications. Submit calculations sealed by a registered professional engineer in the State of Georgia.
 - a) Duct wall thickness shall be adequate to accommodate expected loads noted above.
 - b) Indicate maximum thermal expansion/contraction forces exerted upon any constrained outdoor odor control piping supports. Submit calculations used to determine imposed loads.
 - 2) Manufacturer's Installation Instructions:
 - a) Hangers and Supports: Submit special procedures and assembly of components.
 - 3) Manufacturer's Certificate: Certify products meet or exceed specified requirements.

Section 4
Scope of Work and Technical Specifications
SECTION 40 13 19-3 FIBERGLASS REINFORCED PLASTIC DUCTWORK

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site in original factory packaging, labeled with manufacturer's identification.
- B. Protect from weather and construction traffic, dirt, water, chemical, and damage, by storing in original packaging.

1.05 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.06 WARRANTY

- A. Provide a warranty in accordance with the requirements of General Conditions of the Contract Documents.

PART 2 - PRODUCTS

2.01 GENERAL

- A. Manufacturer: Provide FRP duct as manufactured by one of the following w/o exceptions. All equipment (Duct, dampers, and fittings) shall be the product of a single manufacturer. Out-sourcing of fabrication or parts of the system will not be accepted.
 - 1. Belco Manufacturing
 - 2. Augusta Fiberglass
 - 3. Industrial Plastics Systems
 - 4. Perry Fiberglass Products
 - 5. NOV Fiberglass Systems
- B. Service conditions:
 - 1. All equipment shall be designed for a minimum working pressure of 15" WG. positive and 15" WG negative pressure. The minimum wall thickness for all FRP duct shall conform to the following:
 - a. Minimum temperature: -10 degrees F
 - b. Maximum temperature: +125 degrees F
 - c. Support spacing for FRP duct shall meet the minimum spans requirements identified below:

DUCT SIZE	SPAN
6-inch and smaller	8 feet
8-12 inch	10 feet

Section 4
Scope of Work and Technical Specifications
SECTION 40 13 19-4 FIBERGLASS REINFORCED PLASTIC DUCTWORK

14-16 inch	12 feet
18-inch	14 feet
20-inch	16 feet
24-inch	18 feet
30-inch	20 feet

d. Wall thickness for internal positive pressure should be determined by ASTM D2310 using duct manufacturers Certified ASTM 2992 HDB test results. A full copy of the HDB testing should be submitted with the wall thickness calculations.

e. Duct Inside Diameter (inches)

Duct Inside Diameter (inches)	Minimum Wall Thickness (inches)
3 - 16	0.1875
18 - 24	0.220
30 - 36	0.250
42 – 54	0.375

2. Fiberglass reinforced plastic (FRP) ductwork shall be designed and fabricated for odor control service to carry warm, moisture-laden air with hydrogen sulfide, mercaptans and other organic and inorganic compounds typically associated with wastewater treatment.

2.02 DUCT CONSTRUCTION

A. Materials

1. Resin:

a. Resin shall be premium corrosion-resistant, fire retardant vinyl ester resin. Resin shall not contain pigments, dyes, colorants or fillers. Indoor duct should have a Class 1 flame spread rating of 25 or less.

b. Thixotropic agents may be added to control resin viscosity per resin manufacturer's recommendation.

c. Acceptable resins shall be:

- 1) Ashland Chemical Hetron FR992
- 2) AOC Vipel K022

Section 4
Scope of Work and Technical Specifications
SECTION 40 13 19-5 FIBERGLASS REINFORCED PLASTIC DUCTWORK

3) Interplastics CoRezyn 8442.

2. Reinforcement:

- a. Surfacing veil shall be C glass veil with a silane finish and a styrene soluble binder.
- b. Chopped strand mat shall be Type E glass minimum 1-1/2 ounces per square foot with silane finish and styrene soluble binder.
- c. Continuous roving for chopper gun spray up shall be Type E glass.
- d. Woven roving shall be Type E glass minimum 24 ounces per square yard with a five by four weave.
- e. Continuous roving for filament winding shall be Type E glass with a silane finish.

B. Construction:

- 1. All FRP ductwork shall be of filament wound construction for sizes >10" diameter and hand lay-up or filament wound construction for 10" and smaller. Cast ductwork with no reinforced internal corrosion barrier or press molded fittings will not be accepted.
- 2. Maximum allowable deflection for any size ductwork shall be 1/2 inch between supports and for any size of duct under worse case operating conditions.
- 3. FRP ductwork shall be designed using a safety factor of 10 to 1 for pressure and 5 to 1 for vacuum without exception.
- 4. Out-of-roundness of duct shall be limited to 1% of the diameter.
- 5. Length of all flanged duct sections shall not vary more than $\pm 1/2$ inch at 70 F.
- 6. All un-flanged duct shall be square on the ends in relation to the center axis within $\pm 1/8$ inch up to and including 24-inch diameter and within $\pm 3/16$ inch for all diameters greater than 24-inch.
- 7. Laminates:
 - a. All ductwork shall have a resin-rich inner surface, an interior corrosion barrier, an interior structural layer and an exterior corrosion layer and UV resistant coating.
 - b. Inner surface: Nominal 10 mils thick composed of a single ply of the C glass surfacing veil embedded in a resin-rich surface. Resin content shall be 90%.

Section 4
Scope of Work and Technical Specifications
SECTION 40 13 19-6 FIBERGLASS REINFORCED PLASTIC DUCTWORK

- c. Interior layer: Nominal 90 mils thick composed of at least two layers of chopped strand mat or equivalent chopped strand. Resin content shall be 75%.
- d. Structural layer: Type E glass to meet minimum wall thickness as specified. The total wall thickness includes the inner surface.
 - 1) Contact molded structural layer shall include alternate layers of chopped strand mat and woven roving.
 - 2) Filament wound structural layer shall be preceded by a layer of chopped strand mat or spray chop. The structural layer shall consist of a minimum of two complete cross hatched layers of continuous filaments applied in a helix angle of 55 to 65 degrees for above-ground ductwork and 75 deg. for any buried ductwork.
 - 3) Structural layer thickness shall be set to enable duct to span the support spacing identified in Part 3 of this specification under the ambient conditions identified above. In addition, duct shall withstand wind loading in accordance with the International Building Code.
- e. Exterior corrosion layer: Single A or C Veil shall be applied to all duct exterior
- f. Exterior UV resistant coating: Factory applied paraffinated gel coat with UV inhibitors. Color shall be determined by the Engineer.

C. Fittings:

- 1. All fittings shall be hand lay-up construction fabricated from the same resin and have the same strength as hand lay-up FRP ductwork.
- 2. The internal diameter of all fittings shall be equal to the adjacent duct.
- 3. The tolerance on angles of all fittings shall be ± 1 degree up to and including 24-inch diameter and $\pm 1/2$ degree for 30 inch diameter and above.
- 4. Elbows:
 - a. The centerline radius of all elbows shall be 1-1/2 times the diameter.
 - b. Elbows 24-inch diameter and smaller shall be smooth radius. Elbows 30-inch and larger shall be mitered. Provide a minimum of two mitered joints (3-piece) for all elbows above 45 degrees.

Section 4
Scope of Work and Technical Specifications

SECTION 40 13 19-7 FIBERGLASS REINFORCED PLASTIC DUCTWORK

5. Test Ports: Provide ports for testing, adjusting and balancing air flow in ductwork where indicated on the drawings. Ports shall be 1-inch diameter and shall be sealed with a removable, UV-resistant, EPDM plug.
6. Flanges:
 - a. Provide flanged connections to flexible connectors, expansion joints, vessels, demisters, fans, silencers and other locations as shown on the Drawings.
 - b. Flanges shall be hand lay-up construction. Dimensions shall be in accordance with ASTM D 3982, Table 1, and the Duct Dimension Schedule.
 - c. Flanges shall be drilled in accordance with ASTM D 3982, Table 1. Backs of flange face shall be flat so that washer seats fully on bolt face and flange backing.
 - d. Flange tolerances shall be in ASTM D 3982, Section 8, Tolerances.
 - e. Gaskets shall be EPDM, full face and minimum 1/8 inch thickness.
 - f. All bolts, nuts and washers shall be Type 316 stainless steel.
- D. Joints:
 1. Provide all butt and strap joints in accordance with ASTM D 3982, Table 2, and manufacturer's drawings.
 2. Field weld kits shall be supplied by the duct manufacturer. All necessary fiberglass and reinforcing material shall be supplied pre-cut and individually packaged for each joint. Bulk Glass rolls will not be acceptable.
 3. All resin, catalyst and putty shall be supplied in quantities to complete all field joints plus 20% extra for waste.

2.03 EXPANSION JOINTS

- A. Furnish duct expansion joints as shown on the Drawings and as required to avoid buckling or compression of duct or displacement of equipment.
- B. Expansion joints shall be flanged where connecting ductwork to equipment; otherwise, slip-type will be acceptable.
- C. Expansion joints shall be resistant to ultraviolet light with integral flanges and suitable for outdoor service with FRP duct where applicable. Expansion joints shall be as follows:

Section 4
Scope of Work and Technical Specifications
SECTION 40 13 19-8 FIBERGLASS REINFORCED PLASTIC DUCTWORK

1. Elastomer material: Fiberglass Reinforced EPDM, minimum 1/8" thickness, rated for 300 degrees F continuous temperature. Device shall be rated for a pressure/vacuum of +/- 40" w.c.
 2. Connection Type: Flanged U-Style.
 3. Connection Accessories:
 - a. Backing rings: Type 316 stainless steel
 - b. Minimum 1/2" diameter connection bolting by installing Contractor or Duct Supplier.
 4. Nominal Duct Diameter: As shown on the Drawings.
 5. Extension: 1/2-inch.
 6. Compression: 1-inch.
 7. Lateral offset: 1/2-inch.
 8. Bolt circle configuration: To match FRP duct flange.
- D. Expansion joints shall be:
1. Proco Model 540; or
 2. Hunter Expansion Joints Model H300E

2.04 BUTTERFLY DAMPERS

- A. Fiberglass Reinforced Plastic Dampers
1. FRP fabrication shall meet the corrosion requirements specified in this Section for FRP duct work.
 2. Leakage shall not exceed 3 cfm/sq. ft at 10" W.C. and 5.25 cfm/sq. ft at 30" W.C. for service as an isolation damper. Unless otherwise specified on the drawings, all dampers are assumed to serve in isolation service.
 3. Fabrication:
 - a. Frame and blade: premium vinyl ester. Blade shall fully encapsulate shaft. Blades that bolt to a single side of the shaft will not be accepted.
 - b. Shaft: Type 316 stainless steel for all dampers.
 - c. Bearings and bushings: Teflon.
 - d. Pins and all hardware: Type 316 stainless steel.
 - e. Shaft seals: EPDM.

Section 4
Scope of Work and Technical Specifications

SECTION 40 13 19-9 FIBERGLASS REINFORCED PLASTIC DUCTWORK

- f. Provide all round isolation dampers with a blade stop consisting of FRP angles with full circumference EPDM seals.
- g. All dampers shall have flanged ends. Contractor to provide connecting bolts, nuts and washers.
- h. Dampers shall be supplied with hand quadrant actuators fabricated of Type 316 stainless steel with locking quadrant. All balancing dampers shall have a fully adjustable slot with an extra hole drilled in the handle for contractor to "drill and pin-in place" once system is balanced so handle cannot vibrate loose.
- i. FRP dampers shall be manufactured by Swartwout, Division of Phillips Industries, Belco Manufacturing, or Ershigs.
- j. All Isolation dampers provided shall bear the AMCA seal. Dampers shall be tested in an AMCA laboratory for performance (pressure drop) and leakage.
- k. Dampers may be tested after installation to confirm compliance.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. General: All FRP ducts shall be installed in a neat and workmanlike manner, properly aligned, and cut from measurements taken at the site to avoid interferences with structural members, architectural features, openings and equipment. Exposed ducts shall afford maximum headroom and access to equipment, and where necessary, all ducting shall be installed with sufficient slopes for drainage of liquids and condensate to low points. All installations shall be acceptable to the Engineer. Contractor shall obtain training by the duct manufacturer's field representative in the correct installation and support of all FRP ductwork.
- B. Supports and Anchors: All ducting shall be firmly supported with fabricated or commercial hangers or supports. Where necessary to avoid stress on equipment or structural members, the ducts shall be anchored or harnessed. Expansion joints and guides shall compensate for duct expansion due to temperature differences.

3.02 DUCT PREPARATION

- A. Prior to installation, each duct length and all fittings shall be carefully inspected, flushed clean of any debris or dust, and straightened, if not true. All duct and fittings shall be equally cleaned before assembly.

3.03 DUCT JOINTS

- A. Butt and Wrap Joints: Prior to joining, ends shall be ground smooth. All dust and debris must be fully removed. Ends shall be resin-coated to prevent corrosion, in duct

Section 4
Scope of Work and Technical Specifications
SECTION 40 13 19-10 FIBERGLASS REINFORCED PLASTIC DUCTWORK

24" diameter and above an interior corrosion wrap is required. The joint should be of equal strength as the duct. A butt and wrap sequence and thickness chart should be shown on the fabrication drawings. The laminate sequence for each size duct should be supported by a separate section in the design calculations.

B. Supports and Anchors: All duct shall be firmly supported with fabricated or commercial hangers or supports in accordance with the requirements in the Section titled "Duct Supports". Where necessary to avoid stress on equipment or structural members, the ducts shall be anchored or harnessed. Expansion joints and guides shall compensate for duct expansion due to temperature differences.

3.04 INSPECTION

A. Inspection: All finished installations shall be carefully inspected for proper joints and sufficient supports, anchoring, interference, and damage to duct, fittings, and coating. Damage shall be repaired to the satisfaction of the Engineer.

B. Air Leakage

1. Conduct tests in presence of Engineer, at static pressures equal to maximum design pressure of system or section being tested. If pressure classifications are not indicated, test entire system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure. Give seven days advance notice for testing.

2. Determine leakage from entire system or section of system by relating leakage to surface area of test section.

3. Maximum Allowable Leakage: Comply with requirements for Leakage Classification 6 for pressure classifications from 2- to 12-inch wg.

4. Remake leaking joints and retest until leakage is less than maximum allowable.

5. Leakage Test: Perform tests according to SMACNA's "HVAC Air Duct Leakage Test Manual."

C. Damper Installation

1. Install dampers in accordance with manufacturer's recommendations.

2. All dampers and appurtenances shall be installed in the locations shown on the Drawings, true to alignment and properly supported. Any damage to the above items shall be repaired to the satisfaction of the Engineer before they are installed.

3. Install dampers between duct flanges with 316 stainless steel bolts, nuts and washers.

Section 4
Scope of Work and Technical Specifications

SECTION 40 13 19-11 FIBERGLASS REINFORCED PLASTIC DUCTWORK

4. Support duct at both sides of each damper in a manner that allows removal of dampers for maintenance without temporary duct support.

END OF SECTION

SECTION 40 41 13

INSULATION FOR OUTDOOR PIPING

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required and install to insulate and jacket all above-ground, heat traced piping and fittings.

1.02 RELATED WORK

- A. Excavation and backfill for pipe is included in Section 31 23 00.
- B. Painting is included in Division 9.
- C. Pipe hangers and supports are included in Section 22 05 29.
- D. Valves and appurtenances are included in Section 33 11 15.

1.03 DESCRIPTION OF SYSTEM

- B. All above ground piping and fittings are to be insulated and jacketed after heat tracing installed.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Jacketing: Provide aluminum jackets conforming ASTM B209M ASTM B209, Temper H14, minimum thickness of 0.41 mm 0.016 inch, with factory-applied polyethylene and kraft paper moisture barrier on the inside surface. Provide smooth surface jackets for jacket outside diameters less than 200 mm 8 inches. Provide corrugated surface jackets for jacket outside diameters 8 inches and larger. Provide stainless steel bands, minimum width of 0.5 inch. Provide factory prefabricated aluminum covers for insulation on fittings, valves, and flanges.
- B. Insulation: Provide 1" cellular glass insulation that conforms to ASTM C533, type II, Grade 2. Minimum insulation thickness to be 1" for all above ground piping.

END OF SECTION

SECTION 40 70 00

INSTRUMENTATION DEVICES

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Primary elements.
- B. Transmitters.
- C. Receivers.
- D. Analytical instruments.
- E. Devices.
- F. Cables.

1.02 SYSTEM DESCRIPTION

- A. System consists of all field and panel mounted instrumentation devices as noted, complete with all necessary signal converters, isolators, amplifiers, power supplies, cables and other appurtenances necessary for interfacing with other components.
- B. Except as noted, scale all indicators in engineering units.

1.03 SUBMITTALS

- A. Submit product data.

1.04 MAINTENANCE AND TEST EQUIPMENT

- A. In addition to the tools and test equipment, provide the following complete with carrying cases, patch cords, etc.
 - 1. One portable admittance tester with rechargeable batteries as manufactured by Drexelbrook or equal, to calibrate the admittance instruments provided.
 - 2. One pneumatic calibrator as manufactured by Wallace & Tiernan, Meriam Instrument, or equal.
 - 3. One (1) hand held smart transmitter calibrators shall be provided by the transmitter manufacturer to calibrate all smart field transmitters provided.
- B. Spare Parts
 - 1. Miscellaneous Spare Parts

- a. One year supply of items recommended by the Manufacturer of the equipment for each component.
2. The spares shall be packed in a manner suitable for long term storage and shall be adequately protected against corrosion, humidity and temperature.
3. Provide other spare parts as indicated on the individual device specifications.

PART 2 - PRODUCTS

2.01 INSTRUMENTS AND DEVICES

A. Level Transmitters – Radar (Secondary)

The wetwell level transmitter shall be a non-contact radar level transmitter, serving as the secondary measurement device for wetwell level monitoring. The primary measuring device shall be a submersible pressure transducer.

1. The Radar Level Indicating Transmitter shall be non-contact type.
2. Certifications:
 - a. ISO 9001 International Certified Factory or pre-approved equal
 - b. UL listed.
3. Operating Principle:
 - a. Frequency Modulated, Continuous Wave. Nominal frequency range- 77-81 GHZ
4. Manufacturer:
 - a. Emerson Rosemount Series 1000 or approved equal.
5. Technical requirements:
 - a. Measuring Range: 15 m (50 feet)
 - 1) Accuracy: 2 mm (0.08")
 - 2) Repeatability: 1 mm (0.04")
 - 3) Process pressure range: full vacuum to 8 Bar (116 psig)
 - 4) Process temperature range: -40 to 150 Deg C (-40 F to 302 Deg F)
 - b. Transmitter Housing:
 - 1) Factory-sealed housing to IP66/68 or NEMA 4X

Section 4
Scope of Work and Technical Specifications
SECTION 40 70 00-3 INSTRUMENTATION DEVICES

- 2) Integral M12 electrical connection
 - 3) Electromagnetic compatibility to EMC Directive (2014/30/EU): EN 61326-1
 - 4) NAMUR recommendations NE21 (only 4-20 mA output)
 - 5) Capable of working at 100% Humidity.
 - c. Antenna
 - 1) Integral to the device
 - d. Signal Processing Unit technology:
 - 1) Fast sweep Frequency Modulated Continuous Wave (FMCW) Radar.
 - e. Power: 18-30 VDC
 - f. Primary Output: 4-20mA, configurable for Level, Volume, Flow
 - 1) Other Outputs: IO-Link, Discrete (configurable PnP or NpN)
 - g. Ambient Operating Temperature Range: -40 to 176 degrees F
 - h. Transmitter Mount (typical): NPT connection, ANSI style flanges or Bracket Mount
 6. Telecommunication compliance
 - a. Outdoor installations are compliant with Telecom requirements when the antenna is fitted with an extension (supplied with the bracket mount)
 7. Follow manufacturer's instructions for the minimum mounting height between the level transmitter and the maximum expected liquid level.
 8. Mount transmitter to ensure a clear path to the material surface. Provide proper grounding to the transmitter housing.
 9. Manufacturer's Representative shall provide programming, start-up, and training services.
- B. Level Transmitter (Submersible Pressure Transducer)
1. Type: Pressure sensor
 2. Transmitter: Control box with Local LED display of level in Feet and built-in power supply to convert 110/1/60 to 24 VDC for pressure sensor loop power. Control box to have one or two displays as required.

Section 4
Scope of Work and Technical Specifications
SECTION 40 70 00-4 INSTRUMENTATION DEVICES

- a. Outputs: one or two 4-20 mA outputs
 - b. Accuracy: 0.3% of full range
 - c. Enclosure: NEMA 4X, polycarbonate housing
 - d. Power Supply: 120VAC, 1 PH, 60 HZ
 3. Sensor: 316SS sensor housing and pressure sensor diaphragm with 33' of viton cable. Polarity independent leads for 24 VDC powered loop from transmitter. Atmospheric compensation tube built into cable. Range as specified on instrument chart.
 4. Cleaning: Not required
 5. Transmitter (Control Box) Mounting: mounted to 1/8" aluminum mounting plate with drip lid and SS hinged opaque sun shield.
 6. Sensor Mountings:
 - a. PVC hanger with minimum of 4" of cable contact and SS cable for hanging to eye bolt on side of tank or as specified on instrument chart.
 - b. Slide Rail Mounting: Sensor supplied with two SS clips and 19" long SS Slide rail for wall mounting
 7. Start-Up: provide minimum of 2 hours/meter of service by factory-authorized representative for system start-up plus ½ day of training.
 8. Acceptable Manufacturer: Endress & Hauser Waterpilot FMX 21 model of approved equal.
- C. Level Switch (Float Type) – not for pump control. For pump station flood status only.
1. Type: Submersible coated 316 stainless steel, polypropylene, or polyethylene body; non-mercury switch contact rated 4 amps at 120 VAC; normally open, normally closed, or Form C (N.O. and N.C.) contact configuration as indicated. Mercury float switches are unacceptable.
 2. Cable: Minimum 18 gauge, 300 volt (minimum) rated; heavy-duty type SOW or equivalent. Provide sufficient length for mounting at the elevations indicated.
 3. Junction Box: Provide NEMA 4X stainless steel junction box, mounted near the switch, for terminating vendor supplied cable and discrete control wiring to control panel.
 4. Switch Mounting: The System Manufacturer shall provide 3/4 or 1 inch Schedule 40 PVC, 316 stainless steel pipe, or 1.25 inch cable for mounting the

floats for a particular tank or well. Provide weighted float switch or weighted cable as guide for mounting. The pipe shall extend from two feet above the highest switch setting (up to the top of the vessel) to two feet below the lowest level setting (down to the vessel bottom) for the vessel or well and allow for adjustment of the switch or switches anywhere along the length of the pipe. The method for fixing the float to the pipe shall be easily adjustable and shall provide for protection and strain relief for the float switch cable. Switch location shall be adjustable from ground level without entering wet well. Cable ties or hose clamps are not to be used to secure switch or wiring. Provide a minimum of two mounting brackets for fixing the pipe to the vessel wall while maintaining appropriate standoff distance. The System Manufacturer shall ensure mounting is in accordance with the manufacturer's recommendations.

5. Spare Parts: Provide 1 spare float switch.

6. Acceptable Manufacturers: Equal to Warrick Series M, Anchor Scientific.

D. Pressure and Vacuum Gauges

1. General: Pressure and vacuum gauges shall, unless otherwise specified, conform to the following. Gauges shall be of the stem-mounting type unless panel mounted type is shown on the Schedule. Refer to Section 33 11 15 – Valves, for additional requirements.

2. Construction: Gauges shall be of the bourdon tube or bellows type with 270 degrees clockwise pointer travel. Dials shall be white with black numerals. Dial size shall be 4 1/2-inch. Panel mounted gauges shall have round bezels for flush mounting and rear connection, others shall have a stem-mounting bottom connection. Connections for all gauges shall be male 1/2-inch NPT with square wrench flats. Wetted parts shall be corrosion resistant to the process fluid shown in the Table A and unless specified in the Table A shall be the manufacturer's best quality standard. All dials shall be glycerin filled, hermetically sealed. Cases shall be black phenolic. Accuracy shall be $\pm 0.5\%$ of span.

3. Chemical Seal: Where used for sewage or sludge service, the gauge shall be furnished with a diaphragm seal unless specified elsewhere. Diaphragm seals shall consist of bottom housing, lower ring, diaphragm capsule, fill screw, flushing connection, and a top housing. The diaphragm seal shall attach to the inlet connection of a pressure instrument to isolate its measuring element from the process fluid. The space between the diaphragm and the instruments pressure element shall be completely filled with a suitable fill liquid – defaulting to silicone oil. Displacement of the liquid fill in the pressure element through the movement of the diaphragm shall transmit process pressure changes directly to a gauge, transmitter, switch or any other pressure instrument. The diaphragm seal shall have a removable bottom housing to permit the servicing of the need to refill. All exposed surfaces, top and bottom housings, and diaphragm shall be

constructed of Type 316 stainless steel as a minimum and shall be compatible with the process fluid. The process connection shall be a 3/4-inch threaded connection with a flushing connection. Flushing connection to include stainless steel pipe nipple with a ball valve.

4. Manufacturers: The gauges shall be as manufactured by Ashcroft Duraguage, U.S. Gauge, or user approved equal. The diaphragm seals shall be as manufactured by Ashcroft 200 series, Mansfield and Green SG Series, or approved equal.

E. Gauge Pressure Transmitters

1. Standard specifications:

- a. NEMA 4X, corrosion resistant polyurethane-covered aluminum enclosure.
- b. Provide with integral venting, draining or calibration.
- c. Provide with diaphragm as specified in Paragraph F below. Diaphragms and/or seals shall be factory-installed and factory-calibrated by the supplier of the seal or pressure transmitter prior to delivery to project site.
- d. 24vdc loop powered
- e. Integral digital LCD display
- f. HART communication and transmitter output 4-20 mA
- g. Accuracy +/- 0.06% Span
- h. Stability +/- 0.15% Upper Range Limit.
- i. Local adjustments – zero, span and write protect
- j. Overrange and overload protection
- k. 316 SS diaphragm
- l. Glass-filled PTFE O-Ring
- m. Silicone fill fluid

2. Execution:

- a. Where in contact with clear water or air:
 - 1) Shall be connected to process piping with flexible stainless steel impulse piping such as to limit transmission of vibration to device as directed by civil engineer unless specifically shown otherwise.

2) Impulse piping shall be as short as possible and shall slope at least 1 in./foot upward from the transmitter toward the process connection.

b. Where in contact with other fluids:

1) Diaphragm seals shall be installed onto process piping or vessel as per

manufacturer's recommendations.

2) Flanged annular seal shall be installed in-line within process piping as per

manufacturer's recommendations.

3) Contractor shall coordinate installation (and insertion into or connection to process piping or vessel) with associated piping or vessel prior to ordering materials.

c. Acceptable manufacturers: ABB #266HSH or acceptable equal.

F. In-Line Pressure Seal

1. Where specified provide a pressure isolating ring that uses a elastomer membrane to isolate a pressure measurement from the process fluid in the pipeline. The membrane/diaphragm shall be provide direct contact with the process fluid but shall isolate the pressure measurement from the effects of solids, abrasives and slurries in the pipe line that would clog standard pressure sensing lines.

2. The pressure sensed by the membrane shall be transmitted to the associated pressure sensor, gauges, and/or transmitter via use of a suitable fill fluid – defaulting to silicone oil. Any air between the membrane and the associated pressure devices shall be fully evacuated during the filling process.

3. Inside diameter of the measuring membrane shall match the inside diameter of the associated pipeline.

4. Manufacturers: The in-line pressure seal shall be manufactured by Onxy Valve, Red Valve, or approved equal.

G. Combustible Gas Detector

1. General Requirements

a. The combustible gas detector shall be suitable for continuous monitoring of combustible gas levels in a sewage pump station wetwell environment.

- b. The sensor shall be rated for installation in a Class I, Division 1 hazardous area per NEC (National Electrical Code).
- c. The detector shall include a remote indicating transmitter housed in a NEMA 4X stainless steel enclosure for durability and protection against environmental conditions.
- d. The transmitter shall provide a 4-20mA output signal proportional to the combustible gas concentration.
- e. The system shall include a dry contact Fault status output for connection to a remote Programmable Logic Controller (PLC).

2. Performance Requirements

- a. The sensor shall be capable of detecting methane (CH₄) and other combustible gases commonly found in sewage pump station wetwells.
- b. The detection range shall be 0-100% Lower Explosive Limit (LEL).
- c. The response time shall be $T_{90} \leq 30$ seconds.
- d. The sensor shall be temperature compensated for accuracy in varying environmental conditions.
- e. The system shall have built-in fault diagnostics for sensor malfunction, signal integrity, and power failure.

3. Sensor and Transmitter Design

- a. The sensor element shall be electrochemical, catalytic bead, or infrared type, suitable for operation in high-humidity and corrosive environments.
- b. The sensor shall be explosion-proof with appropriate Class I, Div. 1 enclosure certification.
- c. The remote transmitter shall be constructed of 316 stainless steel and rated NEMA 4X for corrosion resistance and environmental protection.
- d. The transmitter shall be equipped with an LCD display for local readout of gas concentration levels.

4. Electrical & Communication Requirements

- a. The transmitter shall provide a 4-20mA output signal proportional to the detected gas level.

Section 4
Scope of Work and Technical Specifications
SECTION 40 70 00-9 INSTRUMENTATION DEVICES

- b. The Fault status shall be indicated via a dry contact relay output (NO/NC) for remote monitoring.
 - c. The power supply shall operate on 120VAC, 1PH nominal voltage.
- 5. Installation and Mounting
 - a. The sensor shall be designed for wall or conduit mounting within the wetwell.
 - b. The remote transmitter shall be panel or wall-mounted in a dry, accessible location.
 - c. All mounting hardware shall be stainless steel or corrosion-resistant materials.
- 6. Environmental Conditions
 - a. Operating Temperature Range: -40°F to 158°F (-40°C to 70°C).
 - b. Relative Humidity: 0-95% RH, non-condensing.
 - c. The system shall be resistant to hydrogen sulfide (H₂S) and moisture exposure common in wetwell environments.
- 7. Compliance and Certifications
 - a. The sensor shall be certified for Class I, Division 1, Groups B, C, and D hazardous locations.
 - b. The transmitter enclosure shall be NEMA 4X/IP66 rated.
 - c. The system shall comply with UL, CSA, and ATEX/IECEX standards where applicable.
- 8. Warranty & Support
 - a. The manufacturer shall provide a minimum 2-year warranty on the sensor and transmitter.
 - b. Technical support shall be available for installation, calibration, and troubleshooting.
- 9. Acceptable Manufacturers
 - a. MSA Model S5000
 - b. Teledyne Detcon FP-524D
 - c. Emerson Millenium SIR100
 - d. Drager

- e. Approved equal meeting the technical specification.

2.02 CABLES

- A. Industrial Twisted Pair (ITP) 100 Mb Fast Ethernet Cables
 - 1. ITP cable shall have two cores stranded with two dummy elements to form a pair.
 - 2. Each pair shall be sheathed in plastic film and shielded with two plastic-clad aluminum foils.
 - 3. The outer shield braid shall be made of tinned copper wires around all pairs.
 - 4. The plastic sheath shall be PVC.
 - 5. The ITP cable shall be a standard 9 pin cable with RJ45 type connectors.
 - 6. ITP Cables shall be Siemens Industrial Twisted Pair standard cable or equal by AT&T or Belden.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Instrument Tagging
 - 1. Provide stainless steel identification tags attached with stainless steel wire or screws for all field instruments.

3.02 FIELD QUALITY CONTROL

- A. Tests And Calibration
 - 1. Perform continuity and insulation resistance tests on instrumentation conductors.
 - 2. Calibrate each instrument to its published accuracy. Submit calibration sheets including the instrument tag number or name, the date, name of individual performing calibration, procedures and equipment used, and results obtained.

END OF SECTION

SECTION 40 71 13

ELECTROMAGNETIC FLOWMETERS

PART 1 - GENERAL

1.01 SYSTEM DESCRIPTION

- A. System consists of all field and panel mounted instrumentation devices as noted, complete with all necessary signal converters, isolators, amplifiers, power supplies, and other appurtenances necessary for interfacing with other components.
- B. Flow meter must record and totalize in English units.
- C. The Flow meter shall operate on a electromagnetic induction principle and give an output signal directly proportional to the velocity of the process medium

1.02 SUBMITTALS

- A. Submit product data with panel layout and schematic diagrams.

PART 2 – PRODUCTS

2.01 ELECTROMAGNETIC FLOWMETER

- A. Electromagnetic flow meter suitable for fixed-site measurement of bi- directional flow in a full pipe. The flow meter shall consist of a flow tube and a flow transmitter, which shall indicate, totalize, and transmit flow. The flow tube shall use a spool piece configuration with field-interchangeable sensors containing coils and electrodes.
- B. Acceptable Manufacturers: Krohne - Model OptiFlux 2300 IFC 100C, Endress & Hauser, ABB Automation, or Engineer approved alternate.

2.02 PRIMARY FLOW HEAD

- A. Each meter shall have a stainless-steel metering tube and a non-conductive liner suitable for the liquid being metered. End connections shall be steel flanged for sizes 1/2" and greater, ANSI Class 150, for meter sizes up to 24" and AWWA Class B or D for meters larger than 24". The housing shall be epoxy coated steel, welded at all joints. Bolted coil enclosures shall not be acceptable.
- B. The field coils of the meter shall be supplied with a precisely adjusted bi-polar direct current.
- C. There shall be no electronic components on the primary flow head. Coil drive power shall be supplied by an integral or remote signal converter. Output signal from the primary shall be fed through 'DS' proprietary cable supplied with the meter to the signal converter.
- D. The Primary Flowhead shall have a housing rated for:

Section 4
Scope of Work and Technical Specifications
SECTION 40 71 13-2 ELECTROMAGNETIC FLOWMETERS

1. Water protection NEMA 4 X (IP66).
- E. Electrode material shall be compatible with the process fluid. Hastelloy as a minimum
- F. Liner material will be hard rubber.
- G. Meter will have field replaceable electrodes with access ports. High impedance circuits, ultrasonic cleaning, or heated electrodes shall not be acceptable in lieu of “hot tap” removable electrodes.
- H. The instrument shall be manufactured in an ISO 9001 approved facility.
- I. When installed in lined or non-metallic piping, the meter shall be provided with corrosion resistant grounding rings. Grounding electrodes shall not be acceptable.
- J. Meter calibration shall be performed by a direct volumetric comparison method. A calibration certificate shall accompany each meter. Calibration facility shall be certified to 0.03% accuracy and be traceable to national standards.
- K The magnetic inductive flow converter shall be remote mounted and provide precisely controlled and regulated, bi-polar DC primary field excitation pulses at a keyed frequency of either; 2, 1 1/3, 2/3, 1/2, 1/4, 1/6, 1/8, 1/12, 1/18, 1/36 or 1/50 of line frequency digitally selectable.
- L The flow converter shall convert the primary flow meter signal into a standard linear analog or pulse/frequency output directly proportional to the flow rate or flow total. The converter shall have the option of FM Class 1 Division 2 approval. The converter shall be capable of up to (4) inputs or outputs with selectable combinations of:
1. Standard 4-20 mA DC or optionally to Namur 43 compliant, 3.8 – 20.5 mA output with selectable 3.5 mA or 22 mA levels on fault, with HART superimposed digital signal.
 2. Totalized pulses, with each pulse representing a fixed volume or mass.
 3. Frequency output of 0 – 10 kHz
 4. Control Input
 5. Alarm/Status Output
 6. The full scale measuring range shall be a configurable input in all standard engineering units as well as any user defined unit, and freely adjustable over a range from 1.0 to 40 ft/sec velocity.
 7. Converter shall be capable of monitoring all common modes of failure of magnetic inductive flow meters, verifying the flow meter software and hardware components, accuracy and linearity, and process conditions that may adversely affect flow measurement uncertainty. The converter shall provide local display of

detected errors, as well as the ability to assign any or all errors to outputs. All diagnostics shall be available on the standard HART communication protocol, PACTware or other bus protocol as specified.

8. The converter shall be microprocessor based and be completely interchangeable with other converters of the same type. No auxiliary test meter or primary simulator shall be required for commissioning, zeroing, or interchanging of the flow converter. The converter shall have two independent counters, which are assignable as Positive, Negative or Sum totals. Counters shall be password protected to prevent unauthorized resetting. The counters shall maintain their accumulated values with power loss, and continue counting when power resumes. The converter shall be provided with local graphical display (back-lit white), 128 x 64 pixels with three separate display pages.

9. Programming of the flow converter shall be accomplished without removing the cover via 4 push button keys or remotely with hand held HART terminal or with vendor and protocol independent PC configuration software; PACTware (Process Automation Configuration Tool) over HART or other bus protocols. Manufacturer shall provide necessary drivers (DTM's) at no additional charge.

10. Analog outputs shall have user configurable time constant of 0 to 100 seconds. User adjustable low flow cutoff to force readings to zero on decreasing flow and de-activate on increasing flow, settable from 0% to 20% of full scale setting, with the decreasing flow setting < increasing flow setting (providing hysteresis).

11. The basic outputs can be altered in the field by programming. All outputs shall be galvanically isolated from each other and all other circuits.

12. The analog outputs can be assigned to represent any of the following measurements; Flow Velocity, Volume Flow Rate, Mass Flow Rate, Coil Temperature (indicative of process temperature), or Process Conductivity.

13. The converter shall have HART protocol as standard. Optionally the converter shall have Profibus PA protocols as required

14. The converter shall provide the ability to simulate flow rates, to verify analog output spans are correct in receiving devices. The converter shall provide the capability to test all outputs for proper operation to assist in commissioning.

15. The converter shall have ten year data retention storage, without the need for auxiliary power.

16. The signal converter shall be manufactured in an ISO 9001 Facility and shall be a KROHNE model IFC100 C or W or other engineer approved equal.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Instrument Tagging

1. Provide stainless steel identification tags attached with stainless steel wire or screws for all field instruments.

3.02 FIELD QUALITY CONTROL

A. Tests and Calibration

1. Perform continuity and insulation resistance tests on instrumentation conductors.
2. Calibrate each instrument to its published accuracy. Submit calibration sheets including the instrument tag number or name, the date, name of individual performing calibration, procedures and equipment used, and results obtained.

END OF SECTION

SECTION 40 90 00

INSTRUMENTATION AND CONTROL FOR PROCESS SYSTEMS

PART 1 - GENERAL

1.01 SCOPE

A. Requirements specified in Division 01 of these Specifications form a part of Division 26. This Section covers the general requirements for furnishing and installation of the instrumentation, control and monitoring (ICM) system complete in every detail for the purposes specified and shall form a part of the other Sections of Division 26 unless otherwise specified. The other Sections of this Division shall supplement this Section as necessary.

1. Work Included

- a. The intent of Division 40 is to require that the complete Instrumentation, Control and Monitoring System, including other Sections of Division 40 shall be furnished by a single Control Systems Integrator (CSI) to assure system uniformity, subsystem compatibility and coordination of system interfaces.
- b. The new SCADA system shall deliver a complete and functional system as described herein, as per the Contract Documents, and as shown on the Contract Drawings. The SCADA system shall be capable of monitoring and performing controls (as indicated on the drawings) of the Campbellton Road Pump Station and Force Main Project. And shall be capable of communication with the existing Piedmont Water master SCADA workstation to depict the new facility I/O points and new HMI graphics. All equipment, materials, incidentals, software, supervision, and labor shall be provided under this Contract.
- c. Furnish the tools, equipment, materials, and supplies and perform the labor required to complete the furnishing and installation of, including instrumentation signal and power conduit and wiring not specifically shown on the electrical drawings, validation, start up and operational testing of a complete and operable ICM system as indicated on the Contract Drawings and as specified herein.
- d. Provide the equipment components, interconnections and the services of the manufacturers' engineering representatives for the engineering, implementation, startup, operation, and instruction, to ensure that the Owner receives an integrated and operational ICM system as herein specified.

Section 4

Scope of Work and Technical Specifications

SECTION 40 90 00-2 INSTRUMENTATION AND CONTROL FOR PROCESS SYSTEMS

e. Coordinate with the requirements of Division 26 – Electrical and provide for operator restart of all equipment on restoration of loss-of-power condition. Sequence automatically equipment restart and provide for time delays as necessary to prevent breaker trips on inrush from multiple equipment concurrent starting.

2. As a minimum, the CSI shall perform the following work:

a. Implementation of the ICM system:

- 1) Prepare shop drawing submittals.
- 2) Design, develop, and electronically draft loop drawings and control panel designs.
- 3) Prepare the test plan, the training plan, and the spare parts submittals.
- 4) Procure hardware.
- 5) Fabricate panels.
- 6) Program the ICM system as shown on the Contract Drawings.
- 7) Perform factory tests on panels.
- 8) Perform bench calibration and verify calibration after installation.
- 9) Oversee and certify installation.
- 10) Oversee, document, and certify loop testing.
- 11) Oversee, document, and certify system commissioning.
- 12) Conduct the performance test.
- 13) Prepare operations and maintenance manuals.
- 14) Conduct training classes.
- 15) Prepare record drawings.
- 16) Prepare calibration sheets.
- 17) Certify the installation of the ICM system.

b. Integration of the ICM system with instrumentation and control devices being provided under other Sections:

Section 4
Scope of Work and Technical Specifications

SECTION 40 90 00-3 INSTRUMENTATION AND CONTROL FOR PROCESS SYSTEMS

- 1) Develop all requisite loop drawings and record loop drawings associated with equipment provided under other Divisions and Owner equipment.
- 2) Resolve signal, power, or functional incompatibilities between the ICM system and interfacing devices.

3. Work Not Included

- a. Process piping, installation of in line instrumentation, i.e., final control elements in process pipelines, air compressors, main air supply headers, and mechanical work as specified in other Divisions.
- b. Electrical power distribution specifically included under Division 26, circuit protection devices, power conduit and wiring indicated, local equipment control stations, and miscellaneous electrical requirements as specified in Division 26.

B. System Responsibility

1. The ICM system as specified in Division 40 is an integrated system and therefore shall be provided by a competent, qualified CSI who shall have total responsibility for the Work of Division 40. Entire system installation including calibration, validation, start up, operational testing, and training shall be performed by qualified personnel, possessing all the necessary equipment and who have had experience performing similar installations. The System shall be integrated using the CSI's latest, most modern proven design and shall, as far as practical, be by one manufacturer.
2. The Contractor shall perform the Work under this Division 40, through the use of a qualified CSI who shall perform said Work, but it shall be understood that this shall not relieve the Contractor from any responsibility under the Contract.
3. The Contractor shall be responsible for the correct installation of all hardware and systems specified in Division 40.
4. The Contractor shall be responsible to see that all instrumentation components of other Divisions, including primary measuring, indicating, transmitting, receiving, recording, totalizing, controlling, alarming devices and appurtenances are compatible and shall function as outlined, and he shall furnish and install such additional equipment, accessories and appurtenances as are necessary to meet these objectives at no additional cost to the Owner.
5. The Contractor shall use the instrument tag and equipment numbering scheme as shown in Contract Documents, for identifying components which are part of this system.

Section 4
Scope of Work and Technical Specifications

SECTION 40 90 00-4 INSTRUMENTATION AND CONTROL FOR PROCESS SYSTEMS

6. Due to the complexities associated with the interfacing of numerous control system devices, the CSI or vendor shall be responsible to the Contractor for the integration of the ICM system with existing devices and devices provided under other Divisions and provide a completely-integrated control system free of signal incompatibilities; this includes providing review and comment to other vendor equipment submittals and overall coordination of the system.

C. Certification of Intent:

1. Fifteen days after notice to proceed, the Contractor shall submit a certification from the selected CSI. The certification shall be typed on letterhead paper of the CSI. The certification shall be signed by an authorized representative of the CSI. The certification shall include the following statements:

- a. (Company name) "hereby certifies intent to assume and execute full responsibility to the Contractor to perform all tasks defined under Paragraph 1.01 Scope, in full compliance with the requirements of the Contract Documents."
- b. "It is certified that the quotation to the Contractor includes full and complete compliance with the requirements of the Contract Documents without exception."

D. Documentation of Instrumentation Subcontractor Qualifications:

1. General

- a. The entire control system installation including panel building, calibration, validation, start-up, operational testing, and training shall be performed by a control systems integrator (CSI) staffed with qualified personnel, possessing necessary equipment and experience in performing similar installations.
- b. The system shall be integrated using the latest, most modern proven design and shall, as far as practical, be of one manufacturer.
- c. The equipment, level of detail, and overall quality of the control system shall be consistent with a typical industrial type of control system.
- d. Overall system performance shall be guaranteed.
- e. Software packages shall be the latest versions available.

2. System Integrator qualifications:

- a. The following system integrator is pre-qualified to perform the control system work described in Division 40:

Section 4
Scope of Work and Technical Specifications
SECTION 40 90 00-5 INSTRUMENTATION AND CONTROL FOR PROCESS SYSTEMS

1) Global Control System

3. Training and Certification:

- a. Completion of the following training courses (or appropriate portions thereof) or possession of the following certifications may be substituted for portions of the System Integrator's personnel experience requirements described above.
- b. Project manager: Control System Engineer (CSE) registration, Professional Engineer (PE) registration, or completion of the relevant core courses in the Engineering Skills Training program.
- c. Systems engineer: Control System Engineer (CSE) registration, Professional Engineer (PE) registration, or completion of the relevant core courses in the Engineering Skills Training program.
- d. Programmer: Control System Engineer (CSE) registration, Professional Engineer (PE) registration, or completion of the relevant core courses in the Technical Skills Training program.
- e. Field instrument technician: Certified Control Systems Technician (CCST) registration or completion of the relevant core courses in the Technical Skills Training program.
- f. Training program curriculums as offered by ISA.
- g. Training or certification does not satisfy the related project experience requirements described above.
- h. Submit training and registration evidence with the above experience evidence.

E. Contract Drawings

1. Information on the Drawings

- a. The following information relative to the Work of Division 40 is indicated on the Division 26 Contract Drawings.
 - 1) Location of primary elements, control panels, and final control elements.
 - 2) Instrumentation signal and power conduit runs between control panels and field instruments and devices.
 - 3) Quantity and sizes of instrumentation conductors and cables are indicated on the drawings but shall be verified by the Contractor.

Section 4
Scope of Work and Technical Specifications
SECTION 40 90 00-6 INSTRUMENTATION AND CONTROL FOR PROCESS SYSTEMS

4) Location of all equipment having alarm and equipment status contacts.

5) Major instrument conduit runs.

2. Information Not on the Drawings

a. The following information relative to the Work of Division 40 may not be shown on the Drawings but shall be the responsibility of the Contractor to determine, furnish, coordinate with other Trades, and submit for acceptance, based upon the systems specified.

1) Tubing for pneumatic signals, and/or power between main headers and control panels, field mounted primary elements, field instruments and final control elements.

2) Number or sizes of tubing required for pneumatic and hydraulic signals.

3) Point of connection to any hydraulic or pneumatic supply lines.

1.02 REFERENCES

A. Publications listed below form a part of this Section to the extent referenced. The publications are referred to in the text by basic designations only.

1. Instrument Society of American (ISA).

a. ISA S5.4 – Instrument Loop Diagrams.

2. National Electrical Manufacturers Associations (NEMA).

a. NEMA – Electrical Code.

3. American Standard Code for Information Interchange (ASCII).

4. Institute of Electrical and Electronic Engineers (IEEE).

a. IEEE C62.41 – Recommended Practice on Characterization of Surges in Low-Voltage (1000V and Less) AC Power Circuits.

1.03 SUBMITTALS

A. Refer to the General Conditions of the Contract Documents for required method of preparation and transmittal and conform to requirements herein.

1. Pre-submittal Conference

a. Arrange a conference with CSI, the Engineer, and the Owner within thirty (30) days after award of the Contract for the purpose of informally discussing in detail and verifying the correctness of the CSI's

Section 4

Scope of Work and Technical Specifications

SECTION 40 90 00-7 INSTRUMENTATION AND CONTROL FOR PROCESS SYSTEMS

system engineering methods and equipment and to generally provide a framework for communication and coordination. This conference shall be attended by CSI, and duly authorized representatives of the Contractor, Engineer, and Owner.

b. Submit 4 copies of the following items for discussion at the Pre-submittal Conference:

- 1) A list of equipment and materials required for the ICM system and the manufacturer's name and model number for each proposed item. Identify items by tag number, description, function, manufacturer, model number, descriptive literature and statement as to whether item is "as specified" or "equivalent." Items identified as "equivalent" shall be accompanied by a comparative listing of the published specifications for the item specified and for the item proposed. Equivalent items shall only be accepted by the Engineer if the specified item is no longer manufactured.
- 2) A list of proposed clarifications to the Contract Documents along with a brief explanation of each. Resolution shall be subject to a separate formal submittal and review by the Engineer.
- 3) A sample of each type of submittal specified herein.
- 4) A flow chart showing the steps to be taken in preparing and coordinating each submittal.
- 5) A bar-chart type schedule for all system related activities from the Pre-submittal Conference through start-up and training. Dates of submittals, design fabrication, programming, factory testing, deliveries, installation, field testing, and training shall be shown. The schedule shall be subdivided to show activities relative to each major item or group of items when everything in a given group is on the same schedule.
- 6) An overview of the proposed training plan. The Engineer will review the overview and may request changes. All changes to the proposed training shall be resolved at the Pre-submittal Conference. The overview shall include the following for each proposed course:
 - a) Course title and objectives.
 - b) Prerequisite training and experience of attendees.
 - c) Course content – a topical outline.
 - d) Course duration.

Section 4
Scope of Work and Technical Specifications

SECTION 40 90 00-8 INSTRUMENTATION AND CONTROL FOR PROCESS SYSTEMS

- e) Course format – lecture, laboratory demonstration, etc.
- 7) A preliminary copy of the ICSI Qualification submittal.
- c. Take minutes of the Pre-submittal Conference, including all events, questions, and resolutions. Before adjournment, all parties must concur with the accuracy of the minutes and sign accordingly.
- B. Before proceeding with any manufacturing, submit Shop Drawings for acceptance in complete bound sets indexed by specification number. Describe the items being submitted. Manufacturer's specification or data sheets shall be clearly marked to delineate the options or styles to be furnished. Submit only complete systems, not pieces of equipment from various systems. Show dimensions, physical configurations, methods of connecting instruments together, mounting details, and wiring schematics. Schematics shall be complete with tag and terminal numbers. Submit fabrication drawings, nameplate legends, and control panel internal wiring and piping schematic drawings clearly showing equipment and tag numbers on panels. Submit panel graphic drawings where applicable. Include material specifications lists where applicable. Include a draft of the theory of operation for relay logic circuits including those implemented via programmable controllers. Submit detailed field instrument installation drawings for each instrument.
- C. Design Related Submittals
 - 1. In accordance with the requirements of Section 01 - Submittals, provide the following submittals:
 - a. Catalog Cuts
 - 1) Catalog information, descriptive literature, wiring diagrams, and shop drawings shall be provided for all devices, whether electrical or mechanical, furnished under Division 40. This includes, but is not limited to, primary elements, transmitters, analytical equipment, gauges, valves, controllers, indicators, power supplies, switches, lights, relays, timers, etc.
 - 2. Component Data Sheets
 - a. Data sheets, specification sheets, and an instrument list shall be provided for components provided under this Section. The purpose of this material is to supplement the generalized catalog information by providing the specifics of each component (e.g., part numbers, scales, ranges, service, materials of construction, component location, options, and the individual tag number as noted in the Contract Drawings and in Contract Documents.

Section 4

Scope of Work and Technical Specifications

SECTION 40 90 00-9 INSTRUMENTATION AND CONTROL FOR PROCESS SYSTEMS

b. Include such other necessary data as would provide a complete and adequate specification for reordering an exact duplicate of the original item from the manufacturer at some future date. More than one tag numbered item may be included on a sheet.

3. Sizing Calculations

a. Complete sizing calculations shall be provided for all flow elements. The calculations shall include the process data used, minimum and maximum values, permanent head loss and all assumptions made. Equations shall be submitted for all computing modules and function generating modules and shall include the actual scaling factors and units used.

4. Panel Construction Drawings

a. Shop Drawings and Catalog Cuts

1) Provide detailed shop drawings and catalog cuts for panels, instrument racks, and enclosures. Drawings shall show the location of front panel and internal sub-panel mounted devices to scale and shall include a panel legend and bill of materials. Layout drawings shall show major dimensions as well as elevations, in inches from the base up, of the rows of components.

2) Shop drawings shall indicate the location and size of available spare mounting space for rear-of-panel devices.

3) The panel legend shall list and identify the front of panel devices by their assigned tag numbers, nameplate inscriptions, service legends, and annunciator inscriptions.

4) The bill of materials shall include devices mounted within the panel that are not listed in the panel legend, and shall include the device tag number, description, manufacturer, and complete model number.

b. Color Schedule

1) Provide a color schedule with color samples for control panels for the Owner's selection/approval.

5. Power Requirement and Heat Dissipation

a. Provide a summary of the power requirements and heat dissipation for control panels. Power requirements shall state required voltages, currents, and phase(s). Heat dissipations shall be maximums

Section 4

Scope of Work and Technical Specifications

SECTION 40 90 00-10 INSTRUMENTATION AND CONTROL FOR PROCESS SYSTEMS

and shall be given in BTU/Hr. Summary shall be supplemented with calculations.

6. Panel Wiring Diagrams

- a. Wiring diagrams shall be like those diagrams shown in the Contract Drawings, but with the addition of all auxiliary devices such as additional relays, alarms, fuses, lights, hand switches and interlocks.
- b. Provide complete terminal identification of external primary elements, panels, and junction boxes that interface directly to the panel wiring being shown. Polarity of analog signals shall be shown at each terminal.
- c. External wiring that the electrical contractor must provide shall be shown as a dotted line. Special cables that are provided with the instrument shall be clearly identified.
- d. Panel wiring diagrams shall identify wire numbers and types, terminal numbers, and tag numbers. Wiring diagrams shall show each circuit individually. Common or typical diagrams shall not be allowed.
- e. Provide panel power wiring diagrams for panels. The diagrams shall include grounding requirements.

7. Interconnecting Wiring Diagrams

- a. Diagrams shall show component and terminal board identification numbers, external wire and cable numbers. The drawings shall show intermediate terminations between field elements and panels (e.g., terminal junction boxes) This diagram shall be coordinated with the Contractor and shall bear his mark showing that this has been done.

8. Loop Diagrams

- a. Provide an individual wiring diagram for each analog loop showing terminal numbers, the location of the DC power supply, the location of any dropping resistors, the location and connection of the surge protection devices. The loop diagrams shall meet the minimum requirements of ISA S5.4 plus the following requirements:
- b. Each loop diagram shall be divided into three areas for identification of device locations: panel face, back of panel, and field respectively. Each loop diagram shall list (1) Transmitter Drive Capability, (2) Loop Impedance, (3) Transmitter Reserve Drive Capability. Loop diagrams shall be on 11-inch by 17-inch Drawings.

9. Instrument Installation Details

Section 4

Scope of Work and Technical Specifications

SECTION 40 90 00-11 INSTRUMENTATION AND CONTROL FOR PROCESS SYSTEMS

a. The CSI shall review the Contract Documents and develop and submit for review, complete installation details for each field mounted device and panel prior to shipment and installation. Common details, not requiring any modification, may be referenced by an index showing the complete instrument tag number, service, location, and device description. Installation details shall be provided as required to adequately define the installation of the ICM system components.

10. Operator Interface Submittal

a. This submittal shall cover the specific plant control schemes as well as the details of the plant reports and process graphic displays.

b. The submittal shall contain the semi-final details of all logs, reports, and process graphic displays. The specifics of what shall appear on each display and what calculations are required to support them shall be developed and submitted.

c. Submitted process graphic displays shall be no smaller than 8.5-inches by 11-inches and in full color.

d. A complete listing of all signals to be collected for long-term historical information shall be provided. This listing shall also include the frequency of data sampling and the duration for which the data shall be immediately accessible.

e. A complete listing of all signals to be collected for trend display shall be provided. This listing shall also include the frequency of data sampling and duration for which the data shall be immediately accessible.

11. Process Control Strategy Submittal:

a. The process control schemes shall be developed in a ladder logic diagram or functional block (logic) diagram presentation based on information from the Contract Documents. Included with each diagram shall be:

- 1) Brief Scope of the Control Function.
- 2) Listing of all scanned inputs to the control function.
- 3) A short narrative of the control strategy.
- 4) Any assumptions made in developing the program.
- 5) Listing of all inputs and outputs (i.e., AI, DI, AO, DO) from the control function.

Section 4
Scope of Work and Technical Specifications
SECTION 40 90 00-12 INSTRUMENTATION AND CONTROL FOR PROCESS SYSTEMS

- 6) Cross reference list of all I/O showing to which I/O modules or software modules they are linked.
- 7) Listing of all operator inputs/outputs to and from the control function. A description of the operation of any panels shall be described as it relates to the control function.
- 8) Failure contingencies shall be described in detail.
- 9) A flowchart representing the control strategy.

b. This submittal shall cover all of the associated logic developed under the CSI required to implement the control functions specified.

c. The System Integrator shall submit annotated logic on 8-1/2-inch x 11-inch format and as an ASCII file on a USB drive for all logic developed. Annotation shall be 3 lines of 6 characters each for every logic contact. In addition, each network or rung shall be annotated so that a non-technical person can read and easily comprehend what control function the rung or network is performing.

d. This submittal shall also include copies of the PLC I/O configuration tables, I/O reference usage table, complete cross reference to specific rung used of all inputs, outputs, internal coils, data registers, and special purpose coils. In addition, any special switch settings or hardware configuration requirements such as com port configurations shall be described in detail and submitted.

12. Process Control Strategy Submittal

a. Proposed Sewage Pump Station Control Strategy

i. Auto Mode:

- a) When all safety interlocks are met and the wet well liquid level reaches the High Level setpoint (measured by the primary level sensor, a submersible pressure transducer), the Lead pump starts at 40% speed.
- b) The Lead pump will automatically ramp up to 100% speed or continue operating until the wet well level drops below the Low Level setpoint.
- c) If the wet well level continues to rise while the Lead pump is running at 100% speed, the Lag pump will start at 40% speed when the High-High Level setpoint is reached.

Section 4
Scope of Work and Technical Specifications

SECTION 40 90 00-13 INSTRUMENTATION AND CONTROL FOR PROCESS SYSTEMS

d) Both pumps will continue running until the wet well level drops below the Low Level setpoint, at which point they will stop.

e) If the primary level sensor (submersible pressure transducer) signal is lost, the secondary level sensor (ultrasonic level transducer) will be activated to provide level setpoints for pump operation.

ii. Hand Mode:

a) When a pump is manually selected in Hand mode, it will run if:

- i) All hardwired safety interlocks are met
- ii) The wet well level is above the Low Level setpoint.

b) Pump speed control in Hand mode will depend on operator input or predefined settings.

D. Test Related Submittals - Provide five (5) copies of the following:

1. Operational Field Acceptance Test (OAT) Documentation.

a. The CSI shall submit an example of each type of Instrument Calibration Sheet and Loop Status Report that will be used for the OAT.

b. After acceptance of the examples, the CSI shall prepare Loop Status Report Sheet(s) for each loop and an Instrument Calibration Sheet for each active ICM system element (except simple hand switches, lights, etc.) These sheets shall be submitted after the tests are completed.

c. Instrument Calibration Sheets.

1) Provide a written report to the Engineer on each instrument certifying that it has been calibrated to its published specified accuracy. This report shall include all applicable data as listed below plus any defects noted, correction action required, and correction made. Data shall be recorded on prepared forms and shall include not less than the following items:

- a) Facility identification (Name, location, etc.)
- b) Loop identification (Name or function)
- c) Equipment tag and serial numbers.
- d) Scale Ranges and units.

Section 4
Scope of Work and Technical Specifications

SECTION 40 90 00-14 INSTRUMENTATION AND CONTROL FOR PROCESS SYSTEMS

- e) Test mode or type of test.
- f) Input values or settings.
- g) Expected outputs and tolerances
- h) Actual readings at 10%, 50%, and 90% of span.
- i) Explanations or special notes as applicable.
- j) Date, time, and weather.
- k) Tester's certification with name and signature.

2. Functional Acceptance Test Documentation.

a. The CSI shall prepare two types of test procedures and forms as follows.

- 1) Loop Test Documentation
- 2) For functions that can be demonstrated on a loop-by-loop basis, the form shall include:
 - a) Project Name.
 - b) Loop number.
 - c) Loop description.
 - d) Test procedure description, with a space after each specific test to facilitate sign off on completion of each test.
 - e) For each component: tag number, description, manufacturer, and data sheet number.
 - f) Space for sign off and date by the CSI, the Contractor, and the Engineer.

b. Functional Test Documentation

- 1) For those functions that cannot be demonstrated on a loop-by-loop basis, the test form shall be a listing of the specific tests to be conducted. With each test description the following information shall be included:
 - a) Specification page and paragraph of function demonstrated.
 - b) Description of Function.
 - c) Test procedure description.

Section 4
Scope of Work and Technical Specifications

SECTION 40 90 00-15 INSTRUMENTATION AND CONTROL FOR PROCESS SYSTEMS

- d) Space after each specific test to facilitate signoff on completion of each test.

1.04 TESTING

- A. Factory Testing, field Testing, and Final Acceptance Testing shall be provided.
- B. System Commissioning Assistance.
 - 1. Provide the services of a factory trained and field experienced instrumentation engineer to assist Owner's personnel during each startup of the various systems. The purpose of this assistance is to support in making final adjustments of settings on the instrument systems.

1.05 OPERATION AND MAINTENANCE MANUALS

- A. Furnish Instruction Manuals and Parts Lists for instrumentation equipment in accordance with the requirements of Division 1 and as noted herein.
 - 1. Schedule.
 - a. Deliver manuals not later than the equipment shipment date. After installation is complete, update the manuals to reflect any changes which occurred during installation and deliver balance of manuals to Engineer.
 - 2. Material Content. Include in the manuals not less than the following applicable information for each instrument, equipment, subsystem and/or control loop. The O&M Manuals shall consist of, at least, the following material:
 - a. Bill of Materials.
 - 1) A listing of all the panels, racks, instruments, components, and devices supplied. Components shall be grouped by component type, with the component types identified in a similar manner to the component identification code used in these specifications. The list shall contain, as a minimum:
 - a) Instrument, panel, rack or device tag number.
 - b) Description.
 - c) Quantity supplied.
 - d) Reference to component data sheet and/or catalog cut.
 - e) Component type.
 - b. Component Data Sheets.
 - 1) See Paragraph 1.03 C.2 specified herein before.

Section 4
Scope of Work and Technical Specifications
SECTION 40 90 00-16 INSTRUMENTATION AND CONTROL FOR PROCESS SYSTEMS

- c. Catalog Cuts.
 - 1) See Paragraph 1.03 C specified herein before.
- d. Component O&M Manuals.
 - 1) An O&M manual shall be submitted for instruments and devices supplied. The O&M manuals shall contain, as a minimum:
 - a) Operating procedures.
 - b) Installation procedures.
 - c) Maintenance procedures.
 - d) Troubleshooting procedures.
 - e) Calibration procedures.
 - f) Internal device schematics and wiring diagrams.
 - g) Shut down procedures.
 - h) Component parts list.
 - i) Detailed circuit operational description including annotated programmable controller ladder diagrams.
- e. Spare Parts and Expendables List
 - 1) The spare parts and expendables list shall include not only those items supplied, but also the additional items recommended for successful long-term operation.
- f. "As Shipped" Drawings
 - 1) Drawings shall be a record of work "As Shipped" from the factory and shall be labeled as "As Shipped". One copy of applicable schematics and diagrams shall be placed in each control panel in a protective envelope or binder. Provide the following "As Shipped" drawings as a minimum:
 - a) Panel Fabrication Drawings.
 - b) Panel Wiring and Interconnection Drawings.

1.06 FINAL RECORD DOCUMENTATION'S

A. Reproducible Drawings. Contractor shall submit reproducible finished schematics, wiring diagrams and installation drawings to include installed field and panel instruments, mounting details, point to point diagrams with a cable, wire, and termination numbers. Drawings shall be a record of work as actually constructed and shall be

Section 4

Scope of Work and Technical Specifications
SECTION 40 90 00-17 INSTRUMENTATION AND CONTROL FOR PROCESS SYSTEMS

labeled as "RECORD DOCUMENTS", in accordance with the requirements of Section 01 – Contract Closeout. One copy of applicable schematics and diagrams shall be placed in each control panel in a protective envelope or binder.

1. Loop Diagrams.
 - a. See Paragraph 1.03 C.8 specified herein before.
 2. Panel Fabrication and Wiring diagrams.
 - a. See Paragraph 1.03 C.4 and 1.03 C.6 specified herein before.
 3. Interconnecting Wiring Diagrams.
 - a. See Paragraph 1.03 C.7 specified herein before.
 4. Instrument Installation Details.
 - a. See Paragraph 1.03 C.9 herein before.
- B. Process and Instrumentation Diagrams (P&ID's).
1. The Engineer will supply the Contractor with P&IDs on magnetic media for revisions to reflect the final installed system.
 2. The P&IDs shall be updated by the Contractor who may use these drawings for producing the final documentation.
- C. Software Documentation. In addition to the reproducible hard copy of drawings and literature generated specifically for the project, Contractor shall submit electronic copy to the Engineer with all custom files specifically created to generate the drawings, data sheets, bill of materials, operating procedures etc. Drawing format shall be compatible with AutoCAD ver. 2018 or newer.

1.07 TRAINING REQUIREMENTS.

- A. General:
1. Contractor shall provide the services of a CSI factory trained and field experienced instrumentation engineer to conduct group training of Owner's designated personnel in the operation of each instrument system. Obtain Owner's written consent that the training has been adequate. Include instruction covering basic system theory, operating principles and adjustments, routine maintenance and repair, and "hands on" operation. The text for this training shall be the P & ID's, graphic operation interface, PLC and SCADA software, panel wiring diagrams and layouts, and the operation and maintenance manuals furnished under these Specifications.
- B. Duration:

Section 4

Scope of Work and Technical Specifications
SECTION 40 90 00-18 INSTRUMENTATION AND CONTROL FOR PROCESS SYSTEMS

1. Training specific to the system control panel hardware and software. This training shall be for a minimum time period of 30-8-hour days and 6 trips. This training shall be separate from start-up and testing.

C. Operator Training:

1. Operator training shall include instruction in the use of Control Panels and Field Panels furnished.

D. Maintenance Training:

1. Maintenance training shall include instruction in the calibration, maintenance, and repair required for all instruments.

1.08 POST CONTRACT SYSTEM SUPPORT.

A. Maintenance Contract:

1. Duration.

a. Provide a 1-year maintenance contract for components furnished starting from the date of acceptance.

2. Schedule.

b. Develop a program of preventive maintenance visits that includes verification of instrument performance on a monthly basis and complete calibration of instruments on a semi-annual basis. After every visit, submit to the Owner records of instrument verification and calibration on appropriate forms.

1.09 GUARANTEE AND WARRANTIES

A. The equipment manufacturers shall warrant and guarantee against defective equipment, workmanship, and materials under normal use, operation and services, unless otherwise noted in other Division 40 Sections shall be for a period of 2 years after acceptance from the final date or final resolution of the Owner acceptance of Work as substantially complete. For equipment bearing a manufacturer's warranty in excess of two years, furnish a copy of the warranty to Engineer with Owner named as beneficiary.

PART 2 - PRODUCTS

2.01 HARDWARE REQUIREMENTS

A. Job Conditions.

1. Contract Drawings are diagrammatic and show the intended arrangement for system operation, piping, and appurtenances. Conform to Contract Drawings as closely as possible and exercise care (1) to secure neat arrangement of piping, valves, conduit, and like items, and (2) to accommodate structural

Section 4

Scope of Work and Technical Specifications

SECTION 40 90 00-19 INSTRUMENTATION AND CONTROL FOR PROCESS SYSTEMS

features. Verify dimensions and conditions at the project site and install materials and equipment in the available spaces.

B. Materials and Standard Specifications.

1. Provide instruments, equipment and materials suitable for service conditions and meeting standard specifications such as Instrument Society of America (ISA). The intent of this Specification is to secure instruments and equipment of a uniform quality and manufacture throughout the facilities, instruments supplied by the Contractor, of the same type shall be by the same manufacturer. All panel mounted instruments shall have matching style and general appearance. All meters, instruments, and other components shall be the most recent field-proven models marketed by their manufacturers at the time of submittal of the shop drawings unless otherwise required to match existing equipment. This allows the stocking of the minimum number of spare parts.

C. Product Delivery, Storage, and Handling.

1. Box, crate, or otherwise enclose and protect instruments and equipment during shipment, handling, and storage. Keep all equipment dry and covered from exposure to weather, moisture, corrosive liquids and gases or any element which could degrade the equipment. Protect painted surfaces against impact, abrasion, discoloration, and other damage. Repair any damage as directed and approved.

D. Mountings.

1. Mount and install equipment as indicated. Where not shown, mount field instruments according to best standard practice on pipe mounts, pedestal mounts, or other similar means in accordance with suppliers' recommendation. Unless specified otherwise all mounting hardware shall be stainless steel. Where mounted in control panels, mount according to manufacturer recommendations.

2. Equipment specified for field mounting shall be suitable for direct pipe mounting, pedestal mounting, or surface mounting. Non in line indicators and equipment with calibration adjustments or requiring periodic inspection shall be mounted not lower than three (3) feet nor higher than five (5) feet above walkways, platforms, and catwalks. Such equipment shall be weather and splash proof, and corrosion resistant and electrical equipment shall be in Type 316 stainless steel NEMA 4X cases unless otherwise noted.

E. Instrument Identification.

1. Components provided under this Section, both field and panel mounted, shall be provided with permanently mounted name tags bearing the entire ISA

Section 4

Scope of Work and Technical Specifications

SECTION 40 90 00-20 INSTRUMENTATION AND CONTROL FOR PROCESS SYSTEMS

tag number of the component. Panel mounted tags shall be plastic; field mounted tags shall be stamped stainless steel.

2. Nameplates for panels and panel mounted equipment shall be as specified on the design documents.

3. Field mounted tags shall be 16-gauge, Type 304 stainless steel with 3/16-inch-high characters.

4. Tags shall be attached to equipment with a commercial tag holder using a stainless-steel band with a worm screw clamping device or by a holder fabricated with standard stainless steel hose clamps and meeting the same description. In some cases where this would be impractical, use 20 gage stainless steel wire.

5. For field panels or large equipment cases use stainless steel screws, however, such permanent attachment shall not be on an ordinarily replaceable part. In each case, the tag shall be plainly visible to a standing observer and not obscure adjustment ports or impair the function of the instrument. Field mounted control stations, recorders or indicators shall have a nameplate indicating their function and the variable controlled or displayed. Nameplate shall be attached by one of the above methods.

F. Electronic Equipment.

1. If the equipment is electronic in nature, provide solid state equipment to the greatest extent practicable. Select components of construction for their suitability and reliability. Employ adequate component derating to preclude failures because of transients and momentary overloads reasonably expected in normal operation. Where conduit connection is provided for mounting a surge/lightning suppresser directly to the instrument, the arrestor shall be mounted. Field equipment shall have a Joslyn (or accepted equal) surge suppresser mounted on the instrument housing, if such mounting is provided on the instrument, otherwise a threaded surge suppresser connection shall be provided on the conduit as close as practical to the instrument. See Section 16473 – Low Voltage Surge Suppression Devices.

G. Equipment Operating Conditions.

1. Equipment shall be rated for normal operating performance with varying operating conditions over the following minimum ranges:

2. Power:

a. Electrical. 115 VAC +/- 10%, 60 Hz +/- 1 Hz except where specifically stated otherwise on the drawings or in the specifications.

3. Field Instruments:

Section 4
Scope of Work and Technical Specifications

SECTION 40 90 00-21 INSTRUMENTATION AND CONTROL FOR PROCESS SYSTEMS

- a. Atmospheric contaminants (All Areas):
 - 1) Hydrogen Sulfide: 0.1 mg/l.
 - 2) Chlorine: 0.01 mg/l.
 - 3) Ammonia: 0.5 mg/l.
 - 4) Dust: 50.0 □g/m3.
- b. Outdoor Areas:
 - 1) Ambient Temperature: -20oF to +120oF.
 - 2) Ambient Relative Humidity: 10% to 100%.
 - 3) Weather: Rain, wind, sun and blowing sand and dust.
4. Indoor Environmentally Uncontrolled Areas:
 - a. Ambient Temperature: 40oF to +105oF.
 - b. Ambient Relative Humidity: 20% to 80%.
5. Indoor Environmentally Controlled Areas:
 - a. Ambient Temperature: 55oF to +85oF.
 - b. Ambient Relative Humidity: 20% to 80%.
 - c. Short term excursions to temperature limits for non-environmentally controlled areas.
6. Provide, as necessary, enclosures, heat tracing, heaters and sunshields on outdoor transmitters and displays, etc. to ensure normal operations under these conditions.
7. Corrosive Areas: Provide instrument enclosures and hardware suitable for the corrosive location.
8. Hazardous Areas: All equipment used in areas designated as hazardous shall be designed for the Class, Group, and Division as required on the Contract Drawings for the locations. All Work shall be in strict accordance with codes and local rulings, should any work be performed contrary to said rulings, ordinances and regulations, the Contractor shall bear full responsibility for such violations and assume all Owner costs arising there from.
- H. Power Supplies.
 1. Provide electrical instruments and control devices for operation on 120 VAC, 60 Hz current. Protect each device's power supply with properly sized fuses.

Section 4

Scope of Work and Technical Specifications

SECTION 40 90 00-22 INSTRUMENTATION AND CONTROL FOR PROCESS SYSTEMS

2. Unless otherwise indicated provide battery backed up Uninterruptable Power Supply (UPS) with AC inversion for each control panel and PLC. UPS shall be sized to run the peak tributary load for a period of not less than 30 minutes and 8 hours for all components and loop powered devices. UPS shall be mounted in the respective panel. Minimum UPS size shall be 990 watt-hours. Provide bypass switch for panels to run directly from power source or through UPS with front of panel mounted indicator light showing current models.

3. Output overvoltage and overcurrent protective devices shall be provided for DC power supplies to protect instruments from damage due to power supply failure and to power supply from damage due to external failure. Power supplies shall be provided with NEMA 1 enclosures. Power supplies shall be mounted such that dissipated heat does not adversely affect other components. Source of operating power shall be 120 VAC, 60 Hz commercial power. Units shall be mounted within the control panels. Power supply fusing shall be provided with blown fuse indicators.

I. Signal Isolators, Converters and Conditioners.

1. Insure that input output signals of all instruments and control devices (new and existing) are compatible. Analog signals between field and panels shall be 4-20 mA unless specifically accepted otherwise. Granting such acceptance does not relieve the Contractor from the compatibility requirement above. Provide signal isolators and converters as necessary to obtain the required system performance. Mount the devices behind control panels or in the field at point of application, as required for accurate signal acquisition.

J. Auxiliary Contacts by Others.

1. Provide instruments and equipment to connect to auxiliary contacts provided by others for alarms, status of equipment, interlocking, and other functions as indicated and as specified herein.

K. Painting.

1. Provide factory paint for instruments and equipment except where in pipelines.

L. Electrical.

1. Work shall include the power supply wiring, instrumentation wiring, interconnecting wiring and equipment grounding as indicated, specified and required and not specifically included under Division 26.

2. Wiring installations shall include cables, conductors, terminals, connectors, wire markers, conduits, conduit fittings, supports, hardware and all other required materials not specifically included in the Work of other Divisions.

Section 4
Scope of Work and Technical Specifications

SECTION 40 90 00-23 INSTRUMENTATION AND CONTROL FOR PROCESS SYSTEMS

3. Provide the materials and complete the required installations for equipment grounding as specified in Division 26 of these Specifications and indicated on the Contract Drawings.
4. Incidental items not specifically included in the Contract Documents that can legitimately and reasonably be inferred to belong in the instrumentation work shall be provided and installed by the Contractor at no additional cost to the Owner.
5. Field Wiring. For wiring materials, refer to Division 26 and Details on the Contract Drawings. Test signal wiring for continuity prior to termination. Provide wire number tags marked in indelible waterproof form of slip-on type heat shrink label or equal for each termination.

M. Process Connections.

1. Provide instrument piping, tubing, and capillary tubing to meet the intended process service and ambient environmental condition for corrosion resistance, etc. All instrument pneumatic tubing shall be Type 316 stainless steel. Slope lines according to service to promote self-draining or venting back to the process. Terminate connection to process lines or vessels in a service rated block valve that will permit closing off the sense line or removal of the element without requiring shut down of the process. Include drip legs and blow down valves for terminations of sense lines at the instruments when mounted such that condensation can accumulate. Process vessels, line penetrations, connecting fittings, and block valves shall be furnished and installed under other Divisions of these Specifications but coordinated by Division 40.

N. Electrical Transient Protection.

1. Instrument and control equipment mounted outside of protective structures (field mounted equipment) shall be equipped with surge-arresting devices to protect the equipment from damage due to electrical transients induced in the interconnecting lines from lightning discharges or nearby electrical devices. Both power and signal circuits shall be protected with surge and transient protectors installed at the source and destination ends of the circuits. Protective devices used on 120 VAC inputs to field mounted equipment shall be secondary surge protectors conforming to the requirements of IEEE C62.41 8/20 μ s wave form.
2. Surge and transient protectors shall be normally connected to the electrical system ground. When an electrical system ground is not available near the device, the protectors shall be connected to a ground rod located within 10 feet of the device. The ground rod shall meet all the requirements of Section 26 05 26 - Grounding and Bonding, in Division 26, Electrical.

Section 4

Scope of Work and Technical Specifications

SECTION 40 90 00-24 INSTRUMENTATION AND CONTROL FOR PROCESS SYSTEMS

3. Protectors for analog signal circuits on or near field instrument housings shall be Innovative Technology Model OEM D22TX, Phoenix Contact Surge Trab Series, or accepted equal.

4. Protectors shall be provided for conductors penetrating panel enclosures for power circuits protectors shall be Innovative Technology Model HS-P-5P secondary arrestor, Phoenix Contact PT Series, or accepted equal. For analog and data circuits protectors shall be rail mounted Innovative Technology Model HS or accepted equal. Protectors for data utilizing coaxial connections shall be Innovative Technology or accepted equal. Provide multi-stage gas tube and solid-state Innovative Technology, or accepted equal, protectors for digital circuits.

O. Spares and Maintenance Materials.

1. Furnish the following items as specified herein. Deliver to Engineer, as directed, with itemized list in a letter of transmittal accompanying each shipment.

2. Materials shall be delivered in the manufacturer's original containers labeled to completely describe the contents and equipment for which it is furnished.

3. One Fuse of each size and type for every five used but no less than five of each type.

4. One Relay of each type for every five used but no less than two of each type.

5. One Panel Indicating Light Bulb for every five used but no less than four of each type.

6. One Transient Protector for every five used but no less than four of each type.

PART 3 - EXECUTION

3.01 PRODUCT HANDLING

A. Shipping Precautions: After completion of shop assembly, factory test, and acceptance, all equipment, cabinets, panels, and consoles shall be packed in protective crates and enclosed in heavy duty polyethylene envelopes or secured sheeting to provide complete protection from damage, dust, and moisture. Dehumidifiers shall be placed inside the polyethylene coverings. The equipment shall then be skid-mounted for final transport. Lifting rings shall be provided for moving without removing protective covering. Boxed weight shall be shown on shipping tags together with instructions for unloading, transporting, storing, and handling at the job site.

Section 4
Scope of Work and Technical Specifications

SECTION 40 90 00-25 INSTRUMENTATION AND CONTROL FOR PROCESS SYSTEMS

B. Special Instructions: Special instructions for proper field handling, storage, and installation required by the Manufacturer shall be securely attached to each piece of equipment before packaging and shipment.

C. Tagging: Each component shall be tagged to identify its location, instrument tag number, and function in the system. A permanent stainless steel or other non-corrosive material tag firmly attached and permanently and indelibly marked with the instrument tag number, as given in the tabulation, shall be provided on each piece of equipment in the ICM system. Identification shall be prominently displayed on the outside of the package.

D. Storage: Equipment shall not be stored outdoors. Equipment shall be stored in dry permanent shelters, including in-line equipment, and shall be adequately protected against mechanical injury. If any apparatus has been damaged, such damage shall be repaired by the Contractor at no additional cost to the Owner. If any apparatus has been subject to possible damage by water, it shall be thoroughly dried out and put through tests as directed by the Engineer. Such tests shall be at no additional cost to the Owner, and if the equipment fails the tests, it shall be replaced at no additional cost to the Owner.

E. Protection during Construction: Instrumentation and Controls shall at all times during construction be adequately protected against mechanical injury, water damage, corrosion, dirt, dust and foreign material. Equipment equipped with internal electrical heaters shall have them energized to keep the equipment dry. Doors to control panels and cabinets shall be kept closed at all times when work on them is not being done. Control Panels, Analyzers, sensitive electronic or computer equipment and/or controls or other materials not sealed and/or suitable for continuous outdoors storage shall not be stored out-of-doors. Such Instrumentation and Controls shall be stored in dry permanent shelters.

F. Paint Finish: Any damage to factory applied paint finish shall be repaired using touch-up paint furnished by the instrument or equipment manufacturer.

3.02 MANUFACTURER'S SERVICES

A. Furnish the following Manufacturer's services for all instrumentation provided:

1. Perform bench calibration.
2. Oversee installation.
3. Verify installation of installed instrument.
4. Certify installation and reconfirm Manufacturer's accuracy statement.
5. Oversee loop testing, prepare loop validation sheets, and certify loop testing.

Section 4
Scope of Work and Technical Specifications

SECTION 40 90 00-26 INSTRUMENTATION AND CONTROL FOR PROCESS SYSTEMS

6. Oversee pre-commissioning, prepare pre-commissioning validation sheets, and certify pre-commissioning.
7. Train the Owner's personnel.

3.03 INSTALLATION

A. General:

1. All instrumentation, including instrumentation furnished under other Divisions, shall be installed per the manufacturers' instructions and Division 40.
2. Equipment Locations: The monitoring and control system configurations indicated are diagrammatic. The locations of equipment are approximate. The exact locations and routing of wiring and cables shall be governed by structural conditions and physical interferences and by the location of electrical terminations on equipment. All equipment shall be located and installed so that it will be readily accessible for operation and maintenance. Where job conditions require reasonable changes in approximated locations and arrangements, or when the Owner exercises the right to require changes in location of equipment that do not impact material quantities or cause material rework, make such changes without additional cost to the Owner.

B. Conduit, Cables, and Field Wiring

1. All conduit shall be provided, in accordance with Section 26 05 33.
2. All 4-20 mA signal circuits, process equipment control wiring, signal wiring to field instruments, remote I/O, PLC I/O, and other non-specialty field wiring and cables shall be provided and installed, in accordance with Section 26 05 05.
3. All ICM system specialty cables, data highway fiber optic cable and specialty cable termination devices shall be provided under Division 40 and installed, in accordance with Section 26 05 05.
4. All field cables and wiring terminations and wire identification at ICM system equipment furnished under this or any other Division shall be provided in accordance with the requirements of Section 26 05 05. All terminations shall be checked by the equipment supplier and the electrical contractor.

C. Instrumentation Tie-Downs: All instruments, control panels, and equipment shall be anchored by methods that comply with seismic requirements that apply to the site.

D. Existing Instrumentation: Each existing instrument to be removed and reinstalled shall be cleaned, reconditioned and recalibrated by an authorized service facility of the instrument Manufacturer. Provide certification of this Work before reinstallation of each instrument. Provide replacement for interim period as required.

Section 4

Scope of Work and Technical Specifications

SECTION 40 90 00-27 INSTRUMENTATION AND CONTROL FOR PROCESS SYSTEMS

E. Ancillary Devices: The Contract Documents show all necessary conduit and instruments required to make a complete instrumentation system. The Contractor shall be responsible for providing any additional or different type connections as required by the instruments and specific installation requirements at no additional cost to the Owner. All such additions and all such changes, including the proposed method of installation, shall be submitted to the Engineer for acceptance before commencing the Work. Such changes shall not be a basis of claims for extra work or delay.

F. Installation Criteria and Validation: All field-mounted components and assemblies shall be installed and connected according to the requirements below:

1. Installation personnel have been instructed on installation requirements of the Contract Documents.
2. Technical assistance is available to installation personnel at least by telephone.
3. Installation personnel have at least one copy of the accepted and approved shop drawings and data.
4. Instrument process sensing lines shall be installed similar to conduit. Individual tubes shall run parallel and near the surfaces from which they are supported. Supports shall be used at intervals of not more than 3-feet of rigid tubing.
5. Bends shall be formed to uniform radii with the proper tool without deforming or thinning the walls of the tubing. Plastic clips shall be used to hold individual plastic tubes parallel. Ends of tubing shall be square cut and cleaned before being inserted in the fittings. Bulkhead fittings shall be provided at all panels requiring pipe or tubing entries.
6. All differential pressure elements shall have three valve manifolds.
7. All flexible cables and capillary tubing shall be installed in flexible conduits. The lengths shall be sufficient to withdraw the element for periodic maintenance.
8. All power and signal wires shall be terminated with crimped type lugs.
9. All connectors shall be, as a minimum, watertight.
10. All wires shall be mounted clearly with an identification tag that is of a permanent and reusable nature.
11. All wire and cable shall be arranged in a neat manner and securely supported in cable groups and connected from terminal to terminal without splices unless specifically accepted by the Engineer. All wiring shall be protected from sharp edges and corners.

Section 4
Scope of Work and Technical Specifications

SECTION 40 90 00-28 INSTRUMENTATION AND CONTROL FOR PROCESS SYSTEMS

12. All mounting stands and bracket materials and workmanship shall comply with the requirements of the Contract Documents.
13. Verify the correctness of each installation, including polarity of electric power and signal connections, and making sure all process connections are free of leaks. Certify in writing that for each loop or system checked out, all discrepancies have been corrected.
14. The Owner will not be responsible for any additional cost of rework attributable to the actions of the Contractor or the CSI.

3.04 CALIBRATION

- A. General: All devices provided under the instrumentation Sections shall be calibrated according to the manufacturer's recommended procedures to verify operational readiness and ability to meet the indicated functional and tolerance requirements.
- B. Calibration Points: Each instrument shall be calibrated at 20, 40, 60, 80 and 100% of span using test instruments to simulate inputs. The test instruments shall have accuracies traceable to the National Institute of Testing Standards.
- C. Bench Calibration: Instruments that have been bench-calibrated shall be examined in the field to determine whether any of the calibrations are in need of adjustment. Such adjustments, if required, shall be made only after consultation with the Engineer.
- D. Field Calibration: Instruments that were not bench-calibrated shall be calibrated in the field to ensure proper operation in accordance with the instrument loop diagrams or specification data sheets.
- E. Analyzer Calibration: Each analyzer system shall be calibrated and tested as a workable system after installation. Testing procedures shall be directed by the manufacturers' technical representatives. All samples and sample gases shall be furnished by the manufacturers.
- F. Calibration Tags: A calibration and testing tag shall be attached to each piece of equipment or system at a location determined by the Engineer. Have the Instrumentation Supplier sign the tag when calibration is complete. The Engineer will sign the tag when the calibration and testing has been accepted.

3.05 LOOP TESTING

- A. General: Individual instrument loop diagrams per ISA Standard S5.4 - Instrument Loop Diagrams, expanded format, shall be submitted to the Engineer for review before the loop tests. The Contractor shall notify the Engineer of scheduled tests a minimum of 30 days before the estimated completion date of installation and wiring of the ICM. After the Engineer's review of the submitted loop diagrams for correctness and compliance

Section 4

Scope of Work and Technical Specifications

SECTION 40 90 00-29 INSTRUMENTATION AND CONTROL FOR PROCESS SYSTEMS

with the specifications, loop testing shall proceed. The loop check shall be witnessed by the Engineer.

B. Control Valve Tests: All control valves, cylinders, drives and connecting linkages shall be stroked from the operator interface units as well as local control devices and adjusted to verify proper control action, hand switch action, limit switch settings, torque settings, remote control actions, and remote feedback of valve status and position. Control valve actions and positioner settings shall be checked with the valves in place to ensure that no changes have occurred since the bench calibration.

C. Interlocks: All hardware and software interlocks between the instrumentation and the motor control circuits, control circuits of variable-speed controllers and packaged equipment controls shall be checked to the maximum extent possible.

D. Instrument and Instrument Component Validation: Each instrument shall be field tested, inspected, and adjusted to its indicated performance requirement in accordance with its Manufacturer's specifications and instructions. Any instrument that fails to meet any Contract requirement, or, in the absence of a Contract requirement, any published manufacturer performance specification for functional and operational parameters, shall be repaired or replaced, at the direction of the Engineer at no additional cost to the Owner.

E. Loop Validation: Controllers and electronic function modules shall be field tested and exercised to demonstrate correct operation. All control loops shall be checked under simulated operating conditions by impressing input signals at the primary control elements and observing appropriate responses of the respective control and monitoring elements, final control elements, and the graphic displays associated with the SCADA and PLC. Actual signals shall be used wherever available. Following any necessary corrections, the loops shall be retested. Specified accuracy tolerances for each analog network are defined as the root mean square summation of individual component accuracy requirements. Individual component accuracy requirements shall be as indicated by Contract requirements or by published manufacturer accuracy specifications, whenever Contract accuracy requirements are not indicated. Each analog network shall be tested by applying simulated analog or discrete inputs to the first element of an analog network. For networks that incorporate analog elements, simulated sensor inputs corresponding to 20, 40, 60, 80 and 100% of span shall be applied, and the resulting element outputs monitored to verify compliance to calculated root mean square summation accuracy tolerance requirements. Continuously variable analog inputs shall be applied to verify the proper operation and setting of discrete devices. Provisional settings shall be made on controllers and alarms during analog loop tests. All analog loop test data shall be recorded on test that include calculated root mean square summation system accuracy tolerance requirements for each output.

F. Loop Validation Sheets: Prepare loop confirmation sheets for each loop covering each active instrumentation and control device except simple hand switches and lights.

Section 4
Scope of Work and Technical Specifications

SECTION 40 90 00-30 INSTRUMENTATION AND CONTROL FOR PROCESS SYSTEMS

Loop confirmation sheets shall form the basis for operational tests and documentation. Each loop confirmation sheet shall cite the following information and shall provide spaces for sign-off on individual items and on the complete loop provided by the CSI:

1. Project name.
2. Loop number.
3. Tag number, description, manufacturer and model number for each element.
4. Installation bulletin number.
5. Specification sheet number.
6. Loop description number
7. Adjustment check.
8. Space for comments.
9. Space for loop sign-off by Instrumentation Supplier and date.
10. Space for Engineer witness signature and date.

G. Loop Certifications: When installation tests have been successfully completed for all individual instruments and all separate analog control networks, a certified copy of all test forms signed by the Engineer as a witness, with test data entered, shall be submitted to the Engineer together with a clear and unequivocal statement that all instrumentation has been successfully calibrated, inspected, and tested.

3.06 PRE-COMMISSIONING

A. General: Pre-commissioning shall start after acceptance of all wire tests, calibration tests and loop tests, and all inspections have demonstrated that the instrumentation and control system complies with all Contract requirements. Pre-commissioning shall demonstrate proper operation of all systems with process equipment operating over full operating ranges under conditions as closely resembling actual operating conditions as possible.

B. Pre-commissioning Procedures and Documentation: All pre-commissioning and test activities shall follow detailed test procedures and check lists accepted by the Engineer as submitted by the CSI. All test data shall be acquired using equipment as required and shall be recorded on test forms accepted by the Engineer, that include calculated tolerance limits for each step. Completion of all system pre-commissioning and test activities shall be documented by a certified report, including all test forms with test data entered, delivered to the Engineer with a clear and unequivocal statement that all system pre-commissioning and test requirements have been satisfied.

Section 4

Scope of Work and Technical Specifications

SECTION 40 90 00-31 INSTRUMENTATION AND CONTROL FOR PROCESS SYSTEMS

C. Operational Validation: Where feasible, system pre-commissioning activities shall include the use of water to establish service conditions that simulate, to the greatest extent possible, normal final control element operating conditions in terms of applied process loads, operating ranges, and environmental conditions. Final control elements, control panels, and ancillary equipment shall be tested under start up and steady state operating conditions to verify that proper and stable control is achieved using motor control center and local field mounted control circuits. All hardwired and software control circuit interlocks and alarms shall be operational. The control of final control elements and ancillary equipment shall be tested using both manual and automatic (where provided) control circuits. The stable steady state operation of final control elements running under the control of field mounted automatic analog controllers or software-based controllers shall be assured by adjusting the controllers as required to eliminate oscillatory final control element operation. The transient stability of final control elements operating under the control of field mounted, and software based automatic analog controllers shall be verified by applying control signal disturbances, monitoring the amplitude and decay rate of control parameter oscillations (if any) and making necessary controller adjustments as required to eliminate excessive oscillatory amplitudes and decay rates.

D. Loop Tuning: All electronic control stations incorporating proportional, integral or differential control circuits shall be optimally tuned, experimentally, by applying control signal disturbances and adjusting the gain, reset, or rate settings as required to achieve a proper response. Measured final control element variable position/speed set point settings shall be compared to measured final control element position/speed values at 20, 40, 60, 80 and 100% of span and the results checked against indicated accuracy tolerances.

E. Pre-commissioning Validation Sheets: Pre-commissioning shall be documented on one of two types of test forms as follows:

1. For functions that can be demonstrated on a loop-by-loop basis, the form shall include:
 - a. Project name.
 - b. Loop number.
 - c. Loop description.
 - d. Tag number, description, manufacturer and data sheet number for each component.
 - e. Space for sign-off and date by both the CSI and the Engineer.
2. For functions that cannot be demonstrated on a loop-by-loop basis, the test form shall be a listing of the specific tests to be conducted. With each test description, the following information shall be included:

Section 4

Scope of Work and Technical Specifications
SECTION 40 90 00-32 INSTRUMENTATION AND CONTROL FOR PROCESS SYSTEMS

- a. Specification page and paragraph of function demonstrated.
- b. Description of function.
- c. Space for sign-off and date by both the CSI and the Engineer.

F. Pre-commissioning Certification: Submit an ICM system pre-commissioning completion report that shall state that all Contract requirements have been met and shall include a listing of all instrumentation and control system maintenance and repair activities conducted during the pre-commissioning testing. Acceptance of the instrumentation and control system pre-commissioning testing must be provided in writing by the Engineer before the performance testing may begin. Final acceptance of the control system shall be based upon plant completion as stated in the General Conditions.

3.07 ONSITE SUPERVISION

A. Furnish the services of an on-site service engineer to supervise and coordinate installation, adjustment, testing, and start-up of the ICM system. The Engineer will be present during the total period required to affect a complete operating system. A qualified team of the Instrumentation Subcontractor personnel shall be on site as required to check all equipment, perform the tests indicated in this Section, and furnish startup services.

3.08 PERFORMANCE TEST

- A. The entire ICM system shall operate for 30 days without failure.
- B. Furnish all necessary support staff as required to maintain the system and to satisfy the repair or replacement requirements.
- C. If any component fails during the performance test, it shall be repaired or replaced within 4 hours and the ICM system shall be restarted. If the system is not repaired and running within four (4) hours or more than six component failures within the four (4) hour repair period, the system shall be restarted and operate for an additional 30 days without failure.

3.09 TRAINING

- A. Test the entire ECM system.
- B. General: Train the Owner's personnel on the maintenance, calibration and repair of all instruments provided under this Contract.
- C. Instructions: The training shall be performed by qualified representatives of the equipment manufacturers and shall be specific to each piece of equipment.
- D. Duration: Each training class shall be a minimum of 8 hours in duration and shall cover, as a minimum, operational theory, maintenance, troubleshooting/repair, and

Section 4

Scope of Work and Technical Specifications

SECTION 40 90 00-33 INSTRUMENTATION AND CONTROL FOR PROCESS SYSTEMS

calibration of instruments. Include a minimum of 4 hours' training per instrument or control device; for PLC, and software include 8 hours for each type supplied.

E. Schedule: Training shall be performed during the pre-commissioning phase of the project and 30 days after acceptance. The training sessions shall be scheduled a minimum of 3 weeks in advance of when the courses are to be initiated. The Owner and Engineer will review the course outline and the training manual as submitted by the CSI for suitability and provide comments that shall be incorporated.

F. Agenda: The training shall include operation and maintenance procedures, troubleshooting with necessary test equipment, and changing set points, and calibration for that specific piece of equipment.

G. Documentation: Within 10 days after the completion of each session the Contractor shall submit the following:

1. List of all Owner personnel who attended the session.
2. Evaluation of Owner personnel via written testing or equivalent evaluation.
3. Copy of the training materials used including all notes, diagrams, and comments.

3.10 ACCEPTANCE

A. For the purpose of this Section, the following conditions shall be fulfilled before the Work is considered substantially complete:

1. All submittals have been completed and accepted.
2. The ICM system has been calibrated, loop tested and pre-commissioned.
3. The Owner training has been performed.
4. All required spare parts, expendable supplies and test equipment have been delivered to the Owner.
5. The performance test has been successfully completed.
6. All punch-list items have been corrected.
7. All recorded drawings in both hard copy and electronic format have been submitted.
8. Revisions to the operations and maintenance manuals information that may have resulted from the field tests have been made and reviewed.
9. All debris associated with installation of instrumentation has been removed.

Section 4
Scope of Work and Technical Specifications

SECTION 40 90 00-34 INSTRUMENTATION AND CONTROL FOR PROCESS SYSTEMS

10. All probes, elements, sample lines, transmitters, tubing, and enclosures have been cleaned and are in like-new condition.

3.11 WARRANTY

A. Supplier shall warrant design, materials, and workmanship for customary period applicable for the equipment involved, but in no case for less than 24 months from date of acceptance, in accordance with the requirements of Paragraph 1.03, J, 1.

B. During warranty period, if mechanical defects occur, or equipment fails to perform in accordance with specified performance requirements under conditions of normal use within the design limitations of the equipment, supplier shall, upon request of the company, repair or replace equipment or parts as required and shall place equipment in proper working condition, assuming all expenses involved.

C. A written prepaid maintenance contract executed by the CSI shall be provided to the Owner for on-site warranty and travel maintenance services, in accordance with the requirements of Paragraph 1.03, H, and Paragraph I, 1. This maintenance contract shall include all travel and living expenses, labor, parts, and emergency calls providing on-site response within 4 hours, to provide complete system maintenance for a period of one year after the date of final acceptance of the system.

D. The maintenance contract shall include a minimum of 4 (quarterly) preventive maintenance visits by a qualified serviceman of the Supplier who is familiar with the type of equipment and software provided for this project. Each preventive maintenance visit shall include routine adjustment, calibration, cleaning, and lubrication of system equipment and written verification of calibration and correct software operation.

E. An annual fee shall be quoted 90 days before completion of the first-year maintenance contract for annual maintenance subsequent to the first year of operation. Standard per diem rates for providing breakdown service shall be set forth in the contract. Such rates shall be fair and reasonable and reflect the lowest rates offered to most favored customers. The fee quoted shall be firm for a minimum of 90 days from day of issue.

END OF SECTION

SECTION 40 94 03

PROGRAMMABLE LOGIC CONTROLLER SUBSYSTEM (PLCS)

PART 1 - GENERAL

1.01 SCOPE

A. General - This section describes the Programmable Logic Controller (PLC), Input/Output (I/O) equipment, Operator Interface Terminal (OIT), fiber optic industrial Gigabit Ethernet and associated network communication equipment, and associated hardware and equipment, PLC programming software, Human Machine Interface (HMI) SCADA application software including all engineering and programming and development required for monitoring and control. All devices, accessories, programming, and appurtenances required for proper operation of a complete and functional Instrumentation Control and Monitoring (ICM) system shall be provided.

1. The SCADA system shall be designed, coordinated, and supplied by a Control System Integrator (CSI) consisting of PLC based data acquisition and operator interface graphic display systems, who shall guarantee satisfactory operation of the installed ICM system.
2. Develop and provide the PLC and SCADA HMI and OIT graphic display applications programs and hardware configuration needed to monitor and control the process equipment to perform the functional requirements as specified in Division 40 Sections or as required by the process equipment manufacturers and as required by and described in these Contract Documents.
3. SCADA PLCs shall be configured and provided with hardware necessary to communicate with Ethernet enabled process instrumentation and equipment as required in these specifications.
4. In general, communication network from structure to structure shall be via industrial redundant, self-healing Ethernet optical fiber network. Each PLC and Operator Workstation shall be provided with a UPS with a 120-minutes full load minimum. In the event of local power failure, the PLC shall automatically stop fault sequencing, PID windup, and continue accumulation of data and process calculations while notifying the operator via the HMI screens. Communication shall continue with PLC and workstations.

1.02 REFERENCES

A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

1. National Electrical Manufacturers Association (NEMA).
2. Instrument Society of America (ISA).

Section 4
Scope of Work and Technical Specifications
SECTION 40 94 03-2 PROGRAMMABLE LOGIC CONTROLLER SUBSYSTEM (PLCS)

1.03 SUBMITTALS

- A. The Contractor shall make submittals in accordance with Divisions 01 and 40.
- B. The following information shall be provided:
 - 1. Electronic copy of each of the following shall be submitted:
 - a. Manufacturers complete data.
 - b. Shop drawings, which include the following:
 - 1) Outline drawings of all components and a composite drawing.
 - 2) Schematic drawings of auxiliary piping and wiring.
 - 2. Electronic copy of each of the following shall be submitted:
 - a. Operation and maintenance manual.
 - b. Training documentation.

1.04 TESTING

- A. Factory testing, field testing, and final acceptance testing of computers and programmable logic controllers shall conform to the requirements of Section 40 90 00.

1.05 WARRANTY

- A. Conform to warranty requirements of Division 40.
- B. The equipment manufacturers shall warrant and guarantee against defective equipment, workmanship, and materials under normal use, operation and service, for a period of 2 years after acceptance from the final date or resolution of the Owner accepting Work as substantially complete.

1.06 TOOLS, SUPPLIES AND SPARE PARTS

- A. Tools, supplies and spare parts shall be provided as required. In addition, the following specific spare parts items shall be provided:
 - 1. One of each type of CPU and co-processor module for PLC equipment furnished under this Contract.
 - 2. One of each type of input/output module for PLC equipment furnished under this Contract.
 - 3. One of each type and size of PLC and equipment power supply furnished under this Contract.

PART 2 - PRODUCTS

2.01 MANUFACTURER

A. Provide Programmable Logic Controller including necessary equipment and appurtenances as manufactured by the following acceptable manufacturer:

1. Allen Bradley – ContriLogix.

2.02 PROGRAMMABLE LOGIC CONTROLLER AND I/O HARDWARE

A. General

1. Provide PLC hardware including processors, power supplies, rack assemblies, interconnecting cables, grounding system, communication modules, hot standby modules, and accessories required to perform the control and monitoring functions.

B. Programmable Logic Controller (PLC)

1. The PLC shall be provided with the following minimum features:
 - a. The processor shall be the slot mount type, including at least 2MB of available user memory. Minimum CPU shall be CompactLogix series.
 - b. The PLC system shall be able to accommodate the quantity and type of I/O points shown and described including future I/O points. In addition, provide 20% spare I/O points for each type, where a certain type of I/O is not required such as analog output, provide at least one such I/O module.
 - c. The PLC system shall include one Ethernet communication module. Ethernet communication module shall be used for permanent system-type communications from PLC to PLC and to HMI operator workstations throughout the plant. Data transfer rate shall be up to 100Mbit/s.
 - d. The PLC system shall operate over 0-to-60-degree Celsius temperature range, and a 0 to 95% (non-condensing) humidity range.
 - e. The processor shall include diagnostic indicators for power, mode, low battery, communications ports, and memory and I/O errors.
 - f. The PLC system shall allow on-line and off-line programming.
 - g. The CPUs shall have executive firmware which may be upgraded in the field using an upgrade/download procedure which does not require the removal and/or insertion of an IC chip.

Section 4
Scope of Work and Technical Specifications

SECTION 40 94 03-4 PROGRAMMABLE LOGIC CONTROLLER SUBSYSTEM (PLCS)

h. The PLC system shall be capable of communicating with third party devices such as Motor Control Centers, including Variable Frequency Drives (VFD), and packaged vendor equipment systems via Ethernet IP.

2. The PLC system in each control panel shall include a single or redundant processor (when shown on the drawings), power supply, and hot standby module. If the primary PLC system fails, the standby PLC system shall assume primary control functions within 48 milliseconds of the failure. A failed component shall be able to be removed, replaced, and reloaded (with software) without shutting the on-line PLC system down. No special application programming shall be required to implement the hot standby PLC systems.

3. A power supply (quantity and size as required) shall be provided to supply power to the processor and I/O modules. The supply voltage to the power supply shall originate within the control panel and shall be 120 VAC. A separate 24 VDC power supply shall be provided to power the analog loops.

4. I/O modules shall be provided as required to accommodate the types and quantities of I/O points identified. Sample I/O point types include; dry contact outputs, 4-20 mAdc analog inputs, 4-20 mAdc analog outputs, and 120 VAC discrete inputs. Discrete inputs shall use 120 VAC as the voltage signal, and analog loop signals that leave the control panel shall use a 4-20 mAdc current signal. I/O module point density shall not exceed 16 points per module. Each I/O module shall include front panel mounted diagnostic indicators for point status, fault conditions, and active conditions. The I/O modules shall be able to be replaced while under power and shall be keyed to prevent the wrong type of module from being inserted in the wrong slot. All I/O modules shall have removable terminal blocks for termination of field wiring. All terminal blocks shall be 'keyed' to prevent application of terminal block to wrong I/O module. All I/O modules shall report to the CPU should a terminal block fail or be removed.

5. The PLC and I/O modules rack assemblies shall be housed in the control panels as specified.

6. The control panels shall be provided with sufficient I/O modules to allow 20% spare installed and wired I/O points. Spares shall be provided for each different type of I/O.

7. The PLC and I/O equipment shall be a standard industrial grade product mechanically and electrically suitable for use in an industrial environment with a satisfactory product history of at least five years.

2.03 PROGRAMMABLE CONTROLLER APPLICATION & DEVELOPMENT SOFTWARE

A. The PLC programming and configuration software shall be the manufacturer's latest version, and compatible with the Windows 10 operating system. The software

Section 4
Scope of Work and Technical Specifications

SECTION 40 94 03-5 PROGRAMMABLE LOGIC CONTROLLER SUBSYSTEM (PLCS)

package shall consist of all programming, configuration, and documentation software needed to place the control and information system in satisfactory operation. The software shall allow on-line and off-line program development and documentation. Programming shall be accomplished through the use of ladder logic and other IEC 1131.3 languages. PLC programming software shall include electronic documentation.

B. Third-party programming software shall be acceptable if recommended by the manufacturer and if that software exceeds the capabilities of the PLC manufacturer's standard software package.

C. All configuration and programming software necessary shall be provided on each operator workstation computer specified, including the Portable Laptop Programming Terminal, for connection to any PLC processor on the Ethernet network or via direct connection to the processor communications port. All necessary hardware drivers required to perform PLC configuration and programming shall be provided.

D. If available, the configuration and programming software shall support communication over the network to implement its functions remotely from an operator workstation. All configuration and programming software necessary to implement this functionality shall be provided on the SCADA System Operator Workstations. All necessary hardware and software drivers required to allow the operator workstation to perform PLC configuration and programming shall be provided.

E. The ladder logic instruction set for the PLC shall include the following, as a minimum:

1. Relay type instructions.
2. Counter and timer instructions.
3. Comparison instructions (equal, greater than, limit tests, etc.).
4. Integer and floating point mathematical instructions.
5. Advanced math and trigonometric functions.
6. Statistical instructions.
7. Matrix and array instructions.
8. Logical instructions (and, not, or, etc.).
9. BCD conversion instructions.
10. Bit modification, moving, and shift instructions.
11. File instructions (search, copy, fill, etc.).
12. Diagnostic instructions.
13. Sequencer instructions.

Section 4
Scope of Work and Technical Specifications

SECTION 40 94 03-6 PROGRAMMABLE LOGIC CONTROLLER SUBSYSTEM (PLCS)

14. Program control instructions (jump, goto, subroutine, etc.).
15. PID control loops.
16. Block read and write capability.
17. Send/receive messages.
18. Immediate I/O and communications update instructions.

F. The PLC programming & configuration software shall be the latest version of RSLogix as required.

2.04 SCADA HMI APPLICATION SOFTWARE

A. Provide an operator interface software package that, when combined with the operator station computer hardware, will gather, display, and store real-time operating information. The operator interface software package shall be sized according to the appropriate I/O point count and shall be able to accommodate 20% additional I/O in the future, but as a minimum shall accommodate 10,000 I/O.

B. HMI Application Software

1. The operator interface software package shall provide the following minimum functions:
 - a. Compatible with Windows 10 Pro operating system.
 - b. The software package shall be provided with the appropriate Ethernet driver software, Ethernet hardware interfaces, and Ethernet communication/configuration interface software as required.
 - c. The SCADA software shall utilize existing HMI software package.
 - d. Database management shall be performed using Microsoft SQL Server Database. The ability to store historical data (analog or digital) to daily, weekly, or monthly files and the ability to archive historical data to tape.
 - e. Report writing software shall be the latest version of XLReporter by SyTech, Inc., or accepted equal. The system integrator shall coordinate directly with the owner on types of required report as well as the reports format, etc.
 - f. Analog data shall be configured to be stored as average, minimum, maximum, or instantaneous values, in the proper engineering units.
 - g. A complete alarm handling package shall be provided that shall announce alarms in an alarm queue and allow them to be displayed on

Section 4
Scope of Work and Technical Specifications

SECTION 40 94 03-7 PROGRAMMABLE LOGIC CONTROLLER SUBSYSTEM (PLCS)

the process graphic displays with messages or by changing colors or otherwise massaging graphic display symbols. An alarm summary screen shall be provided. Alarms shall be able to be acknowledged by an operator at the operator station screen on an individual or screen basis and nuisance alarms shall be able to be disabled. Alarms shall be logged to the alarm printer.

h. Password protection for the various levels of access (day-to-day functions versus configuration changes), Log in and Log out at all times and Auto log off with set time.

i. The database points shall be identifiable by tag numbers.

j. The entire system configuration, including database, shall be able to be backed up on Cloud Storage (cloud services shall be prepaid by the system integrator for at least 3 years) as well as a local External Drive.

2. Real Variables Processing.

a. Real Variables shall represent process data for which there are analog signal inputs to the system. The system shall sample each of these input signals at their selected scan frequency and perform the proper conversions and scaling to obtain the instantaneous engineering values. These values then shall be used to update real-time data on screen displays, check for alarm conditions, and store for use in the historical files.

3. Calculated Variables Processing:

a. Calculated variables shall represent process parameters for which there are no direct analog inputs to the system. These variables shall utilize Real Variables and manually entered constants or laboratory data to compute their value.

b. There shall be two types of calculated variables defined:

1) Calculated Variables that utilize one or more Real Variables and/or manually entered constants. These variables shall be treated in the same manner as Real Variables and shall have the same attributes as Real Variables (including alarming and control), with the exception that the calculation shall be performed automatically every 5 seconds.

2) Calculated Variables which are used only for the Daily, Monthly, and Annual Operation Summary reports, and which utilize laboratory input data shall be computed once a day for inclusion in the Daily report and stored for use in the Monthly and

Section 4
Scope of Work and Technical Specifications

SECTION 40 94 03-8 PROGRAMMABLE LOGIC CONTROLLER SUBSYSTEM (PLCS)

Annual reports. The ability to display these variables shall be provided.

c. The System shall provide for a minimum of 4096 calculated variables.

4. Manual Input Data Handling.

a. The application software shall provide the capability to enter data manually from any operator's keyboard. This data shall consist of additional values for the current data file (e.g., laboratory analyses), inserting alarm limits, set point changes, adjustments to process constants, control system set point changes and system tuning parameter adjustments.

b. All manually entered data shall be entered and stored in the appropriate engineering units. All data entered shall be displayed for confirmation on the data entry device prior to incorporation to the database.

2.05 MANAGED ETHERNET SWITCHES

A. The managed Ethernet switch will be IEEE 802.3 compliant.

B. The switch shall be powered by a nominal 24VDC supply.

C. The switch will have a permissible voltage range of 18.5 VDC to 30.2 VDC

D. Switch will support redundant power inputs that allow immediate switchover without switch operation interruption.

E. The switch shall have an operating temperature range of 0°C to +55°C.

F. The permissible storage temperature range for the switch will be -20°C to +70°C.

G. The switch will withstand a maximum continuous operating humidity of 95% without condensation.

H. Units should be of fan-less design to increase reliability

I. Switching Capabilities:

1. Auto-negotiation.

a. All Copper TX ports will support auto negotiation.

b. Each TX port will be able to interface to 10/100/1000 Mbps or full/half duplex devices.

c. Fiber optic ports will support continuous 10/100/1000 Mbps full duplex communications.

Section 4
Scope of Work and Technical Specifications

SECTION 40 94 03-9 PROGRAMMABLE LOGIC CONTROLLER SUBSYSTEM (PLCS)

2. Auto Cross.
 - a. All TX ports will support MDIX providing cable autocross capability.
 3. Auto Polarity.
 - a. The switch will support automatic port polarity change in the event a pair of twisted pair receive cables (RD+/RD-) are connected incorrectly.
 4. Serial Interface.
 - a. The device will have a V.24 RS232 communications interface.
 5. Accuracy & Capacity of switching table.
 - a. The switch will only forward valid Ethernet frames using the store and forward, or equivalent method.
 - b. The MAC address table will have a storage capacity of 8000 addresses.
 6. Configurations.
 - a. The switch will support a removable memory device for the storing of switch settings, and the ability to share settings among like switches.
- J. Diagnostics:
1. Port Status LED's.
 - a. Link: Each port will have an LED indication that there is a proper electrical connection to the attached device as well as providing an indication that there is port activity.
 - b. Communication: Each port will have an LED indication for detection of packet collisions and showing communication duplex mode.
 - c. To simplify the process of troubleshooting, the status indication of heavy communications traffic vs. the status of an active link with no communications traffic will be unambiguous.
 2. LED Display.
 - a. The switch will employ a multi-position diagnostic display for reporting various startup and operational states, or error conditions that may occur.
 3. Alarm Contact.

Section 4
Scope of Work and Technical Specifications

SECTION 40 94 03-10 PROGRAMMABLE LOGIC CONTROLLER SUBSYSTEM (PLCS)

- a. Switch to be equipped with an alarm contact to enable automatic audible or visual alarm in the event of loss of port communication, or either (or both) power supply inputs.
 - b. Switch to be equipped with an LED to indicate the status of the alarm contact.
 - 4. Power Supply LED.
 - a. Switch will have a separate power indication LED for each power supply connection.
- K. Internal Switch Functions:
 - 1. Simple Network Management Protocol (SNMP).
 - a. The switch will support SNMP v1, v2 for network monitoring and configuration.
 - b. The switch will operate with any industry MIB browser.
 - c. Switch will have a system of fully configurable SNMP Trap messages.
 - 2. Device Addressing.
 - a. The switch will, by default, support dynamic device addressing via BootP.
 - b. The switch will be capable of operation with a static IP address assignment.
 - c. Support for switch IP address assignment via DHCP will be available.
 - d. Switch address can be set via serial port connection.
 - 3. Redundancy.
 - a. Rapid Spanning Tree Protocol (RSTP).
 - 1) The switch will conform to the IEEE standard 802.1w for redundancy.
 - 2) The switch will support redundant port connections and loops without causing network operation failure
 - 3) The system of redundancy will be applicable for any network topology
 - 4) Entire redundancy method will be integral to the individual switch and not dependent upon a separate management device.

Section 4
Scope of Work and Technical Specifications
SECTION 40 94 03-11 PROGRAMMABLE LOGIC CONTROLLER SUBSYSTEM (PLCS)

- b. Fast Ring Detection (FRD).
 - 1) The Switch shall support the RSTP extension Fast Ring Detection to enable data channel recovery times faster than standard RSTP.
 - c. Media Redundancy Protocol (MRP).
 - 1) Switch will support MRP in accordance with the IEC protocol 62439.
- 4. Web-Based Management.
 - a. The switch will be programmed with an embedded web server.
 - b. The web server will provide a comprehensive configuration, and diagnostic mechanism for the switch.
- 5. Security.
 - a. The switch will provide the user with the ability to entirely disable the Web-based management interface.
 - b. Switch will support an IP address-based method for restriction of Web server access.
 - c. Modifications to switch settings will be protected by a user selectable/changeable password.
 - d. The switch will support an optional MAC address-based mechanism for controlling port access.
- 6. Port Mirroring.
 - a. The switch will have the ability to send a copy of all network packets seen on one switch port to a network monitoring connection on another switch port.
 - b. The switch will support mirroring of both ingress and egress traffic.
- 7. Firmware Administration.
 - a. The switch will be structured so that future functionalities can be added through firmware upgrades.
 - b. The switch will have the capability to receive firmware upgrades as a field serviceable process.
 - c. Firmware upgrades will be performed via the integrated web server in conjunction with any TFTP server software, or via the serial connection.

Section 4
Scope of Work and Technical Specifications
SECTION 40 94 03-12 PROGRAMMABLE LOGIC CONTROLLER SUBSYSTEM (PLCS)

8. IGMP Snooping and Query.
 - a. The switch will be capable of passively monitoring IGMP (multicast) messages and dynamically creating appropriate groups for proper message forwarding.
 - b. The query interval and snoop aging times will be user configurable to up to 60 minutes.
 - c. The switch will support up to 128 multicast groups.
9. Large Ring Networks.
 - a. The switch will support a configurable "Large Tree" extension to the Rapid Spanning Tree option, making a ring topology suitable for 28 switches along the relevant path from the Root.
 - b. This support option will provide the capability of constructing an RSTP ring topology of up to 57 switches, when all switches are configured with the same function.
10. Traffic Prioritization.
 - a. The switch will support multiple priority queues for adjusting the internal packet processing sequence.
 - b. The switch will employ "Strict Priority" for transmitting data telegrams to ensure all high-priority data packets are transmitted.
 - c. Switch will have a user settable internal prioritization for individual ports, so that the processing of Ethernet data for a particular port can be optimized.
11. Power over Ethernet (PoE).
 - a. Switch shall provide support of Power over Ethernet in compliance with IEEE standard 802.3af.
12. Virtual LAN (VLAN).
 - a. The switch is able to maintain up to 32 concurrent VLANs.
 - b. The switch will support GARP VLAN Registration Protocol (GVRP) for dynamic VLAN implementation.
13. Link Layer Discovery Protocol (LLDP).
 - a. The switch will support LLDP according to IEEE 802.1ab, for topology detection of devices that also have LLDP activated.

Section 4
Scope of Work and Technical Specifications

SECTION 40 94 03-13 PROGRAMMABLE LOGIC CONTROLLER SUBSYSTEM (PLCS)

L. Managed Ethernet switches shall be Allen Bradley, N-Tron, Cisco, Phoenix Contact, Hirschman, or accepted equal.

2.06 UNMANAGED ETHERNET SWITCH SPECIFICATION

A. Ethernet Interfacing & Switching Capabilities

1. The Unmanaged Ethernet switch will be IEEE 802.3 compliant.
2. The switches must be capable of reading and processing high priority Ethernet packets before low priority during times of heavy network traffic in accordance with the priority levels of IEEE 802.1P/Q.
3. Auto-negotiation:
 - a. All Copper TX ports will support auto negotiation. Each TX port will be able to interface to 10/100 meg or full/half duplex devices.
4. Auto Cross:
 - a. All TX ports will provide cable autocross capability.
5. Accuracy & Capacity of switching table.
 - a. The switch will only forward valid Ethernet frames using the store and forward or equivalent method.
 - b. The address table will have a minimum capacity of 4000 addresses.

B. Diagnostics.

1. Port Status LED's.
 - a. Link Active: Each port will have an LED indication that there is a proper electrical connection to the attached device.
 - b. Communications Status: Each port will have an LED indication of communications activity.
 - c. To simplify the process of troubleshooting, the status indication of heavy communications traffic vs. the status of an active link with no communications traffic will be unambiguous.

C. Installation Requirements.

1. Mounting.
 - a. The Switch will be din rail mountable out of the box and without the need to add/assemble adaptor or similar mounting plates.
 - b. All power connections will be wired using removable connectors.

Section 4
Scope of Work and Technical Specifications
SECTION 40 94 03-14 PROGRAMMABLE LOGIC CONTROLLER SUBSYSTEM (PLCS)

2. Port Security.

- a. The switch will be configured to accept optional security frames. When installed, these frames will lock inserted cables or plugs into place, requiring the use of a small mechanical key for cable or plug removal.

D. Environmental Specifications & Agency Approvals.

1. Temperature & Humidity.

- a. The Switch will have an operating temperature range of 0 to 60c or greater. For extended application life, the maximum temperature will be a minimum of 10 degrees C lower than the specified operating temperature of the internal switch chips.
- b. The switch will withstand a maximum continuous operating humidity of 95% without condensation.

2. Electrical Noise Immunity.

- a. The switch will conform to the IEC61000-4-2 to 4-8 series of noise specifications as specified below:
 - 1) IEC 61000-4-2Electrostatic Discharge: Criterion B.
 - 2) IEC 61000-4-3Radiated Noise Immunity: Criterion A.
 - 3) IEC 61000-4-4Fast Transient (Burst) Withstand: Criterion B.
 - 4) IEC 61000-4-5Surge Voltage: Criterion B.
 - 5) IEC 61000-4-6Conducted Noise Interference: Criterion A.
 - 6) IEC 61000-4-8 Electromagnetic Field withstand: Criterion A.

3. Shock & Vibration.

- a. The operating shock rating will conform to IEC60068-2-27 and withstand a shock pulse of 25G or more for 11ms.
- b. The operating vibration spec will conform to IEC60068-2-6 (Criterion 3) at 5G 150Hz, in all 3 axes.

4. Agency Certifications.

- a. The switch will be certified for UL/Cul 508.

E. Unmanaged Ethernet switches shall be Allen-Bradley, N-Tron, Hirschman, Phoenix Contact, Weidmuller, or accepted equal.

Section 4
Scope of Work and Technical Specifications

SECTION 40 94 03-15 PROGRAMMABLE LOGIC CONTROLLER SUBSYSTEM (PLCS)

2.07 ETHERNET COMMUNICATION NETWORKS

A. General

1. Ethernet links shall be provided to connect all PLCs to Network Interface Panels (NIP), Motor Starters (MCC), and Control Panels as shown on the Contract Drawings. The Ethernet communication system shall use modular rack or back of panel mounted components for interfacing with required field connections. Provide necessary racks, interface modules, gateways, segment couplers, power supplies, Fiber-to-Ethernet converters, fiber patch panels and all other components as necessary for a complete and operable Ethernet communications system.

PART 3 - EXECUTION

3.01 PROGRAMMABLE LOGIC CONTROLLER APPLICATION SOFTWARE & DEVELOPMENT

- A. Provide programming to produce completely annotated application programs. Application programs shall be produced on equipment supplied by the Contractor as part of the Work. The application programming shall be developed as follows:

1. The application programs shall be developed in a neat, professional, logical, and efficient manner such that the available PLC memory is not wasted. The application programming shall be completely documented with detailed rung comments and address comments that correspond to tag numbers provided on the Contract Drawings or in the description of operation. Application programming that manipulates analog signals shall utilize values that are scaled in the proper engineering units and are of the correct magnitude. Formulas utilized shall be described in detail.
2. Use the system descriptions from Contract Drawings, process equipment manufacturer supplied information, and other application-oriented documents to develop the application programs.
3. The application programming shall account for the fact that an HMI operator interface will be communicating with the PLC. The programming and addressing schemes shall allow efficient and logical block mapping of points between the various pieces of equipment.
4. Provide programming package software and hardware tools at the conclusion of the Project, including USB Memory drives and reference manuals.

- B. The manufacturer's license agreements for software packages shall be made out to the Owner.

3.02 SCADA HMI APPLICATION SOFTWARE DEVELOPMENT

Section 4

Scope of Work and Technical Specifications

SECTION 40 94 03-16 PROGRAMMABLE LOGIC CONTROLLER SUBSYSTEM (PLCS)

A. Data Management.

1. The workstations shall scan the PLCs on demand and as necessary to retrieve and send analog, discrete and virtual input information for displays, control and related operator workstation functions. The current database shall be resident in the distributed network devices as appropriate.
2. Elapsed running time values shall be maintained in the database for all process drives. This data shall be expressed in hours and tenths of hours and shall be updated every sixty seconds using the last scanned value for each associated discrete input. Accumulated runtime data shall be periodically updated (once per hour) in disk memory. The exact time and date of initiation shall be maintained for each runtime accumulation. The operator may, at any time, from any operator workstation, access historical or current accumulated runtime values and either display or print reports containing accumulated runtime for certain specified equipment (i.e., sorted by accumulated hours, equipment ID, etc. within a user specified range) or all equipment. The operator shall be able to selectively reset any or all runtime accumulations to zero (or other legal values). The specified spreadsheet and database software shall be furnished with all required macros/applications to perform the reporting functions.
3. For reporting purposes, the database shall perform averaging and integration on a point basis over the following time periods:
 - a. Five second – derived from readings accumulated at scan rates, stored for 3 days.
 - b. Five minutes – derived from above 5-second values, stored for 3 days.
 - c. Hourly – derived from above five-minute values, stored for 1 year.
 - d. Daily – derived from above one-hour values, stored for 1 year.
 - e. Monthly – derived from above shift values, stored for 1 year.
 - f. Annually – derived from above monthly values, stored for 1 year.

B. Graphic Display Organization - General

1. The display system described in the following paragraphs only defines those types of displays commonly used during normal operations and overall display organization. Displays shall be based upon information contained on the process flow diagrams, mechanical sheets, electrical drawings, other related drawings, and written narrative descriptions contained in the Specifications. The Contractor shall provide sufficient displays to satisfy all specified plant instrumentation and control system requirements

Section 4
Scope of Work and Technical Specifications

SECTION 40 94 03-17 PROGRAMMABLE LOGIC CONTROLLER SUBSYSTEM (PLCS)

2. The description of the workstation operation in the remainder of this Section is based on the use of a mouse with screen icons. Should an alternate device be provided, operation shall be functionally equivalent to the procedures outlined below.
3. Alternative, but equivalent, graphic display formats and organization may be submitted for acceptance by the Engineer. However, any such substitution shall conform to all functional requirements specified herein.
4. Each display format may consist of more than one page. If so, the display shall contain the message MORE (or other suitable descriptive text) as an icon on the bottom line and the next page shall be obtained by a strike on the "page forward" (PF) or the MORE icon. Back paging shall be accomplished by a strike in the "page back" (PB) icon.
5. The Page Forward (FRWD) and Page Back (BACK) icons shall permit the user to page forward and back page on a multipage listing. If a listing is larger than the capacity of a single screen page, a MORE icon shall appear on the display. MORE means that there is more data for this display which can be accessed a page at a time with the MORE or FRWD icon. The BACK icon shall be used to reverse the forward display sequence, a page at a time. FRWD or BACK icons shall not be used on a single page display.
6. For map based and/or site plan displays, system pan/zoom features as well as system vertical horizontal and vertical scroll bars may be used for this purpose.
7. Vector targets shall be employed to move vertically and laterally between related displays or, alternatively, the vertical and horizontal window can be used, where appropriate.
8. The formats for all schematic diagrams (e.g., unit process, process partition and control strategy diagrams) shall be based on the site plan, mechanical and electrical power distribution drawings and shall be submitted to the Engineer for review. Process displays shall generally be site plan oriented, unless otherwise accepted by the Engineer.
9. The operator screens shall be made of any number of the following components, as appropriate:
 - a. Static and dynamic alphanumeric information.
 - b. Static and dynamic graphic objects.
 - c. Dynamic bar graph displays.
 - d. Dynamic analog trending displays.

Section 4

Scope of Work and Technical Specifications
SECTION 40 94 03-18 PROGRAMMABLE LOGIC CONTROLLER SUBSYSTEM (PLCS)

- e. Password protected operator actions.
- f. Screen navigation commands.

10. Dynamic analog information shall be capable of at least eight value related color changes with or without flashing in response to a change in value, state, or alarm condition for linked tags. Dynamic displays linked to digital tags shall be capable of displaying at least three states with corresponding color/flash indications.

11. All data displayed on operator screens on each workstation shall be valid and current. Current values displayed on operator screens shall be instantly replaced with an error indication for "bad" data, loss of data or loss of communications for each individual tag. These conditions shall be treated as alarms, with specified reporting and routing.

12. When communications are restored and/or errors are cleared, data displays shall automatically display actual values, and "change in status" messages shall be routed to all alarm reports and files.

13. While viewing screens, and through password access, operator interaction with individual, modifiable data points shall include: value changes; placing points on/off scan; manual/automatic mode changes; alarm acknowledge; alarm enable/disable; etc.

14. A "pick" point in an operator screen indicates possible operator interaction for data entry, screen navigation or task switching. When the mouse pointer is "dragged" across operator "pick" points, a highlight box shall appear around each. In addition to pointing and clicking, the operator may press the "down" arrow key, to select a "pick" point and then press enter.

15. Point-click procedures shall be available for all operator/screen interface for navigation, data entry, etc. Operator data entry procedures shall be configured as keyboard entry; point-click calculator; multiple choice point-click, up/down ramping or data value slide.

16. Provide user changeable lower, upper and rate-of-change limits on all screen setpoint entry points. Initial limits shall be set at: lower = 10%, upper = 85% and rate-of-change = 10% of value. The user shall not be able to enter setpoint changes beyond these valid limits.

17. Configure the software at each workstation to check, verify and require appropriate password login prior to each start/stop action, setpoint change, tuning parameter change or any other equipment control or functional change.

18. The system shall respond to each operator request to perform any of these actions in the following manner:

Section 4
Scope of Work and Technical Specifications

SECTION 40 94 03-19 PROGRAMMABLE LOGIC CONTROLLER SUBSYSTEM (PLCS)

- a. Present a "pop up" start/stop faceplate screen with start and stop push buttons for each individually or grouped equipment start/stop system requirement.
- b. Present a "pop up" setpoint entry faceplate screen for each system setpoint change requirement.
- c. Present a "pop up" control parameter tuning faceplate screen for each system control parameter tuning requirement.
- d. English language operator prompting prior to any system response to operator request. Prompting shall inform the operator of the action about to be taken and provide a confirming "proceed" or "quit" choice.
- e. Each action and system response shall be clearly displayed in the appropriate "pop up" screen.
- f. System response indication shall be the most positive feedback required by this specification. At a minimum, the actual PLC register containing the data to be verified shall be displayed and shall be used for any sequential, interlocked or other related control scheme.
- g. At a minimum, each "pop up" screen shall provide for operator input/action and positive feedback indication. Each digital and feedback control display shall provide an English word rather than a digital number indicating conditions. These shall be: start, stop, enable, disable, etc.
- h. Each variable input shall allow operator keyboard or vertical slide bar data entry. Each variable, input, and feedback shall be displayed in number and bar graph formats, both individually and in color-coded multiple bar chart for system evaluation.

19. Objects in screens shall indicate field status, such as "stopped" or "running" by appropriate animation, positioning and color coding.

20. The software on all workstations shall be configured to allow password protected user screen configuration without the use of dedicated programmers, the need to change or reconfigure hardware or cabling, or the need to reboot.

C. Graphic Screen Navigation

1. Each operator screen display shall be configured with a multiple-choice Menu bar at the top of the screen. Each selection button shall display a related pull-down menu of additional selections, screen navigation, system administration, diagnostics and task switching with appropriate password protection.

Section 4

Scope of Work and Technical Specifications

SECTION 40 94 03-20 PROGRAMMABLE LOGIC CONTROLLER SUBSYSTEM (PLCS)

2. Each selection shall be made by a single point-click or by pressing the "down" arrow to the appropriate selection and then pressing [ENTER]. None of these selections shall cause screen updating, database updating, data collection, alarm monitoring or any other system function to pause or stop.
3. When a Menu bar selection is made, the Menu bar button and text for that selection shall protrude and become bold to positively indicate user's selection, and the pull-down menu shall be displayed. When pull-down menus are closed or when a new operator screen is displayed, Menu bar selections return to previous, normal states.
4. Menu bar selections and related pushbutton menu selections and functions shall include:
 - a. SYSTEM Menu bar selection: shall display a pull-down menu with the following selections:
 - 1) SECURITY LOGIN selection: shall display a password login dialogue box, enabling the system user to login by entering an assigned login name and password.
 - 2) SYSTEM ADMINISTRATION selection: shall provide a pull-down menu with the following selections:
 - a) SECURITY CONFIGURATION selection: shall display workstation security configuration dialogue boxes enabling the user, through password protection, to modify or disable/enable workstation security functions.
 - b) FILE MANAGEMENT selection: shall provide the user with password protected access to Windows file manager.
 - c) TASK MANAGER selection: shall provide the user with password protected access to the Windows Task Manager through which any Windows program can be run.
 - d) HISTORICAL CHART CONFIGURATION selection: shall provide password protected access to workstation historical chart, pen and time group configuration through which the user shall be able to view, add and modify historical data charts.
 - e) SYSTEM BACKUP selection: shall provide password protected access to the workstation on-board CD-ROM or tape drive backup function, through which the user shall be able to partially or totally backup workstation software files.

Section 4

Scope of Work and Technical Specifications

SECTION 40 94 03-21 PROGRAMMABLE LOGIC CONTROLLER SUBSYSTEM (PLCS)

- 3) MESSAGE CENTER selection: shall provide access to a personal message center, through which users shall be able to provide brief messages to other users at any workstation on the network.
- 4) DIAGNOSTICS selection: shall display a pull-down menu providing the following selections:
 - a) NETWORK STATUS selection: shall provide workstation network diagnostics indicating status of all network sessions, activity and trouble.
 - b) I/O COMMUNICATION STATUS selection (available on the field I/O server workstations): shall provide password protected interactive display indicating data request/transmit communications status and error conditions between the field I/O server workstation and the PLC data highway.
 - c) COMPUTER DIAGNOSTICS selection: shall provide password protected total workstation review and diagnoses of computer hardware, memory, drives, ports, etc. This function shall also provide hard copy reporting of the entire diagnostics review or any portion thereof.
- 5) FIELD I/O AND PLC CONFIGURATION selection: shall provide a set of screens for each PLC including:
 - a) Manufacturer
 - b) Model Number
 - c) Rack I.D.
 - d) Model number, type and location for each rack module.
 - e) I/O device, associated database tag, and module position for all field I/O points.
- 6) SYSTEM ACTIVITY selection: shall provide a password protected pop-up display of live system activity including alarms, alarm resets, operator entries, communication errors, system messages and database configuration activity. This display shall be used to provide real time feedback for operator requests, troubleshooting, alarm management assistance, etc. This pop-up display shall be sized, moved, closed and set to be always "on-top" during screen navigation by user request and at any time

Section 4

Scope of Work and Technical Specifications

SECTION 40 94 03-22 PROGRAMMABLE LOGIC CONTROLLER SUBSYSTEM (PLCS)

without pausing or stopping data updates, data collection or alarm monitoring.

- b. ALARM Menu bar selection; shall provide user interactive alarm summary screen as specified in the alarms section of this specification.
- c. HELP Menu bar selection: shall provide project-specific full-function Microsoft Windows help including: "contents", "search", "back", etc.
- d. TREND Menu bar selection: shall provide a pull-down menu selection listing for:
 - 1) LIVE TREND choice: shall provide a multiple trend menu of predefined live trends.
 - 2) HISTORICAL TREND selection: shall provide a menu selection listing of predefined historical trends.
- e. REPORTS Menu bar selection: shall provide access to a menu listing for all configured reports with features as described herein.
- f. DISPLAY MENU Menu bar selection: shall display a menu of all plant area displays for screen navigation.
- g. OVERVIEW Menu bar selection: shall display the plant overview screen.
- h. PRINT Menu bar selection: shall print the current display.
 - 1) CONTROL PANEL Menu bar selection: shall provide date and time display and access to Microsoft Windows Control Panel. A single point-click action from a supervisor's security level or above shall display the Control Panel icon group through which modification can be made for:
 - 2) System Date and Time.
 - 3) System Fonts.
 - 4) Printers Setup.
 - 5) Other Standard Windows Control Panel Functions.

D. Process Overview Display(s)

- 1. The process overview graphic display shall be obtained by selecting the OVERVIEW icon. One or more targets or icons shall be provided for each unit process and shall permit the operator to directly access an associated unit process display. The plant site plan layout shall be used as the basis for the

Section 4
Scope of Work and Technical Specifications

SECTION 40 94 03-23 PROGRAMMABLE LOGIC CONTROLLER SUBSYSTEM (PLCS)

process overview display, which shall provide display vectoring functions to subordinate unit process displays. A separate display containing a text-based listing of all system graphic displays shall also be provided, accessible from the Overview Display or a separate Menu bar selection.

2. Intermediate process overviews shall be provided to summarize information from a number of similar or identical unit process equipment items (e.g., filter overview showing all filters, aeration system overview, etc.). These intermediate overview displays shall allow vectoring to/from the plant overview(s) and the individual equipment detail displays and shall show appropriate summary process data.

E. Functional Area Display (s)

1. Functional Area Display(s) Unit Process Graphic Displays shall be provided to show all plant process areas and equipment in detail. Except where specified otherwise, all operator control actions shall be performed at the Unit Process Display level. Any unit process display shall be selectable from the process overview display or from an adjacent process area or otherwise related process display. A unit process display shall be a schematic representation of a process and use standard symbols to represent process equipment such as pumps, tanks, motors, etc. Process status shall be indicated using both color and alphanumeric annotations. Symbol color coding for all displays shall be based on the following convention:

2. All text shall be shown in white except alarm condition statements that are illuminated in either yellow or magenta.

- a. Yellow blinking = device has a noncritical alarm not yet acknowledged.
- b. Yellow = device has a noncritical alarm that has been acknowledged.
- c. Magenta blinking = device has critical alarm not yet acknowledged.
- d. Magenta = device has a critical alarm that has been acknowledged.
- e. Cyan = device off or not available. This may represent future equipment or equipment that has been taken offline for maintenance purposes.
- f. Red = device is on, running, energized, open.
- g. Green = device is available, ready to run, de-energized, closed.

Section 4
Scope of Work and Technical Specifications

SECTION 40 94 03-24 PROGRAMMABLE LOGIC CONTROLLER SUBSYSTEM (PLCS)

h. White with a black target background = device is in automatic (or semi-automatic) control mode.

1) White with a blue target background = device is in manual mode.

3. The displays shall show all ID numbers, current status values and setpoints associated with a given process display and shall be updated with current values every five seconds or less.

4. The control status of each controllable device shall be modifiable and shall be displayed in text adjacent to that device. Control status shall be AUTO, MANUAL, AVAILABLE, etc., and shall be updated continuously. When the operator wishes to take control of the device or modify setpoints, the procedure shall be as follows:

a. The operator shall click on the device symbol with the mouse.

b. A dialog box shall appear which provides the current state or setpoint and enables the operator to make the appropriate change.

c. For two-state devices, the dialog box shall allow the operator to start or stop, open or close, or otherwise change the state of the device.

d. For setpoints and modulating final control devices (analog outputs), the dialog box shall display the old value and shall allow the operator to enter a new value using standard Windows editing techniques. It shall also be possible for the operator to ramp the current value up and down by clicking on ramp targets.

e. Prior to the execution of the operator-commanded action, a confirmation message and target shall be displayed stating the old and new values and asking the operator to confirm the modification.

f. Control strategies shall be changed from AUTO to MAN or OFF (or vice versa) in the same manner as two-state devices.

F. Alarm & Event configuration

1. The operator workstation software shall be configured to provide alarm handling, reporting and archiving. Alarm grouping, printing and display shall be coordinated with Engineer and Owner prior to configuration.

2. Alarm management shall be provided for each database field input and shall include:

a. Alarm reporting enable or disable.

Section 4
Scope of Work and Technical Specifications
SECTION 40 94 03-25 PROGRAMMABLE LOGIC CONTROLLER SUBSYSTEM (PLCS)

- b. Alarm suppression to avoid nuisance alarms such as start up spiking.
 - c. Re-alarming.
 - d. Alarm routing to specific workstations and printers as appropriate.
 - e. Alarm grouping for specific visual and audible group notification.
 - f. Analog alarm types to include at least: low low; low; high; high high; rate of change; deviation; deadband; bad input; and off scan.
 - g. Discrete alarm types to include at least: change from normal; return to normal; change of state; bad input; and off scan.
 - h. Alarm acknowledgement and condition clear format.
- 3. The operator workstation software shall provide date and time stamped alarm reporting to at least five destinations. These destinations shall be:
 - a. Operator screen alarm summaries.
 - b. Alarm printers.
 - c. System alarm and history file.
 - d. System alarm and history display.
 - e. Workstation network.
- 4. All points or modules that have the capability of being alarmed for amplitude or rate of change limit violations, and all discrete alarm inputs shall be linked to an associated discrete point for alarm suppression under specified conditions. For example, when there is no flow through a flow meter, the "not running" signal from the associated prime mover shall be used to suppress all alarms associated with the flow signal. Time delays shall be provided as necessary to eliminate transient alarm annunciation under start-up/shutdown conditions.
- 5. All alarms shall be OLE and Windows Sound System enabled. Sound files shall be individually assigned to each alarm point.
- 6. The system shall provide an alarm summary display as a pre-defined dynamic link within the graphics package. This alarm summary display shall show a list of the pending alarms in the system. As new alarms are detected, entries shall be made to the display list. As the alarm conditions clear, the entries shall be removed from the list.
- 7. The alarm summary display shall be user-configurable to the extent that the user can select the placement of tag name, current value, descriptor, time of

Section 4
Scope of Work and Technical Specifications

SECTION 40 94 03-26 PROGRAMMABLE LOGIC CONTROLLER SUBSYSTEM (PLCS)

alarm, and alarm status on the line as well as the color codes to be used to indicate the various alarm conditions.

8. Only alarms, including the loss of network, data highway and individual field I/O point communications, shall be reported to operator screen alarm summaries, which shall allow the operator to sort alarms in descending or ascending time order. The operator shall also be allowed to apply various priority level filters and to reconfigure alarm summary columns for detailed analyses, while viewing.

9. Alarms shall be acknowledged from the alarm summary display either individually (by clicking on an alarm acknowledgement field) or by a full page using a menu pull-down. The system shall support up to twenty (adjustable) alarm messages in the summary display.

10. Each graphic display shall be configured with the indication of the last three alarms at the bottom of the screen.

11. An unacknowledged alarm shall flash in configured foreground/background colors until it is acknowledged. When an alarm is acknowledged, it shall stop flashing but remain displayed until the alarm condition is cleared.

12. When an alarm condition has been both acknowledged and cleared, the alarm statement shall be removed from the alarm summary.

13. Alarm summaries shall use system colors and provide at least the following column information:

- a. Date and time.
- b. Workstation name.
- c. Tag number.
- d. Tag description.
- e. Alarm condition.
- f. Tag value.

14. Configure alarm summaries with a distinctive color format for:

- a. Background color.
- b. High value alarms.
- c. Low value alarms.
- d. Rate-of-change alarms.

Section 4
Scope of Work and Technical Specifications
SECTION 40 94 03-27 PROGRAMMABLE LOGIC CONTROLLER SUBSYSTEM (PLCS)

- e. Digital status alarms such as change of state, change from normal, etc.
 - f. Plant area/access alarms.
15. The following color codes shall be used in conjunction with alarm displays:
- a. Cyan = normal.
 - b. Yellow, blinking = noncritical, not acknowledged alarm.
 - c. Yellow = noncritical, acknowledged alarm.
 - d. Magenta, blinking = critical, not acknowledged alarm.
 - e. Magenta = critical, acknowledged alarm.
16. The following alarm condition statements shall be provided as a minimum:
- a. RTN NRML - Return to Normal.
 - b. HHHH LMT - Second High Limit.
 - c. HI LMT - High Limit.
 - d. LO LMT - Low Limit.
 - e. LOLO LMT - Second Low Limit.
 - f. ROC LMT - Rate of Change Limit.
 - g. STAT CHGE - Status Change.
 - h. OFF SCAN - Off Scan.
 - i. OPEN FAIL - Open Failure.
 - j. CLOSE FAIL - Close Failure.
 - k. START FAIL - Start Failure.
 - l. STOP FAIL - Stop Failure.
 - m. FAULT – Fault.
 - n. HI DEV - High Deviation.
 - o. LO DEV - Low Deviation.
 - p. DISCREP – Discrepancy.
 - q. UNAVAIL – Unavailable.

Section 4
Scope of Work and Technical Specifications

SECTION 40 94 03-28 PROGRAMMABLE LOGIC CONTROLLER SUBSYSTEM (PLCS)

17. Date and time stamped alarm reporting shall be sent to alarm printers with similar formatting, configuration and routing procedures as specified for alarm summaries.
18. Configure alarm and history files for sequential date and time stamped activity reporting for the entire system, on each workstation. This file shall be a daily text file with a file name indicating the date that the file was created, and shall include all system wide activity including:
 - a. Alarms.
 - b. Alarm acknowledgement.
 - c. Loss and recovery of network, data highway and individual field I/O point communications.
 - d. Status changes.
 - e. Alarm clear and return to normal messages.
 - f. Operator keyboard entries.
 - g. Other system related activities (system startup, save/reload database, etc.).
19. Information format shall include:
 - a. Date and time.
 - b. Description.
 - c. Condition.
 - d. Current value.
20. Alarm and history files shall be saved to computer backup media including CD's or tapes if selected by the operator.
21. The alarm and history display shall provide live viewing of alarm and history file entries, giving the operator instantaneous activity review and operator action verification.
22. The system alarm and history display, with on-line height and width adjustment capabilities, shall be displayed as part of operator screens, upon demand. The operator shall be able to size and move the display, as desired. Further, the operator shall be able to close this display, upon demand, or cause it to be continually displayed as the operator navigates through operator screens.
23. The opening, closing, moving or resizing of this display shall not cause screen updating, database updating, historical data collection, alarm monitoring or any other system function to pause or stop.

Section 4
Scope of Work and Technical Specifications
SECTION 40 94 03-29 PROGRAMMABLE LOGIC CONTROLLER SUBSYSTEM (PLCS)

24. Workstations shall be configured to report all alarm conditions, operator activity, etc. to all other workstations.
25. The system shall be configured to provide a periodic date stamp on the alarm printout at the alarm printer to provide clear date/time evaluation of printed alarms.
26. Each workstation shall be configured for alarm and history activity file backup and archiving to the on-board tape or CD drive. Provide alarm and history file backup, and disk space management procedures.

G. System Security

1. Observer.
 - a. Graphic display viewing and navigation.
 - b. Historical data display.
 - c. Password login and logout.
 - d. Observer shall be the system default security mode.
2. Operator.
 - a. Observer privileges.
 - b. Password protected start/stop, setpoint entries, system activity display, etc.
 - c. Lead Operator/Supervisor.
 - d. Operator privileges.
 - e. Historical data chart configuration.
 - f. Report viewing, modification and exporting/printing.
 - g. Task switching to the Windows operating system.
 - h. Software system shut down.
 - i. Windows NT Task Manager access.
3. System Administrator/Engineer.
 - a. All privileges.
4. The software at each workstation shall be configured to automatically log in the observer group upon system startup.

Section 4

Scope of Work and Technical Specifications

SECTION 40 94 03-30 PROGRAMMABLE LOGIC CONTROLLER SUBSYSTEM (PLCS)

5. The security system at each workstation shall be configured to not allow SCADA software shut down or Windows NT security access unless requested through Supervisors' or System Administrator security privileges.
6. The security configuration shall be exportable to a text file, which shall not include passwords. This text file shall have a user defined acronymic, mnemonic file name and shall be capable of being imported into the system to modify or create workstation security configuration.
7. All workstation security activity, including violations, shall be reported in a date and time stamped format to a daily text file for review and evaluation at any time. This security text file shall have a file name indicating the date that the security file was created. It shall be possible for any text editor to edit these files.
8. Each workstation shall be configured for security activity file backup and archiving to the on-board tape drive.

H. Trend Configuration

1. The system shall provide multiple sets of live trends in operator screens. Each set of live trends shall be capable of the following:
 - a. Displaying up to eight pens.
 - b. Being temporarily modified, while viewing.
 - c. Displaying straight line or varying data value "target" curves.
 - d. Full screen trend curve displays when trend screen is opened.
2. Each live trend chart shall allow temporary, on-line pen, range and chart X-Y parameter changes by the user. Each trend display shall allow on-line user modifiable straight-line "target" curve for each trended data point and as specified, a user selected varying data value "target" curve based on pre-defined modeling for trended data points.
3. Trends shall automatically shut down and release system resources when closed.

I. Historical Data Management Configuration

1. The operator workstation SCADA, database, spreadsheet and reporting software shall be configured to provide historical data gathering for system and operations validating, testing, maintenance and regulatory reporting.
2. The system shall provide multiple choice options for historical data file size and shall automatically assign file names indicating the date and duration for data contained in each file. The installed system shall be configured for sequential data files beginning at midnight.

Section 4

Scope of Work and Technical Specifications

SECTION 40 94 03-31 PROGRAMMABLE LOGIC CONTROLLER SUBSYSTEM (PLCS)

3. For data and system resource management the system shall allow the assignment of any number and type of database tags and tag groups for historical data collection with the following attributes:
 - a. Collection rate and phasing.
 - b. Data collection start/stop condition.
 - c. Data collection deadband.
4. For additional resource management, the operator workstation software shall be configured to automatically delete historical data files when they reach a certain age, which is user selectable from a multiple-choice options list. Set initial automatic file deletion at 20 days with backup and archiving procedures occurring prior to deletion.
5. Configure each workstation for historical data files backup and archiving to Cloud Storage and local external Drive.
6. Provide historical data files backup, and disk space management procedures.
7. All attributes of each historical display chart shall be able to be configured or modified at any time.
8. In addition, the user shall be able to make temporary, view only modifications, while viewing historical trend charts.
9. The system shall be configured for the following on-line historical data user functionality, without pausing or stopping any system function:
 - a. Zoom to any specific area of a chart.
 - b. Automatic real-time update of historical data, upon demand.
 - c. Reset to original trend chart parameters, upon demand.
 - d. Request completely different start/stop time and duration parameters, upon demand.
 - e. Chart data display update forward or backward in time, by a single point-click for two sets of modifiable time increments in each direction.
 - f. Export displayed trend chart data into a text file with a user defined acronymic, mnemonic file name.
 - g. Print any displayed historical trend chart, upon demand.
 - h. Display multiple historical trend charts at the same time with time synchronizing for detailed analyses.

Section 4
Scope of Work and Technical Specifications
SECTION 40 94 03-32 PROGRAMMABLE LOGIC CONTROLLER SUBSYSTEM (PLCS)

- i. Data trend charts configured by combining any pen and time groups.
 - j. Trend chart display format changes including colors, titles, legends, etc.
- 10. When configuring tag pen groups, the system shall provide for user configuration of at least:
 - a. Individual tag and related attributes.
 - b. Default or specific data value range.
 - c. Individual color for each tag pen.
 - d. A specific letter to further document each pen related curve.
 - e. Trend chart display format.
- 11. Time group configuration shall include at least the following:
 - a. Start/stop dates and times.
 - b. Duration.
 - c. Sample, average value, high value and low value displays individually or together.
 - d. Trend chart display format.
- 12. Historical data files shall be saved to computer backup media including diskettes, tapes or optical disks if the operator chooses this option. The system shall allow these files to be restored to the appropriate system file path and reviewed with all system functions at any time, as if they had continued to be hard disk resident.
- 13. The collection of historical data shall begin automatically upon software system start-up.
- 14. All analog and digital field inputs shall be historically collected. Provide collected data in the "sample" mode with collection rate, phasing, etc. attributes assigned to maximize data collection and system resources.
- 15. Provide the following time groups:
 - a. The previous hour.
 - b. The previous twenty-four (24) hours.
 - c. The previous thirty (30) days.

Section 4
Scope of Work and Technical Specifications

SECTION 40 94 03-33 PROGRAMMABLE LOGIC CONTROLLER SUBSYSTEM (PLCS)

16. Operator access for viewing or printing any individual project specific, pre-defined historical trend chart shall be through a single point-click action while viewing operator screens via the TREND Menu bar selection.

J. Reports Configuration

1. The report generator shall employ the specified electronic spreadsheet, report writing and database programs to provide the user with an interactive method to define, change, and replace report formats. The specified database, spreadsheet, and reporting software shall be furnished with all required applications and macros to perform the specified reporting functions.

2. The report generator shall permit arithmetic, relational, logical and statistical operations on individual or groups of data values contained in the distributed database and shall be employed to build shift, daily, equipment runtime and other specified reports utilizing network based dynamic data exchange access to the databases.

3. The reporting module shall provide the user with all standard Excel-type interactive spreadsheet formats, functions, linking, various kinds of charts, live spreadsheet/database interaction, fonts, math functions, macros, print options, and report saving.

4. All tags in the Control and Information System, including inputs, outputs, calculations and historical data shall be available for use in reports. Points shall be referenced in report formats by tag names or pen/time groups, and linking to reports shall be automatic and transparent to the user.

5. Each report shall be capable of linking and displaying the following:

- a. All attributes of database tags including:
 - 1) Current value.
 - 2) Engineering units.
 - 3) Descriptors.
 - 4) Field I/O equipment addresses.
 - 5) Alarm parameters.
- b. Any combination of historian pen/time groups.
- c. Manually entered data.
- d. Text.
- e. Date and Time.

Section 4

Scope of Work and Technical Specifications

SECTION 40 94 03-34 PROGRAMMABLE LOGIC CONTROLLER SUBSYSTEM (PLCS)

6. The report package shall allow on-line user selection of a value or groups of values, and instantaneously create charts in X-Y, bar graph, pie and other formats. Charts shall be modifiable upon viewer demand. Chart printouts, on demand, shall be provided.
7. Reports shall display entries indicating "no data" and "bad data" to distinguish error conditions from zero values for individual report data links.
8. Report generation or configuration shall not cause screen updates, database updates, historical collection, alarm monitoring nor any other system operation to pause or stop.
9. The report module shall open on top of operator screens, so that, upon exiting, the previous operator screen shall be automatically displayed and shall be fully functioning and updating.
10. The reporting of system operating data shall occur once per day at user-specified times. Data recorded on these reports shall be extracted from the operator workstation data files as required. Report data shall consist of the arithmetic average and sums of variable readings taken by the control system on scans made during the previous 24-hour period and from manually entered data. Where applicable, total, average, maximum, and minimum values shall be provided for each column of data on each report.
11. User access to any individual report shall be provided by means of a single point-click from a menu of all project specific reports.
12. Password protected access to reports shall also enable the user to create and/or modify reports through standard Microsoft Excel configuration and system macro procedures.
13. No reports access, work, viewing or any other reports related activity shall require the suspension, modification or the stopping/starting of the report's scheduler. Nor shall this activity cause any pausing or stopping of data updating, data collection, alarm monitoring, or any other Control and Information System function.

3.03 SYSTEM CONFIGURATION AND EXPANSION

- A. The system shall provide an on-line installation and configuration program for configuring the various computers on the network. This configuration software shall allow assigning unique node names to each computer as well as selecting the functions that the machine will perform.
- B. The system shall allow additional computers to be added to the network while on-line, without disrupting the operations of the other machines.

3.04 DIAGNOSTICS

Section 4

Scope of Work and Technical Specifications

SECTION 40 94 03-35 PROGRAMMABLE LOGIC CONTROLLER SUBSYSTEM (PLCS)

A. The system shall provide on-line diagnostics that display the current status and operation of the local area network and its nodes. The diagnostic display shall include the LAN adapter status for the machine showing the display, as well as the current number of messages, errors and retries.

B. An additional display shall show the current session status (established, pending, offline) of all stations on the network. A session monitor program that automatically monitors and recovers communications shall be supplied with the system.

3.05 LICENSE AGREEMENTS/SECURITY

A. The manufacturer's license agreements for software packages shall be made out to the Owner.

B. Contractor developed application programs shall become the property of the Owner at the conclusion of the Contract. There shall be no license agreements of any kind for these programs.

C. The Owner shall be provided with passwords required to access the PLC application programs and operator interface configuration data. There shall be no Contractor programmed security schemes that prevent access to the application programs or configuration data.

END OF SECTION

SECTION 44 13 16

CARBON ADSORPTION ODOR CONTROL SYSTEM

PART 1 – GENERAL

1.01 SCOPE

A. Furnish all materials, equipment, and incidentals required to install one (1) odor control system for the control of odorous atmospheric Hydrogen Sulfide (H₂S) gases at levels as specified herein. The odor control system shall be an engineered, dry chemical media system consisting of media containment vessel, centrifugal fan, mist and grease filter, dry media, interconnecting duct work, and other appurtenances for a complete operating system.

B. The system shall include the following components:

1. Insulated FRP Radial Vessel
2. Dry Media
3. Fan and Motor Assembly
4. Instruments
5. Control Panel
6. Mist and Grease Filter
7. Interconnecting Ductwork
8. Fan Acoustic Enclosure
9. Exhaust Stack with Rain Cap

1.02 REFERENCES

A. ASTM International

1. D2563, Standard Practice for Classifying Visual Defects in Glass Reinforced Plastic Laminate Parts.
2. D2584, Standard Test Method for Ignition Loss of Cured Reinforced Resins.
3. D2854, Standard Test Method for Apparent Density of Activated Carbon.
4. D 2867, Standard Test Methods for Moisture in Activated Carbon.
5. D3299, Standard Specifications for Filament-Wound Glass-Fiber-Reinforced Thermoset Resin Corrosion-Resistant Tanks.

Section 4
Scope of Work and Technical Specifications

SECTION 44 13 16-2 CARBON ADSORPTION ODOR CONTROL SYSTEM

6. D3467, Standard Test Method for Carbon Tetrachloride Activity of Activated Carbon.
 7. D3802, Standard Test Method for Ball-Pan Hardness for Activated Carbon.
 8. D4097, Standard Specification for Contact-molded Glass Fiber Reinforced Thermoset Resin Corrosion-Resistant Tanks.
 9. D3982, Standard Specification for Contact Molded Glass Fiber Reinforced Thermoset Resin Duct and Hoods
- B. National Bureau of Standards (NBS) PS 15-69, Custom molded reinforced polyester for chemical resistant process equipment.
- C. National Electric Code (NEC)
- D. Air Moving and Conditioning Association (AMCA)
- E. National Institute of Standards (NIST)
- F. National Electrical Manufacturers Association (NEMA)

1.03 SUBMITTALS

- A. Submittals shall be made in accordance with the requirements of Section 01 30 00.
- B. Vendor shall provide a detailed engineering submittal for the proposed equipment. All materials contained in the submittal package must be specific to addressing items below, submittals that include any general data sheets or general marketing material will be rejected without review. If more than two submittal packages are rejected the contractor may incur additional cost for additional review. Submittals shall include:
1. General Specification Compliance Document
 - a. A copy of this specification with a notation beside each line item confirming compliance or any deviations / exceptions. Any deviations or exceptions should be clearly explained in a separate section of the submittal. If any items are not found to be addressed during an engineer review the submittal will be rejected.
 - b. Professional engineer/designer's resume showing experience in radial flow dry media system design.
 - c. Installation list with engineering data for each individual reference and contact information.
 2. Vessel, Isolation Damper and Interconnecting Ductwork:

Section 4
Scope of Work and Technical Specifications
SECTION 44 13 16-3 CARBON ADSORPTION ODOR CONTROL SYSTEM

- a. Provide structural calculations, including material property test data.
- b. Vessel fabrication details and materials of the components shall be included in shop drawings and submitted for approval before fabrication.
- c. Vessel design calculations stamped by a professional engineer.
- d. Resin manufacturer's certificate listing the nomenclature, composition, and characteristics of the resin shall be furnished for all major components including the vessel, dampers and ductwork. This should include a letter from the resin manufacturer stating recommended corrosion liner for service outlined in this specification.
- e. AMCA certified pressure drop and leakage tests for the vessel isolation damper accompanied by a letter confirming the product has current AMCA certification.
- f. Vessel fabricator's certificate of compliance with fabrication requirements.
- g. Copy of fabricator's quality assurance (QA) program.
- h. Detailed information on the internal media retention system to include free area calculations, construction data, baffling system and compaction compensation calcs. Calculations shall be supported by detailed CFD (Computational fluid dynamic) modeling. CFD shall have been performed by a professional engineer.

3. Prefilter

- a. Detailed drawing showing wall construction, pad construction details, end connections and access configuration.
- b. Installation instructions and O&M Data.
- c. Detailed removal and performance calculations.
- d. List of previous installations where a similar prefilter has been utilized by the system supplier complete with names and contact numbers.
- e. Detailed pressure-drop and removal calculations for the prefilter.

4. Media:

- a. Furnish within 60 days after contract execution a certificate from the media manufacturer certifying that the proposed media will meet the

Section 4
Scope of Work and Technical Specifications
SECTION 44 13 16-4 CARBON ADSORPTION ODOR CONTROL SYSTEM

specifications. Provide a 1-gallon representative carbon sample of each media and specification sheet.

b. Statement of origin and manufacturers test data noting lot numbers. Submitted lot numbers shall be confirmed with actual material delivered.

c. Media manufacturer's certificate to include statement of origin and test results.

d. Calculations showing the theoretical anticipated life of media (based on anticipated H₂S concentrations).

5. Catalog information, descriptions, specifications layouts, sketches and other information sufficient to clearly and readily demonstrate compliance with all parts of the specifications and drawings.

6. Dimensional and weight information. Include empty weight and operating weight with carbon.

7. A list of installations where similar radial flow equipment by the manufacturer is currently in service; include contact name, telephone number, mailing address, and the names of the engineer, owner, and installation contractor.

8. CFD modeling of the proposed radial flow model showing airflow distribution through the air plenum and media consumption.

9. Resin manufacturer's certificate listing the nomenclature, composition, and characteristics of the resin shall be furnished for all major components including the vessel, dampers and ductwork. This should include a letter from the resin manufacturer stating recommended corrosion liner for service outlined in this specification.

10. Special shipping, storage, and protection, and handling instruction.

11. Suggested spare parts list to maintain the equipment in service for a period of 1 year.

C. The manufacturer shall provide a quarterly analysis of the media to the Owner to be reported as "H₂S capacity." This service shall be furnished for one year from acceptance of the system.

D. Operation & Maintenance Manuals: Furnish O&M Manuals after approval of submittal. Each item of mechanical and electrical equipment supplied as stated below:

1. Complete operating instructions.

2. Lubrication Schedule.

Section 4
Scope of Work and Technical Specifications
SECTION 44 13 16-5 CARBON ADSORPTION ODOR CONTROL SYSTEM

3. Preventative Maintenance Procedures and Schedules.
4. Recommended Troubleshooting and Start-Up Procedures

1.04 QUALIFICATIONS

- A. All systems shall be supplied by a single manufacturer fully experienced, reputable, and qualified in the manufacture of the equipment to be furnished.
- B. The manufacturer shall provide at least 10 references of Radial Flow installations above 5,000 CFM along with contact information.
- C. In order to ensure unity of responsibility, skid, fan, interconnecting duct, vessel, control panel, dry media, and other miscellaneous system appurtenances shall be furnished by a single manufacturer.
- D. Make sure the complete system and all items of equipment conform to all applicable Federal, State and local codes, laws, rules, and regulations and to all applicable safety standards including those for the safety of personnel.
- E. Media manufacturer shall be responsible for free media sampling analysis once per quarter. Media Samples shall be shipped to odor control manufacturer for laboratory analysis.
- F. Third party media analysis shall be by others.

1.05 WARRANTY

- A. The manufacturer shall warrant that the equipment sold shall be free from defects in material and workmanship for a period of one (1) year from the date of system acceptance or 18 months from the date of shipment, whichever comes first. The warranty does not apply to the media itself.

PART 2 – PRODUCTS

2.01 GENERAL

- A. The system supplier shall furnish all of the items required to provide a properly functioning system for the service conditions listed herein, including but not limited to the vessels, media, fan, controls, interconnecting ductwork, mist and grease filter, exhaust stack, damper, interconnecting ductwork, inlet / outlet flexible connectors for the fan and all appurtenances necessary for a complete system. The Basis of design is model RF1010 Radial Flow System from PureAir Filtration.
- B. The products shall be the end products of one responsible system supplier in order to achieve standardization of appearance, operation, maintenance, spare parts, and manufacturer's services. Acceptable suppliers of the full packaged system include PureAir Filtration and ECS Environmental Solutions of Belton TX. Alternate suppliers shall be preapproved prior to the bid date.

Section 4
Scope of Work and Technical Specifications
SECTION 44 13 16-6 CARBON ADSORPTION ODOR CONTROL SYSTEM

C. A submittal package prepared in accordance with 1.03 shall be submitted to the engineer prior to bid tender to gain approval as an approved system supplier. The submittal package shall be complete with all components listed noting any deviations or exceptions that will be taken to the base system design.

2.02 SERVICE CONDITIONS

A. The odor control system shall be designed to remove the odorous constituents from the process air stream under the following operating conditions:

Parameter	Value
Duty	Continuous
Inlet Air Temp	0 to 120 degrees F
Inlet Relative Humidity	30% to 90%
Designed system airflow	9,000 CFM
Removal Required	
10 PPM AVG. H ₂ S	99.5% Removal
0.5 PPM Methyl Mercaptans	95% Removal
0.5 PPM Dimethyl Sulfides	80% Removal
100,000 Odor Units (OU) Concentration	95% Removal

B. The vessels shall conform to the following parameters:

Parameter	Value
Vessel Type	Radial Flow
Vessel Material of Construction	FRP
Pressure Drop (Max) (Vessel Inlet to Outlet)	6-inches WG
Media Volume (Min)	481 Cubic Ft
Media Bed Depth:	3 Ft
Max Avg Bed Velocity	60 FPM
Empty Bed Contact Time	3.2 Seconds
Vessel Diameter:	10 Ft

2.03 ADSORBER VESSEL AND DUCTWORK

A. The FRP adsorber vessels shall be filament-wound, manufactured in accordance with ASTM D3299. The visual defects, per ASTM D2563, shall not exceed Level II on the vessel interior and Level III on the vessel exterior. The resin used shall be Dow 510, AOC K022, or approved equal suitable for continuous exposure to saturated water vapor, hydrogen sulfide gas, and their associated acidic products. The resin system should provide a Class 1 flame spread rating. Antimony, Nyacol or any other additives are not allowed. A permanent wax containing resin coating, formulated according to the resin manufacturer's most recent recommendations (or other Engineer-approved method) shall be used for surface protection and to prevent air inhibition of resin curing. Contact molded accessories shall be manufactured in accordance with NBS PS15. The

Section 4
Scope of Work and Technical Specifications

SECTION 44 13 16-7 CARBON ADSORPTION ODOR CONTROL SYSTEM

completed vessel shall be translucent until it is gel coated. The final gel coat color shall be selected by the Owner or Engineer. A certificate from the resin manufacturer listing the nomenclature, composition, and characteristics of the resin shall be furnished with the vessel. Stainless, PVC, HDPE, PP or other non-reinforced plastic vessels will not be acceptable. Acceptable manufacturers for the FRP vessel are Diamond Fiberglass, Ershigs, Belco, Ancor, Design Tank or prequalified equals.

B. An inner corrosion barrier shall be provided consisting of no less than three laminated layers. The inner corrosion layer shall be resin rich, not to exceed 20 percent plus or minus 5 percent glass by weight, and a minimum thickness of 10 to 15 mils. The inner corrosion layer shall be followed by at least two layers of chopped-strand mat or two passes of chopped roving to a total of 3 ounces per foot. Should the chopped roving technique be employed, the chopped fibers shall be 1/2 inch to 2 inches in length. The total corrosion barrier shall total 100 mils minimum and be 27 percent plus or minus 5 percent glass by weight.

C. The structural aspects of the vessel shall be sufficient to meet recommended requirements, including seismic requirements for all conditions during the design life. Manufacturer shall include with the shop drawings, detailed calculations illustrating the seismic characteristics of the proposed vessels. Calculations shall be signed and stamped by a registered mechanical engineer.

D. In addition to the above requirements, the adsorber vessel shall have an average glass content of 55 percent plus or minus 5 percent by weight per ASTM D2584.

E. Tie down lugs and lifting lugs shall be 316 stainless-steel. Quantity and design shall be determined in the PE stamped vessel calculations.

F. The adsorber vessel shall be complete with integral carbon screen support structure, access manways, air inlet connection, air outlet, discharge stack with rain cap, pressure differential assembly, a fill connection, a drain connection, sample port nozzles, 316 stainless grounding rod and all necessary accessories as shown on the Drawings and/or specified within. All exhaust air shall leave the vessel at the top. Provide sufficient access manway so that all internal parts can be easily removed from the vessel. All metal parts shall be Type 316 stainless steel with no metallic parts contacting the carbon except for grounding purposes. No pultruded components shall be used on the interior of the vessel unless they are completely coated with the specified 100-mil corrosion barrier and manufactured using the specified resin systems.

G. The adsorption vessel shall have dual media design for the installation of two independent media beds. Each bed can be emptied and refilled completely separate from the other, all through large shared manways.

H. Access manway covers shall be airtight at the pressure equal to or higher than the corresponding fan static pressure. The fabrication details and materials of the

Section 4

Scope of Work and Technical Specifications
SECTION 44 13 16-8 CARBON ADSORPTION ODOR CONTROL SYSTEM

components shall be included in shop drawings and submitted for approval before fabrication.

- I. Vessel shall have an internal slope bottom. Bottom shall be sloped to a drain nozzle at 1/8" per foot in diameter. The low point of the slope shall be raised to ensure full drainage.
- J. Vessels shall have a flanged top section to facilitate complete removal of all internal components. The Flange shall be designed for 12" positive pressure and full hydrostatic loading.
- K. Vessel design and airflow configuration shall be furnished to accommodate a cylindrical, vertical media bed. Airflow shall be horizontal through the bed.
- L. Support system requirements;
 - 1. The bed and vessel configuration are to be conducive to easy carbon replacement. Beds shall have carbon fill / access ports and one access manway placed so man-entry of the vessel is not required.
 - 2. Each vessel shall be provided with two independent internal support columns.
 - 3. Columns shall be manufactured from FRP, 316 Stainless Steel or Hastelloy. Unreinforced plastic columns (PVC, PP, HDPE) are not acceptable. Retention screen shall inter-wound in the support column so that it cannot be disturbed during filling / removal of media. If metal is utilized, retention screen shall have an independent structure on either side. Loose retention screen is not acceptable.
- M. Each bed shall be grounded with a 316 stainless steel rod to prevent static electricity from accumulating. A predrilled and tapped copper grounding pad shall be located on external vessel walls.
- N. All cut-walls from tank wall nozzle cutouts shall be reinforced as required by service conditions. Press molded or compression molded flanged nozzles are not acceptable.
- O. Add ultraviolet absorbers to surfacing to improve weather resistance.
- P. No dyes, pigments or colorants except in exterior gel coating.
- Q. Vessel sidewall and top surface shall be insulated at the factory. Insulation system shall consist of 2" rigid foam board encapsulated with a 1/4" thick FRP outer skin. R value should be minimum 14.
- R. The Vessel shall be provided with the following:
 - 1. Anchor Lugs – 316 SS

Section 4
Scope of Work and Technical Specifications
SECTION 44 13 16-9 CARBON ADSORPTION ODOR CONTROL SYSTEM

2. Lifting Lugs – 316 SS
3. Manways and Cover for Media Filling
4. 24-inch Side Access Manway to Media Support Bed
5. Integrated Media Support System Compatible with H₂S.
6. Inlet Flange
7. Outlet Flange
8. Media Sampling Ports
9. Pressure Taps
10. Air Sampling Ports
11. Grounding Rod
12. Vessel Drain

2.04 ACTIVATED CARBON MEDIA

A. The Odor Control System shall contain two types of media – Sulphasorb XL and CPS12 Blend Media to provide complete removal of noxious odors.

B. The Sulphasorb XL media shall be spherical or cylindrical porous pellets formed from a combination of powdered activated alumina and other binders, suitably impregnated with potassium permanganate to provide optimum adsorption, absorption, and oxidation of a wide variety of gaseous contaminants. The Sulphasorb XL Media shall be UL Class 2 listed. The Sulphasorb XL Media shall be capable of absorbing and removing odorous gases throughout the entire pellet. The Sulphasorb XL Media shall have the following physical properties:

1. H₂S Removal Capacity (by volume): 0.30 g/cc
2. H₂S Removal Capacity (by weight): H₂S: 75%
3. CTC value: 70% min
4. Surface Area: 1050 m²/g
5. Density: 580 kg/m³
6. Moisture Content: 15%
7. Hardness: 95 min
8. Ignition Temperature: 425 C

Section 4
Scope of Work and Technical Specifications
SECTION 44 13 16-10 CARBON ADSORPTION ODOR CONTROL SYSTEM

C. The CPS12 Blend Media shall be UL Class 1 listed. The CPS12 Blend Media shall be capable of absorbing and removing odorous gases throughout the entire pellet. The CPS12 Blend Media shall have the following physical properties:

1. Removal Capacity:
 - a. Hydrogen Sulfide: 0.20 g/cc min (24% by weight)
 - b. Sulfur Dioxide: 0.11 g/cc min (12% by weight)
 - c. Nitric Oxide: 0.06 g/cc min (7.5% by weight)
 - d. Nitrogen Dioxide: 0.024 g/cc min (3.0% by weight)
 - e. Formaldehyde: 0.04 g/cc min (5.0% by weight)
2. Manufacturing Quality Assurance Standards:
 - a. Leach Test (Indication of Porosity)- 180 minute or less
 - b. Permanganate Content: 12 % minimum
 - c. Moisture Content: 20 % maximum
 - d. Crush Strength: 40 to 60 %
 - e. Abrasion Loss: 3.0 % maximum
 - f. Nominal Pellet Diameter: 1/8" (approximately 4 mm), 85% after screening
 - g. Nominal Density: 50 lbs/ft³ (0.80 g/cc)

2.05 FAN

A. The activated carbon adsorber fan shall be backward-inclined or radial blade, V-belt driven, centrifugal FRP fan designed for continuous 24 hour per day service. The fan housing, impeller, inlet flange, and outlet flange shall be constructed of fiber glass reinforced plastic in accordance with NBS PS 15. The surface of fiber glass reinforced plastic in contact with the odorous air shall be corrosion resistant. The exterior surface of the fiber glass reinforced plastic in contact with the atmosphere shall be finished with a final gel coat. The finished exterior shall be smooth with no exposed fiber, sharp projections, foreign inclusions, air bubbles, pin holes, or delamination's. The shaft and other metal parts in contact with the odorous air shall be encapsulated with fiber glass reinforced plastic.

B. The fan inlet and outlet shall have integral transitions to circular or rectangular flanged openings as indicated. The flange ends shall be suitable for attachment to flexible duct connectors in accordance. The blower shall be statically and dynamically balanced at operating speed prior to shipment. The blower housing shall be equipped with a threaded PVC drain coupling and shut-off valve at its lowest point.

Section 4
Scope of Work and Technical Specifications

SECTION 44 13 16-11 CARBON ADSORPTION ODOR CONTROL SYSTEM

- C. The fan shall be rated for 9,000 CFM. The fan motor shall be a heavy-duty type, TEFC, Premium Efficiency for 460-volt, 3 phase, 60 Hz power supply. Each belt shall be capable of driving the fan at rated capacity if the second belt breaks. A sliding motor base plate shall be provided for belt tension adjustment.
- D. The fan shall accommodate external static pressure in addition to total static pressure as calculated by the manufacturer of the Carbon Scrubber.
- E. The fan shall meet AMCA requirements. All parts of the fan that are exposed to the airstream shall be encapsulated in FRP with graphite impregnation to insure corrosion resistance and spark proof operation.
- F. All fans shall be equipped with the following features and accessories:
1. Flanged inlet/outlet
 2. PVC coupling drain
 3. Teflon Shaft Seal
 4. Shaft and Belt Guards
 5. Constant-speed V-belt drive

2.06 SOUND ATTENUATION PACKAGE

- A. A FRP sound enclosure shall be provided by the system supplier. Construction and performance shall be as follows:
- B. Walls shall be vacuum-formed construction with two layers of FRP over a honey-comb core.
- C. Resin, liner, color and exterior coating system shall be the same as specified for the adsorber vessel.
- D. Enclosure shall have an exhaust fan with explosion-proof motor and acoustic louver installed.
- E. Enclosure shall be manufactured so that it can be easily removed for maintenance. A single split-line is to be centered on the fan outlet.
- F. Enclosure shall be single-piece construction. No seams or joints are allowed. Bolt-together kit enclosures are not acceptable.
- G. Enclosure shall have a minimum 2-inch thick sound-adsorb lining all internal surfaces.
- H. Performance of the enclosure design should produce a 20 Db insertion loss at 3 feet.

2.07 MIST AND GREASE FILTER

A. Filter Housing shall be manufactured using fiberglass reinforced plastic. The housing construction shall meet or exceed ASME RTP-1 level 2 visual inspection criteria.

1. Resin system shall be a corrosion resistant vinyl ester with a class 1 flame spread rating. Acceptable products are AOC K022-AC or Dow Derakane 510-B series. Resin system shall not require any additives such as Nyacol or Antimony to achieve the Class 1 flame spread rating. Finished laminate including liner and structure shall be translucent.

2. All internal surfaces shall have a 100-mil corrosion liner made up of a single Nexus veil followed by two layers of 1.5 oz chopped strand matt.

3. All exterior surfaces shall have gelcoat applied. This coating shall contain UV inhibitors, color to be selected by the owner.

4. Housing shall have machined UHMW Polyethylene guides to prevent stainless frame on filter pad from scratching or damaging the corrosion liner.

5. Filter housing shall be designed for 12" negative pressure with a maximum of 1/8" deflection.

6. Housing shall have an access door for pad removal complete with EPDM gasket and 316 Stainless hinges / quick latches. For filter housings larger than 3' across, two access doors shall be provided. Access doors shall have stainless toggle clamps for easy pad access. Bolt-on access doors are not acceptable. Plastic clamps are not acceptable.

7. Housing shall be provided with a 2" drain connection at the base and come from the manufacturer complete with ball valve. Drain shall direct liquid from a 2" diameter base sump extending the width of the housing to a point where the effluent can be handled. External drain piping shall have a water trap, no valves are allowed.

8. For installation, housing shall have two (2) legs. Length of legs shall be coordinated with the contactor. Housing shall be supported by these legs independent of the connecting ductwork, anchored with stainless steel Hilti bolts.

9. Housing shall have a differential gauge bracket and be supplied with a dwyer magnehelic pressure gauge and connections for gauge on either side of filter pad. Unit shall come complete from the factory with all DP equipment pre-assembled and installed.

10. Filter pad shall have 2" of stainless mesh followed by 4" of poly mesh. Mesh shall be held together by a stainless-steel frame. Total pad width including pads and frame shall be 8".

Section 4
Scope of Work and Technical Specifications
SECTION 44 13 16-13 CARBON ADSORPTION ODOR CONTROL SYSTEM

11. Maximum pad segment width of pads is 24". Pads larger than 24" wide must be segmented to allow easy removal by the owner. Segment width should not exceed 24".

B. Dimensions and Design:

1. End connections shall match the connecting ductwork. Flange thickness shall not be less than that listed in ASTM 3982.
2. Inlet cone shall be designed so that the airstream can spread evenly over the pad surface. Cone angle shall be no less than 60 deg.
3. Housing shall be sized so that air velocity through the filter pad is no greater than 400 ft/min.
4. Particle removal efficiency shall be 99% of particles 10 microns or larger.

2.08 DUCTWORK AND FLEXIBLE CONNECTORS

A. The system supplier shall be responsible for supplying an inlet and outlet flexible connectors for the fan, and ductwork between the mist/grease filter and fan inlet, and between fan outlet and vessel inlet.

1. Interconnecting ductwork shall be manufactured and designed using the same construction, resin system and finish as the carbon adsorber vessel. All flanges shall be drilled per ASTM 3982 standards and furnished 316 stainless hardware / EPDM gaskets.
2. Fan outlet shall have an AMCA Certified ultra-low leak isolation damper installed.
3. Flexible connectors shall be W design configuration. Material of construction shall be EPDM and have flanged construction. Backing rings shall be 316 stainless-steel. Slip-on type flexible connectors are not acceptable.

2.09 INSTRUMENTATION

A. Pressure differential instruments shall be provided and include Magnehelic style pressure gauges to measure the pressure differential in inches of water column across the carbon, fan and prefilter. Tubing shall be bonded to a solid acrylic plastic block that contains safety traps. Magnehelic shall be Dwyer or equal.

B. Sampling Ports: Each adsorption unit shall have three 2-inch diameter sample ports which extend into the carbon bed 1 foot minimum, suitable for extracting carbon samples. Provide one grain thief that can extract a core sample of the in-place carbon through the sample ports. Ports shall be adequate to provide suitable extraction of air samples from the carbon bed and be nonbinding. Each port nozzle shall extend outside the vessel wall and be blocked off with a 2-inch ball valve. One additional air sampling port shall be provided above the carbon bed.

Section 4
Scope of Work and Technical Specifications
SECTION 44 13 16-14 CARBON ADSORPTION ODOR CONTROL SYSTEM

2.10 CONTROLS

A. Control Panel / Motor Starter – The system shall be furnished with a Local Control Panel. The panel shall be housed in a NEMA 4X Stainless Steel enclosure with 3-point latching system. The control panel shall be mounted 3 feet away for any leakage sources.

B. The local control panel shall control the odor control fan.

1. NEMA 4X SST enclosure with:
 - a. 480v main circuit breaker
 - b. Control transformer – 120v
 - c. Controls/Contacts/Alarms
 - 1) HOA switch for fan
 - 2) Main power disconnects
 - 3) Emergency Stop
 - 4) Reset
 - 5) Red “On” pilot light
 - 6) Air Flow Indication
 - 7) Low Air Flow Alarm
 - 8) High Airflow Alarm
 - 9) Fan Low Suction Pressure Shutdown
 - 10) Fan High Discharge Pressure Shutdown
 - 11) Fan High Motor Temperature Shutdown
 - 12) High Mist/Grease Filter Pressure Drop
 - 13) High Carbon Media Pressure Drop
 - 14) Dry Contacts for:
 - a) Fan Run
 - b) Fan Fault

C. HMI/SCADA

1. Air Flow Indication
2. Low Air Flow Alarm

3. High Air Flow Alarm
4. High Mist/Grease Filter Pressure Drop
5. High Carbon Media Pressure Drop

2.11 REAL TIME MEDIA LIFE ANALYZER

A. Electronic Bed Monitor (EBM)- The gas-phase filtration system shall include an EBM which will measure the engineered adsorbent media consumption in real time. The system shall provide a consumption resolution of one percent. The engineered adsorbent consumption shall be displayed on a local NEMA 4X panel at the filtration unit and provide SCADA remote alarm. In addition, the EBM panel will communicate "days remaining" value of the adsorbent consumption. The EBM shall also have the capability to send monthly monitoring reports via email which provide the following information at a minimum monthly:

1. Unit Identification/Location/Serial Number
2. Adsorbent Media Install Date
3. Adsorbent Media Consumption
4. Predicted Adsorbent Media depletion date

B. The electronic carbon consumption monitor shall be manufactured by PureAir Filtration or pre-approved equal. Prequalification criteria shall include the successful implementation of ten installations of a qualifying device which have been in place for two life cycles of the carbon. Systems which rely on prediction of theoretical capacity and inlet concentration or do not actually measure actual carbon consumption shall not be considered.

2.12 SYSTEM ACCESSORIES

A. 16-gauge Stainless Steel name plate with 1/4" die-stamped equipment tag number securely mounted in a readily visible location.

B. Vessel shall be supplied with a Dwyer differential pressure gauge assembly complete with isolation valves.

PART 3 – EXECUTION

3.01 FACTORY TESTING

A. All equipment shall be factory tested for compliance with the requirements specified herein.

3.02 FUNCTIONAL TESTING

A. Functional testing shall be conducted after the installation of the carbon vessels and all appurtenances, and the equipment has been operated for a sufficient period to

Section 4
Scope of Work and Technical Specifications

SECTION 44 13 16-16 CARBON ADSORPTION ODOR CONTROL SYSTEM

make any corrections or adjustments. Each carbon vessel shall be subject to field functional tests under actual operating conditions to determine that operation is satisfactory and in compliance with the specifications.

B. The Contractor will provide, calibrate, and install all temporary gauges and meters, and install all temporary piping and wiring required for the functional tests.

C. The functional tests shall include the following:

1. Alignment: Test complete assemblies for correct and proper alignment and connection, and quiet operation.
2. Airflow: Measured by system or temporary instrumentation.
3. Discharge and Inlet Static Pressure: Measured by system instrumentation or temporary measurement devices.
4. Test all system components for proper adjustment and operation in both manual and automatic operating modes.

D. Performance testing shall be required with full testing report. Testing shall require Acrulog devices as both inlet and outlet to simultaneously read the inlet and outlet concentrations of H₂S. Results shall determine the effectiveness of the media removal capabilities. This test shall commence over the period of (1) day when H₂S is present in the effluent airstream. The contractor shall be responsible for providing/producing H₂S needed for the test. Test cannot be performed without H₂S present.

E. All system start-up, functional and performance testing shall be performed by the qualified technician of the manufacture.

Section 4
Scope of Work and Technical Specifications

SECTION 44 13 16-17 CARBON ADSORPTION ODOR CONTROL SYSTEM

3.03 MANUFACTURER'S SERVICES

A. Factory Technician: Present at Site and/or classroom designated by Owner for minimum person-days listed below excluding travel time:

1. One person-day for installation assistance.
2. One person-day for inspection, functional testing, completion of Manufacturer's Certificate of Proper Installation, and training.

END OF SECTION

Section 4
Scope of Work and Technical Specifications
APPENDIX A-1 REPORT OF GEOTECHNICAL EXPLORATION

APPENDIX A
REPORT OF GEOTECHNICAL EXPLORATION

APPENDIX B
SEISMIC REPORT

PAYMENT AND PERFORMANCE BONDS

Payment Bond

INSTRUCTIONS

1. This form is required for use in connection with the Agreement identified on its face. There shall be no deviation from this form without approval by the County.
2. The full legal name and business address of the Principal shall be inserted in the space designated "Principal" on the face of the form. The bond shall be signed by an authorized person. Where such person is signing in a representative capacity (e.g., an attorney-in-fact), but is not a member of the firm, partnership, or joint venture, or an office of the corporation involved, evidence of this authority must be furnished.
3. Corporation executing the bond as surety must be among those appearing on the U.S. Treasury Department's most current list of approved sureties and must be acting within the amounts and limitations set forth therein.
4. Corporate surety shall be duly authorized by the Commissioner of Insurance of the State of Georgia to transact surety business in the State of Georgia.
5. Do not date this bond. The County will date this bond the same date or later than the date of the Agreement.
6. The Surety shall attach a duly authorized power-of-attorney authorizing signature on its behalf of any attorney-in-fact.
7. Corporations executing the bond shall affix their corporate seals. Individuals shall execute the bond opposite the word "Seal."
8. The name of each person signing this bond shall be typed or printed in the space provided.

PAYMENT BOND

"County:" means Fulton County Government; a political subdivision of the State of Georgia (hereinafter called the "Owner").

"Project:" means 23RFP139070K-JAJ Progressive Design/Build Services Campbellton Pump Station & Force Main (Phase 2)

"Principal:" (Legal Name and Business Address), the _____ [Insert Name of Contractor (hereinafter called "Principal")]

Type of Organization ("X" one): _____ Individual
_____ Partnership
_____ Joint Venture
_____ Corporation

"Surety:" (Name and Business Address) _____

_____ duly authorized by the Commissioner of Insurance of the State of Georgia to transact surety business in the State of Georgia.

"Contract:" Agreement between Principal and Owner, dated _____ day of _____, 2025 regarding performance of Work relative to the Project.

"Penal Sum:" [100% of contract amount] _____

KNOW ALL MEN BY THESE PRESENTS, that we, the Principal and Surety hereto, as named above, are held and firmly bound to the Owner in the above Penal Sum for the payment of which well and truly to be made we bind ourselves, executors, administrators, successors and assigns, jointly and severally.

WHEREAS, the Principal and the Owner entered into a certain written Contract identified above, which is incorporated herein by reference in its entirety (hereinafter called the "Contract"), for construction-type services for the Project identified above;

NOW, THEREFORE, the conditions of this obligation are such that if the Principal shall promptly make payment of all persons working on or supplying labor or materials or equipment for the performance of said work, this obligation shall be void; otherwise of full force and effect.

1. A "Claimant" shall be defined herein as any subcontractor, person, party, partnership, corporation or the entity furnishing labor, services or materials used, or reasonably required for use, in the performance of the Contract, without regard to whether such labor, services or materials were sold, leased or rented, and without regard to whether such Claimant is or is not in privity of contract with the Principal or any subcontractor performing work on the Project, including, but not limited to, the following labor, services, or materials: water, gas, power, light, heat, oil, gasoline, telephone service or rental of equipment directly applicable to the Contract.
2. In the event a Claimant files a lien against the property of the Owner, and the Principal fails or refuses to satisfy or remove it promptly, the Surety shall satisfy or remove the lien promptly upon written notice from the Owner, either by bond or as otherwise provided in the Contract.
3. The Surety hereby waives notice of any and all modifications, omissions, additions, changes, alterations, extensions of time, changes in the payment terms, and any other amendments in or about the Contract and agrees that the obligations undertaken by this Bond shall not be impaired in any manner by reason of any such modifications, omissions, additions, changes, alterations, extensions of time, changes in payment terms, and amendments.
4. The Surety hereby agrees that this Bond shall be deemed amended automatically and immediately, without formal or separate amendments hereto, upon any amendment or modifications to the Contract, so as to bind the Principal and Surety, jointly and severally, to the full payment of any Claimant under the Contract, as amended or modified, provided only that the Surety shall not be liable for more than the penal sum of the Bond, as specified in the first paragraph hereof.
5. This Bond is made for the use and benefit of all persons, firms, and corporations who or which may furnish any materials or perform any labor for or on account of the construction-type services to be performed or supplied under the Contract, and any amendments thereto, and they and each of them may sue hereon.
6. No action may be maintained on this Bond after one (1) year from the date the last services, labor, or materials were provided under the Contract by the Claimant prosecuting said action.
7. This Bond is intended to comply with O.C.G.A. Section 13-10-1 and shall be interpreted so as to comply with the minimum requirements thereof. However, in the event the express language of this Bond extends protection to the Owner beyond that contemplated by O.C.G.A. Section 13-10-1 and 36-91-1, *et seq.*, or any other statutory law applicable to this Project, then the additional protection shall be enforced in favor of the Owner, whether or not such protection is found in the applicable statutes.

IN WITNESS WHEREOF, the Principal and Surety have hereunto affixed their corporate seals and caused this obligation to be signed by their duly authorized representatives this _____ day of _____, _____.

PRINCIPAL: _____

President/Vice President (Sign)

President/Vice President (Type or Print)

Attested to by:

Secretary/Assistant Secretary (Seal)

SURETY: _____

By: _____
Attorney-in-Fact (Sign)

Attorney-in-Fact (Type or Print)

Secretary/Assistant Secretary (Seal)

PERFORMANCE BOND

INSTRUCTIONS

1. This form is required for use in connection with the Agreement identified on its face. There shall be no deviation from this form without approval by the County.
2. The full legal name and business address of the Principal shall be inserted in the space designated "Principal" on the face of the form. The bond shall be signed by an authorized person. Where such person is signing in a representative capacity (e.g., an attorney-in-fact), but is not a member of the firm, partnership, or joint venture, or an office of the corporation involved, evidence of this authority must be furnished.
3. Corporation executing the bond as surety must be among those appearing on the U.S. Treasury Department's most current list of approved sureties and must be acting within the amounts and limitations set forth therein.
4. Corporate surety shall be duly authorized by the Commissioner of Insurance of the State of Georgia to transact surety business in the State of Georgia.
5. Do not date this bond. The County will date this bond the same date or later than the date of the Agreement.
6. The Surety shall attach a duly authorized power-of-attorney authorizing signature on its behalf of any attorney-in-fact.
7. Corporations executing the bond shall affix their corporate seals. Individuals shall execute the bond opposite the word "Seal."
8. The name of each person signing this bond shall be typed or printed in the space provided.

PERFORMANCE BOND

"County:" means Fulton County Government; a political subdivision of the State of Georgia (hereinafter called the "Owner").

"Project:" means 23RFP139070K-JAJ Progressive Design/Build Services Campbellton Pump Station & Force Main (Phase 2)

"Principal:" (Legal Name and Business Address), [Insert Name of Contractor (hereinafter called the "Principal")]

Type of Organization ("X" one):
_____ Individual
_____ Partnership
_____ Joint Venture
_____ Corporation

"Surety:" (Name and Business Address)

duly authorized by the Commissioner of Insurance of the State of Georgia to transact surety business in the State of Georgia.

"Contract:" Agreement between Principal and Owner, dated _____ day of _____, 2025 regarding performance of Work relative to the Project.

"Penal Sum:" [100% of contract amount]_____.

KNOW ALL MEN BY THESE PRESENTS, that we, the Principal and Surety hereto, as named above, are held and firmly bound to the Owner in the above Penal Sum for the payment of which well and truly to be made we bind ourselves, our executors, administrators, successors and assigns, jointly and severally.

WHEREAS, the Principal and the Owner entered into a certain written Contract identified above, which is incorporated herein by reference in its entirety (hereinafter called the "Contract"), for construction-type services for the Project identified above;

NOW, THEREFORE, the conditions of this obligation are such that if the Principal shall faithfully and fully comply with, perform and fulfill all of the undertakings, covenants, conditions and all other of the

terms and conditions of said Contract, including any and all duly authorized modifications of such Contract, within the original term of such Contract and any extensions thereof, which shall include, but not be limited to any obligations created by way of warranties and/or guarantees for workmanship and materials which warranty and/or guarantee may extend for a period of time of one year beyond completion of said Contract, this obligation shall be void; otherwise, of full force and effect.

Whenever the Principal shall be, and declared by the Owner to be, in default under the Construction-Type Contract, the Surety shall promptly remedy the default as follows:

1. Complete the Contract in accordance with its terms and conditions; or, at the sole option of the Owner,
2. Obtain a bid or bids for completing the Contract in accordance with its terms and conditions, and upon determination by the Surety and the Owner of the lowest responsible bidder, arrange for a contract between such bidder and Owner and make available as the work progresses (even though there should be a default or succession of defaults under the Contract or contracts of completion arranged under this paragraph) sufficient funds to pay the cost of completion less the balance of the contract price; but not exceeding, including other costs and damages for which the Surety may be liable hereunder, the penal sum set forth in the first paragraph hereof, as may be adjusted, and the Surety shall make available and pay to the Owner the funds required by this Paragraph prior to the payment of the Owner of the balance of the contract price, or any portion thereof. The term "balance of the contract price," as used in this paragraph, shall mean the total amount payable by the Owner to the Contractor under the Contract, and any amendments thereto, less the amount paid by the Owner to the Contractor; or, at the sole option of the Owner,
3. Allow Owner to complete the work and reimburse the Owner for all reasonable costs incurred in completing the work.

In addition to performing as required in the above paragraphs, the Surety shall indemnify and hold harmless the Owner from any and all losses, liability and damages, claims, judgments, liens, costs and fees of every description, including reasonable attorney's fees, litigation costs and expert witness fees, which the Owner may incur, sustain or suffer by reason of the failure or default on the part of the Principal in the performance of any or all of the terms, provisions, and requirements of the Contract, including any and all amendments and modifications thereto, or incurred by the Owner in making good any such failure of performance on the part of the Principal.

The Surety shall commence performance of its obligations and undertakings under this Bond promptly and without delay, after written notice from the Owner to the Surety.

The Surety hereby waives notice of any and all modifications, omissions, additions, changes, alterations, extensions of time, changes in payment terms, and any other amendments in or about the Contract, and agrees that the obligations undertaken by this Bond shall not be impaired in any manner by reason of any such modifications, omissions,

additions, changes, alterations, extensions of time, change in payment terms, and amendments.

The Surety hereby agrees that this Bond shall be deemed amended automatically and immediately, without formal or separate amendments hereto, upon any amendment to the Contract, so as to bind the Principal and the Surety to the full and faithful performance of the Contract as so amended or modified, and so as to increase the penal sum to the adjusted Contract Price of the Contract.

No right of action shall accrue on this Bond to or for the use of any person, entity or corporation other than the Owner and any other obligee named herein, or their executors, administrators, successors or assigns.

This Bond is intended to comply with O.C.G.A. Section 36-91-1 et seq. and shall be interpreted so; as to comply with; the minimum requirements thereof. However, in the event the express language of this Bond extends protection to; the Owner beyond that contemplated by O.C.G.A. Section 36-91-1 et seq. and O.C.G.A. Section 13-10-1, as amended, or any other statutory law applicable to this Project, then the additional protection shall be enforced in favor of the Owner, whether or not such protection is found in the applicable statutes.

IN WITNESS WHEREOF, the Principal and the Surety have caused these presents to be duly signed and

sealed this _____ day of _____, 20____.

PRINCIPAL:_____

President/Vice President (Sign)

President/Vice President (Type or Print)

Attested to by:

Secretary/Assistant Secretary (Seal)

SURETY:_____

By: _____
Attorney-in-Fact (Sign)

Attorney-in-Fact (Type or Print)

LIST OF DRAWINGS



Printed on Tue Mar 11, 2025 at 10:50 am EDT

24-014 PDB Campbellton PS & FM
8700 Campbellton Fairburn Rd
Fairburn, Georgia 30213

Current Drawings

Drawing No.	Drawing Title	Revision	Drawing Date	Received Date	Set
General					
G-000	COVER PAGE	2	02/28/2025	03/03/2025	80% Design Drawings (02/28/25)
G-001	SHEET INDEX AND GENERAL NOTES	2	02/28/2025	03/03/2025	80% Design Drawings (02/28/25)
G-002	FULTON COUNTY NOTES	2	02/28/2025	03/03/2025	80% Design Drawings (02/28/25)
G-003	FEMA MAPS	2	02/28/2025	03/03/2025	80% Design Drawings (02/28/25)
G-004	OVERALL KEY PLAN	1	02/28/2025	03/03/2025	80% Design Drawings (02/28/25)
G-005	ARC CHATTAHOOCHEE RIVER CORRIDOR PLAN (MAP 1)	1	02/28/2025	03/03/2025	80% Design Drawings (02/28/25)
G-006	ARC CHATTAHOOCHEE RIVER CORRIDOR PLAN (MAP 2)	1	02/28/2025	03/03/2025	80% Design Drawings (02/28/25)
G-007	ARC CHATTAHOOCHEE RIVER CORRIDOR PLAN (MAP 3)	1	02/28/2025	03/03/2025	80% Design Drawings (02/28/25)
Civil					
C-001	CIVIL LEGEND, ABBREVIATIONS AND GENERAL NOTES	2	02/28/2025	03/03/2025	80% Design Drawings (02/28/25)
C-101	CAMPBELLTON PUMP STATION EXISTING CONDITIONS PLAN	0	02/28/2025	03/03/2025	80% Design Drawings (02/28/25)
C-201	CAMPBELLTON PUMP STATION SITE PLAN	2	02/28/2025	03/03/2025	80% Design Drawings (02/28/25)
C-202	CAMPBELLTON PUMP STATION TRUCK TURNING PLAN	1	02/28/2025	03/03/2025	80% Design Drawings (02/28/25)
C-203	CAMPBELLTON PUMP STATION TRUCK AND TRAILER TURNING PLAN	2	02/28/2025	03/03/2025	80% Design Drawings (02/28/25)
C-204	CAMPBELLTON PUMP STATION GRADING PLAN	1	02/28/2025	03/03/2025	80% Design Drawings (02/28/25)
C-205	SANITARY SEWER AND STORM PROFILES	1	02/28/2025	03/03/2025	80% Design Drawings (02/28/25)
C-206	SANITARY SEWER PROFILES (CONT.)	1	02/28/2025	03/03/2025	80% Design Drawings (02/28/25)
C-207	PUMP STATION DRIVEWAY PLAN	0	02/28/2025	03/03/2025	80% Design Drawings (02/28/25)
C-301	PLAN AND PROFILE 1	2	02/28/2025	03/03/2025	80% Design Drawings (02/28/25)
C-302	PLAN AND PROFILE 2	2	02/28/2025	03/03/2025	80% Design Drawings (02/28/25)
C-303	PLAN AND PROFILE 3	2	02/28/2025	03/03/2025	80% Design Drawings (02/28/25)
C-304	PLAN AND PROFILE 4	2	02/28/2025	03/03/2025	80% Design Drawings (02/28/25)
C-305	PLAN AND PROFILE 5	2	02/28/2025	03/03/2025	80% Design Drawings (02/28/25)
C-306	PLAN AND PROFILE 6	2	02/28/2025	03/03/2025	80% Design Drawings (02/28/25)
C-307	PLAN AND PROFILE 7	2	02/28/2025	03/03/2025	80% Design Drawings (02/28/25)
C-308	PLAN AND PROFILE 8	2	02/28/2025	03/03/2025	80% Design Drawings (02/28/25)
C-309	PLAN AND PROFILE 9	2	02/28/2025	03/03/2025	80% Design Drawings (02/28/25)
C-310	PLAN AND PROFILE 10	2	02/28/2025	03/03/2025	80% Design Drawings (02/28/25)
C-311	PLAN AND PROFILE 11	2	02/28/2025	03/03/2025	80% Design Drawings (02/28/25)
C-312	PLAN AND PROFILE 12	2	02/28/2025	03/03/2025	80% Design Drawings (02/28/25)
C-313	PLAN AND PROFILE 13	2	02/28/2025	03/03/2025	80% Design Drawings (02/28/25)
C-314	PLAN AND PROFILE 14	2	02/28/2025	03/03/2025	80% Design Drawings (02/28/25)
C-315	PLAN AND PROFILE 15	2	02/28/2025	03/03/2025	80% Design Drawings (02/28/25)



Sol Construction

Printed on Tue Mar 11, 2025 at 10:50 am EDT

24-014 PDB Campbellton PS & FM
8700 Campbellton Fairburn Rd
Fairburn, Georgia 30213

Drawing No.	Drawing Title	Revision	Drawing Date	Received Date	Set
C-316	PLAN AND PROFILE 16	2	02/28/2025	03/03/2025	80% Design Drawings (02/28/25)
C-317	PLAN AND PROFILE 17	2	02/28/2025	03/03/2025	80% Design Drawings (02/28/25)
C-318	PLAN AND PROFILE 18	2	02/28/2025	03/03/2025	80% Design Drawings (02/28/25)
C-319	PLAN AND PROFILE 19	2	02/28/2025	03/03/2025	80% Design Drawings (02/28/25)
C-320	PLAN AND PROFILE 20	2	02/28/2025	03/03/2025	80% Design Drawings (02/28/25)
C-321	PLAN AND PROFILE 21	2	02/28/2025	03/03/2025	80% Design Drawings (02/28/25)
C-401	CONSTRUCTION DETAILS	1	02/28/2025	03/03/2025	80% Design Drawings (02/28/25)
C-402	CONSTRUCTION DETAILS 2	1	02/28/2025	03/03/2025	80% Design Drawings (02/28/25)
C-403	CONSTRUCTION DETAILS 3	1	02/28/2025	03/03/2025	80% Design Drawings (02/28/25)
C-404	CONSTRUCTION DETAILS 4	1	02/28/2025	03/03/2025	80% Design Drawings (02/28/25)
C-405	CONSTRUCTION DETAILS 5	1	02/28/2025	03/03/2025	80% Design Drawings (02/28/25)
C-406	CONSTRUCTION DETAILS 6	1	02/28/2025	03/03/2025	80% Design Drawings (02/28/25)
C-407	CONSTRUCTION DETAILS 7	1	02/28/2025	03/03/2025	80% Design Drawings (02/28/25)
Erosion Control					
EC-001	ES&PC NARRATIVE	1	02/28/2025	03/03/2025	80% Design Drawings (02/28/25)
EC-002	ES&PC COMPREHENSIVE MONITORING PLAN	1	02/28/2025	03/03/2025	80% Design Drawings (02/28/25)
EC-003	NDPES PERMITTING NOTES	1	02/28/2025	03/03/2025	80% Design Drawings (02/28/25)
EC-004	NPDES CHECKLISTS	1	02/28/2025	03/03/2025	80% Design Drawings (02/28/25)
EC-005	SOILS MAP	1	02/28/2025	03/03/2025	80% Design Drawings (02/28/25)
EC-201	INITIAL PHASE ES&PC PLAN	1	02/28/2025	03/03/2025	80% Design Drawings (02/28/25)
EC-202	INTERMEDIATE PHASE ES&PC PLAN	1	02/28/2025	03/03/2025	80% Design Drawings (02/28/25)
EC-203	FINAL PHASE ES&PC PLAN	1	02/28/2025	03/03/2025	80% Design Drawings (02/28/25)
EC-301	EROSION CONTROL PLAN	1	02/28/2025	03/03/2025	80% Design Drawings (02/28/25)
EC-302	EROSION CONTROL PLAN 2	1	02/28/2025	03/03/2025	80% Design Drawings (02/28/25)
EC-303	EROSION CONTROL PLAN 3	1	02/28/2025	03/03/2025	80% Design Drawings (02/28/25)
EC-304	EROSION CONTROL PLAN 4	1	02/28/2025	03/03/2025	80% Design Drawings (02/28/25)
EC-305	EROSION CONTROL PLAN 5	1	02/28/2025	03/03/2025	80% Design Drawings (02/28/25)
EC-306	EROSION CONTROL PLAN 6	1	02/28/2025	03/03/2025	80% Design Drawings (02/28/25)
EC-307	EROSION CONTROL PLAN 7	1	02/28/2025	03/03/2025	80% Design Drawings (02/28/25)
EC-308	EROSION CONTROL PLAN 8	1	02/28/2025	03/03/2025	80% Design Drawings (02/28/25)
EC-309	EROSION CONTROL PLAN 9	1	02/28/2025	03/03/2025	80% Design Drawings (02/28/25)
EC-310	EROSION CONTROL PLAN 10	1	02/28/2025	03/03/2025	80% Design Drawings (02/28/25)
EC-311	EROSION CONTROL PLAN 11	1	02/28/2025	03/03/2025	80% Design Drawings (02/28/25)
EC-401	EROSION CONTROL DETAILS	1	02/28/2025	03/03/2025	80% Design Drawings (02/28/25)
EC-402	EROSION CONTROL DETAILS 2	1	02/28/2025	03/03/2025	80% Design Drawings (02/28/25)
Landscape					
L-001	LANDSCAPE GENERAL NOTES	1	02/28/2025	03/03/2025	80% Design Drawings (02/28/25)
L-101	TREE DEMOLITION & PROTECTION PLAN	1	02/28/2025	03/03/2025	80% Design Drawings (02/28/25)



Sol Construction

Printed on Tue Mar 11, 2025 at 10:50 am EDT

24-014 PDB Campbellton PS & FM
8700 Campbellton Fairburn Rd
Fairburn, Georgia 30213

Drawing No.	Drawing Title	Revision	Drawing Date	Received Date	Set
L-201	LANDSCAPE PLAN	1	02/28/2025	03/03/2025	80% Design Drawings (02/28/25)
L-401	LANDSCAPE STANDARD DETAILS	1	02/28/2025	03/03/2025	80% Design Drawings (02/28/25)
Structural					
S-001	STRUCTURAL ABBREVIATIONS, LEGEND AND NOTES	1	02/28/2025	03/03/2025	80% Design Drawings (02/28/25)
S-101	TOP SLAB PLAN	1	02/28/2025	03/03/2025	80% Design Drawings (02/28/25)
S-102	FOUNDATION SLAB PLAN	1	02/28/2025	03/03/2025	80% Design Drawings (02/28/25)
S-201	WALL ELEVATIONS	1	02/28/2025	03/03/2025	80% Design Drawings (02/28/25)
S-202	WALL ELEVATIONS 2	1	02/28/2025	03/03/2025	80% Design Drawings (02/28/25)
S-401	MONORAIL FRAMING PLAN AND SECTIONS	1	02/28/2025	03/03/2025	80% Design Drawings (02/28/25)
S-402	EQUIPMENT FOUNDATION PLANS	1	02/28/2025	03/03/2025	80% Design Drawings (02/28/25)
S-403	GENERATOR PLATFORM FRAMING PLAN	1	02/28/2025	03/03/2025	80% Design Drawings (02/28/25)
S-501	TYPICAL DETAILS	1	02/28/2025	03/03/2025	80% Design Drawings (02/28/25)
S-502	DETAILS	0	02/28/2025	03/03/2025	80% Design Drawings (02/28/25)
Instrumentation					
I-001	PROCESS LEGEND AND ABBREVIATIONS	1	02/28/2025	03/03/2025	80% Design Drawings (02/28/25)
I-002	PIPING & INSTRUMENTATION DIAGRAM	1	02/28/2025	03/03/2025	80% Design Drawings (02/28/25)
I-100	SCADA BLOCK DIAGRAM	2	02/28/2025	03/03/2025	80% Design Drawings (02/28/25)
I-101	ODOR CONTROL P&ID	1	02/28/2025	03/03/2025	80% Design Drawings (02/28/25)
Mechanical					
D-201	PUMP STATION PLAN VIEW	2	02/28/2025	03/03/2025	80% Design Drawings (02/28/25)
D-301	PUMP DISCHARGE ELEVATION	2	02/28/2025	03/03/2025	80% Design Drawings (02/28/25)
D-302	LOWER WETWELL PLAN & SECTION	2	02/28/2025	03/03/2025	80% Design Drawings (02/28/25)
D-303	METERING PLAN AND SECTION	1	02/28/2025	03/03/2025	80% Design Drawings (02/28/25)
D-400	PROCESS DETAILS	1	02/28/2025	03/03/2025	80% Design Drawings (02/28/25)
H-001	ODOR CONTROL NOTES, ABBREVIATIONS, DETAIL AND SCHEDULES	1	02/28/2025	03/03/2025	80% Design Drawings (02/28/25)
H-201	ODOR CONTROL PLAN AND SECTION	1	02/28/2025	03/03/2025	80% Design Drawings (02/28/25)
Electrical					
E-001	ELECTRICAL LEGENDS AND NOTES	2	02/28/2025	03/03/2025	80% Design Drawings (02/28/25)
E-010	ONE LINE DIAGRAM	2	02/28/2025	03/03/2025	80% Design Drawings (02/28/25)
E-011	PANELBOARD SCHEDULE	2	02/28/2025	03/03/2025	80% Design Drawings (02/28/25)
E-101	OVERALL ELECTRICAL AND POWER PLAN	1	02/28/2025	03/03/2025	80% Design Drawings (02/28/25)
E-102	ELECTRICAL POWER PLAN	1	02/28/2025	03/03/2025	80% Design Drawings (02/28/25)
E-103	LIGHTING PLAN	1	02/28/2025	03/03/2025	80% Design Drawings (02/28/25)
E-201	INTERCONNECTION WIRING DIAGRAM	2	02/28/2025	03/03/2025	80% Design Drawings (02/28/25)
E-202	INTERCONNECTION WIRING DIAGRAM 2	2	02/28/2025	03/03/2025	80% Design Drawings (02/28/25)
E-203	INTERCONNECTION WIRING DIAGRAM 3	2	02/28/2025	03/03/2025	80% Design Drawings (02/28/25)
E-204	INTERCONNECTION WIRING DIAGRAM 4	1	02/28/2025	03/03/2025	80% Design Drawings (02/28/25)
E-205	INTERCONNECTION WIRING DIAGRAM 5	0	02/28/2025	03/03/2025	80% Design Drawings (02/28/25)



Sol Construction

Printed on Tue Mar 11, 2025 at 10:50 am EDT

24-014 PDB Campbellton PS & FM
8700 Campbellton Fairburn Rd
Fairburn, Georgia 30213

Drawing No.	Drawing Title	Revision	Drawing Date	Received Date	Set
E-206	INTERCONNECTION WIRING DIAGRAM 6	0	02/28/2025	03/03/2025	80% Design Drawings (02/28/25)
E-301	ELECTRICAL INSTALLATION DETAILS	1	02/28/2025	03/03/2025	80% Design Drawings (02/28/25)
E-302	ELECTRICAL INSTALLATION DETAILS 2	1	02/28/2025	03/03/2025	80% Design Drawings (02/28/25)
E-303	ELECTRICAL INSTALLATION DETAILS 3	0	01/17/2025		60% Design Drawings (01/17/25)
EC-403	EROSION CONTROL DETAILS 3	0	02/28/2025	03/03/2025	80% Design Drawings (02/28/25)
EC-404	EROSION CONTROL DETAILS 4	0	02/28/2025	03/03/2025	80% Design Drawings (02/28/25)

CERTIFICATE OF INSURANCE



CERTIFICATE OF LIABILITY INSURANCE

DATE (MM/DD/YYYY)

9/30/2025

THIS CERTIFICATE IS ISSUED AS A MATTER OF INFORMATION ONLY AND CONFERS NO RIGHTS UPON THE CERTIFICATE HOLDER. THIS CERTIFICATE DOES NOT AFFIRMATIVELY OR NEGATIVELY AMEND, EXTEND OR ALTER THE COVERAGE AFFORDED BY THE POLICIES BELOW. THIS CERTIFICATE OF INSURANCE DOES NOT CONSTITUTE A CONTRACT BETWEEN THE ISSUING INSURER(S), AUTHORIZED REPRESENTATIVE OR PRODUCER, AND THE CERTIFICATE HOLDER.

IMPORTANT: If the certificate holder is an **ADDITIONAL INSURED**, the policy(ies) must have **ADDITIONAL INSURED** provisions or be endorsed. If **SUBROGATION** IS **WAIVED**, subject to the terms and conditions of the policy, certain policies may require an endorsement. A statement on this certificate does not confer rights to the certificate holder in lieu of such endorsement(s).

PRODUCER Sterling Seacrest Pritchard, Inc. 2500 Cumberland Pkwy Suite 400 Atlanta GA 30339	CONTACT NAME: Thomas Collins PHONE (A/C, No, Ext): 678-424-6500 E-MAIL: tcollins@sspins.com ADDRESS:
INSURER(S) AFFORDING COVERAGE	
INSURED Sol Construction, LLC 4120 Presidential Pkwy STE 115 Atlanta GA 30340	SOLCONS-01 INSURER A: Travelers Property Casualty Co of America INSURER B: The Phoenix Insurance Co INSURER C: Nautilus Insurance Company INSURER D: Travelers Casualty Insurance Co of America INSURER E: Admiral Insurance Company INSURER F:

COVERAGES

CERTIFICATE NUMBER: 1007187008

REVISION NUMBER:

THIS IS TO CERTIFY THAT THE POLICIES OF INSURANCE LISTED BELOW HAVE BEEN ISSUED TO THE INSURED NAMED ABOVE FOR THE POLICY PERIOD INDICATED. NOTWITHSTANDING ANY REQUIREMENT, TERM OR CONDITION OF ANY CONTRACT OR OTHER DOCUMENT WITH RESPECT TO WHICH THIS CERTIFICATE MAY BE ISSUED OR MAY PERTAIN, THE INSURANCE AFFORDED BY THE POLICIES DESCRIBED HEREIN IS SUBJECT TO ALL THE TERMS, EXCLUSIONS AND CONDITIONS OF SUCH POLICIES. LIMITS SHOWN MAY HAVE BEEN REDUCED BY PAID CLAIMS.

INSR LTR	TYPE OF INSURANCE	ADDL INSD	SUBR WVD	POLICY NUMBER	POLICY EFF (MM/DD/YYYY)	POLICY EXP (MM/DD/YYYY)	LIMITS
B	☒ COMMERCIAL GENERAL LIABILITY ☐ CLAIMS-MADE ☒ OCCUR GEN'L AGGREGATE LIMIT APPLIES PER: ☐ POLICY ☒ PRO-JECT ☐ LOC OTHER:			CO7T357834	9/1/2025	9/1/2026	EACH OCCURRENCE \$1,000,000 DAMAGE TO RENTED PREMISES (Ea occurrence) \$500,000 MED EXP (Any one person) \$10,000 PERSONAL & ADV INJURY \$1,000,000 GENERAL AGGREGATE \$2,000,000 PRODUCTS - COMP/OP AGG \$2,000,000 \$
B	AUTOMOBILE LIABILITY ☒ ANY AUTO ☐ OWNED AUTOS ONLY ☐ SCHEDULED AUTOS ☒ HIRED AUTOS ONLY ☒ NON-OWNED AUTOS ONLY			BA7T35719A-25-26-G	9/1/2025	9/1/2026	COMBINED SINGLE LIMIT (Ea accident) \$1,000,000 BODILY INJURY (Per person) \$ BODILY INJURY (Per accident) \$ PROPERTY DAMAGE (Per accident) \$ \$
A E	UMBRELLA LIAB ☒ OCCUR EXCESS LIAB ☐ CLAIMS-MADE DED ☒ RETENTION \$ 10,000			CUP7T360076 UX000001995-01	9/1/2025 9/1/2025	9/1/2026 9/1/2026	EACH OCCURRENCE \$5,000,000 AGGREGATE \$5,000,000 \$
A	WORKERS COMPENSATION AND EMPLOYERS' LIABILITY ANY PROPRIETOR/PARTNER/EXECUTIVE OFFICER/MEMBER EXCLUDED? ☐ Y ☒ N (Mandatory in NH) If yes, describe under DESCRIPTION OF OPERATIONS below		N/A	UB9T420061	9/1/2025	9/1/2026	☒ PER STATUTE ☐ OTH-ER E.L. EACH ACCIDENT \$1,000,000 E.L. DISEASE - EA EMPLOYEE \$1,000,000 E.L. DISEASE - POLICY LIMIT \$1,000,000
C D	Professional & Pollution Liabilit Leased/Rented Equipment Installation Coverage			CPP2044578-11 660-7T499418-TIL-25	9/1/2025 9/1/2025	9/1/2026 9/1/2026	Each Occurrence/Aggr. Per Item/Aggregate Limit \$5,000,000 \$600,000 1,500,000

DESCRIPTION OF OPERATIONS / LOCATIONS / VEHICLES (ACORD 101, Additional Remarks Schedule, may be attached if more space is required)
 Project: #23RFP139070K-JAJ Campbellton Pump Station and Force Main Phase 2

CERTIFICATE HOLDER

CANCELLATION

Fulton County Government Purchasing Department
 130 Peachtree Stret, S.W Ste 1168
 Atlanta GA 30303

SHOULD ANY OF THE ABOVE DESCRIBED POLICIES BE CANCELLED BEFORE THE EXPIRATION DATE THEREOF, NOTICE WILL BE DELIVERED IN ACCORDANCE WITH THE POLICY PROVISIONS.

AUTHORIZED REPRESENTATIVE

© 1988-2015 ACORD CORPORATION. All rights reserved.

ADDITIONAL COVERAGES

Ref #	Description Excess 5 x 5 liability Policy #UX000001995-01 Eff:9/1/25 - 9/1/26				Carrier: R-T Specialty	Coverage Code	Form No.	Edition Date
Limit 1 5,000,000	Limit 2 5,000,000	Limit 3	Deductible Amount	Deductible Type	Premium			

Ref #					Coverage Code	Form No.	Edition Date
Limit 1	Limit 2	Limit 3	Deductible Amount	Deductible Type	Premium		

Ref #					Coverage Code	Form No.	Edition Date
Limit 1	Limit 2	Limit 3	Deductible Amount	Deductible Type	Premium		

Ref #	]				Coverage Code	Form No.	Edition Date
Limit 1	Limit 2	Limit 3	Deductible Amount	Deductible Type	Premium		

Ref #	Description				Coverage Code	Form No.	Edition Date
Limit 1	Limit 2	Limit 3	Deductible Amount	Deductible Type	Premium		

Ref #	Description				Coverage Code	Form No.	Edition Date
Limit 1	Limit 2	Limit 3	Deductible Amount	Deductible Type	Premium		

Ref #	Description				Coverage Code	Form No.	Edition Date
Limit 1	Limit 2	Limit 3	Deductible Amount	Deductible Type	Premium		

Ref #	Description				Coverage Code	Form No.	Edition Date
Limit 1	Limit 2	Limit 3	Deductible Amount	Deductible Type	Premium		

Ref #	Description				Coverage Code	Form No.	Edition Date
Limit 1	Limit 2	Limit 3	Deductible Amount	Deductible Type	Premium		

Ref #	Description				Coverage Code	Form No.	Edition Date
Limit 1	Limit 2	Limit 3	Deductible Amount	Deductible Type	Premium		

THIS ENDORSEMENT CHANGES THE POLICY. PLEASE READ IT CAREFULLY.

BLANKET ADDITIONAL INSURED – AUTOMATIC STATUS IF REQUIRED BY WRITTEN CONTRACT (CONTRACTORS)

This endorsement modifies insurance provided under the following:

COMMERCIAL GENERAL LIABILITY COVERAGE PART

The following is added to **SECTION II – WHO IS AN INSURED**:

Any person or organization that:

- a. You agree in a written contract or agreement to include as an additional insured on this Coverage Part; and
- b. Has not been added as an additional insured for the same project by attachment of an endorsement under this Coverage Part which includes such person or organization in the endorsement's schedule;

is an insured, but:

- a. Only with respect to liability for "bodily injury" or "property damage" that occurs, or for "personal injury" caused by an offense that is committed, subsequent to the signing of that contract or agreement and while that part of the contract or agreement is in effect; and
- b. Only as described in Paragraph (1), (2) or (3) below, whichever applies:
 - (1) If the written contract or agreement specifically requires you to provide additional insured coverage to that person or organization by the use of:
 - (a) The Additional Insured – Owners, Lessees or Contractors – (Form B) endorsement CG 20 10 11 85; or
 - (b) Either or both of the following: the Additional Insured – Owners, Lessees or Contractors – Scheduled Person Or Organization endorsement CG 20 10 10 01, or the Additional Insured – Owners, Lessees or Contractors – Completed Operations endorsement CG 20 37 10 01;

the person or organization is an additional insured only if the injury or damage arises out of "your work" to which the written contract or agreement applies;

- (2) If the written contract or agreement specifically requires you to provide additional insured coverage to that person or organization by the use of:

- (a) The Additional Insured – Owners, Lessees or Contractors – Scheduled Person or Organization endorsement CG 20 10 07 04 or CG 20 10 04 13, the Additional Insured – Owners, Lessees or Contractors – Completed Operations endorsement CG 20 37 07 04 or CG 20 37 04 13, or both of such endorsements with either of those edition dates; or

- (b) Either or both of the following: the Additional Insured – Owners, Lessees or Contractors – Scheduled Person Or Organization endorsement CG 20 10, or the Additional Insured – Owners, Lessees or Contractors – Completed Operations endorsement CG 20 37, without an edition date of such endorsement specified;

the person or organization is an additional insured only if the injury or damage is caused, in whole or in part, by acts or omissions of you or your subcontractor in the performance of "your work" to which the written contract or agreement applies; or

- (3) If neither Paragraph (1) nor (2) above applies:

- (a) The person or organization is an additional insured only if, and to the extent that, the injury or damage is caused by acts or omissions of you or your subcontractor in the performance of "your work" to which the written contract or agreement applies; and
- (b) Such person or organization does not qualify as an additional insured with respect to the independent acts or omissions of such person or organization.

The insurance provided to such additional insured is subject to the following provisions:

- a. If the Limits of Insurance of this Coverage Part shown in the Declarations exceed the minimum limits required by the written contract or agreement, the insurance provided to the additional insured will be limited to such minimum required limits. For the purposes of determining whether

COMMERCIAL GENERAL LIABILITY

this limitation applies, the minimum limits required by the written contract or agreement will be considered to include the minimum limits of any Umbrella or Excess liability coverage required for the additional insured by that written contract or agreement. This provision will not increase the limits of insurance described in Section III – Limits Of Insurance.

b. The insurance provided to such additional insured does not apply to:

(1) Any "bodily injury", "property damage" or "personal injury" arising out of the providing, or failure to provide, any professional architectural, engineering or surveying services, including:

(a) The preparing, approving, or failing to prepare or approve, maps, shop drawings, opinions, reports, surveys, field orders or change orders, or the preparing, approving, or failing to prepare or approve, drawings and specifications; and

(b) Supervisory, inspection, architectural or engineering activities.

(2) Any "bodily injury" or "property damage" caused by "your work" and included in the "products-completed operations hazard" unless the written contract or agreement specifically requires you to provide such coverage for that additional insured during the policy period.

c. The additional insured must comply with the following duties:

(1) Give us written notice as soon as practicable of an "occurrence" or an offense which may

result in a claim. To the extent possible, such notice should include:

(a) How, when and where the "occurrence" or offense took place;

(b) The names and addresses of any injured persons and witnesses; and

(c) The nature and location of any injury or damage arising out of the "occurrence" or offense.

(2) If a claim is made or "suit" is brought against the additional insured:

(a) Immediately record the specifics of the claim or "suit" and the date received; and

(b) Notify us as soon as practicable and see to it that we receive written notice of the claim or "suit" as soon as practicable.

(3) Immediately send us copies of all legal papers received in connection with the claim or "suit", cooperate with us in the investigation or settlement of the claim or defense against the "suit", and otherwise comply with all policy conditions.

(4) Tender the defense and indemnity of any claim or "suit" to any provider of other insurance which would cover such additional insured for a loss we cover. However, this condition does not affect whether the insurance provided to such additional insured is primary to other insurance available to such additional insured which covers that person or organization as a named insured as described in Paragraph 4., Other Insurance, of Section IV – Commercial General Liability Conditions.

PAYMENT AND PERFORMANCE BONDS

Payment Bond

INSTRUCTIONS

1. This form is required for use in connection with the Agreement identified on its face. There shall be no deviation from this form without approval by the County.
2. The full legal name and business address of the Principal shall be inserted in the space designated "Principal" on the face of the form. The bond shall be signed by an authorized person. Where such person is signing in a representative capacity (e.g., an attorney-in-fact), but is not a member of the firm, partnership, or joint venture, or an office of the corporation involved, evidence of this authority must be furnished.
3. Corporation executing the bond as surety must be among those appearing on the U.S. Treasury Department's most current list of approved sureties and must be acting within the amounts and limitations set forth therein.
4. Corporate surety shall be duly authorized by the Commissioner of Insurance of the State of Georgia to transact surety business in the State of Georgia.
5. Do not date this bond. The County will date this bond the same date or later than the date of the Agreement.
6. The Surety shall attach a duly authorized power-of-attorney authorizing signature on its behalf of any attorney-in-fact.
7. Corporations executing the bond shall affix their corporate seals. Individuals shall execute the bond opposite the word "Seal."
8. The name of each person signing this bond shall be typed or printed in the space provided.

PAYMENT BOND

"County:" means Fulton County Government; a political subdivision of the State of Georgia (hereinafter called the "Owner").

"Project:" means 23RFP139070K-JAJ Progressive Design/Build Services Campbellton Pump Station & Force Main (Phase 2)

"Principal:" (Legal Name and Business Address), the _____ [Insert Name of Contractor (hereinafter called "Principal")]

Type of Organization ("X" one): _____ Individual
_____ Partnership
_____ Joint Venture
_____ Corporation

"Surety:" (Name and Business Address) _____

duly authorized by the Commissioner of Insurance of the State of Georgia to transact surety business in the State of Georgia.

"Contract:" Agreement between Principal and Owner, dated _____ day of _____, 25____, regarding performance of Work relative to the Project.

"Penal Sum:" [100% of contract amount]_____

KNOW ALL MEN BY THESE PRESENTS, that we, the Principal and Surety hereto, as named above, are held and firmly bound to the Owner in the above Penal Sum for the payment of which well and truly to be made we bind ourselves, executors, administrators, successors and assigns, jointly and severally.

WHEREAS, the Principal and the Owner entered into a certain written Contract identified above, which is incorporated herein by reference in its entirety (hereinafter called the "Contract"), for construction-type services for the Project identified above;

NOW, THEREFORE, the conditions of this obligation are such that if the Principal shall promptly make payment of all persons working on or supplying labor or materials or equipment for the performance of said work, this obligation shall be void; otherwise of full force and effect.

1. A "Claimant" shall be defined herein as any subcontractor, person, party, partnership, corporation or the entity furnishing labor, services or materials used, or reasonably required for use, in the performance of the Contract, without regard to whether such labor, services or materials were sold, leased or rented, and without regard to whether such Claimant is or is not in privity of contract with the Principal or any subcontractor performing work on the Project, including, but not limited to, the following labor, services, or materials: water, gas, power, light, heat, oil, gasoline, telephone service or rental of equipment directly applicable to the Contract.
2. In the event a Claimant files a lien against the property of the Owner, and the Principal fails or refuses to satisfy or remove it promptly, the Surety shall satisfy or remove the lien promptly upon written notice from the Owner, either by bond or as otherwise provided in the Contract.
3. The Surety hereby waives notice of any and all modifications, omissions, additions, changes, alterations, extensions of time, changes in the payment terms, and any other amendments in or about the Contract and agrees that the obligations undertaken by this Bond shall not be impaired in any manner by reason of any such modifications, omissions, additions, changes, alterations, extensions of time, changes in payment terms, and amendments.
4. The Surety hereby agrees that this Bond shall be deemed amended automatically and immediately, without formal or separate amendments hereto, upon any amendment or modifications to the Contract, so as to bind the Principal and Surety, jointly and severally, to the full payment of any Claimant under the Contract, as amended or modified, provided only that the Surety shall not be liable for more than the penal sum of the Bond, as specified in the first paragraph hereof.
5. This Bond is made for the use and benefit of all persons, firms, and corporations who or which may furnish any materials or perform any labor for or on account of the construction-type services to be performed or supplied under the Contract, and any amendments thereto, and they and each of them may sue hereon.
6. No action may be maintained on this Bond after one (1) year from the date the last services, labor, or materials were provided under the Contract by the Claimant prosecuting said action.
7. This Bond is intended to comply with O.C.G.A. Section 13-10-1 and shall be interpreted so as to comply with the minimum requirements thereof. However, in the event the express language of this Bond extends protection to the Owner beyond that contemplated by O.C.G.A. Section 13-10-1 and 36-91-1, *et seq.*, or any other statutory law applicable to this Project, then the additional protection shall be enforced in favor of the Owner, whether or not such protection is found in the applicable statutes.

IN WITNESS WHEREOF, the Principal and Surety have hereunto affixed their corporate seals and caused this obligation to be signed by their duly authorized representatives this _____ day of _____, _____.

PRINCIPAL: _____

President/Vice President (Sign)

President/Vice President (Type or Print)

Attested to by:

Secretary/Assistant Secretary (Seal)

SURETY: _____

By: _____
Attorney-in-Fact (Sign)

Attorney-in-Fact (Type or Print)

Secretary/Assistant Secretary (Seal)

PERFORMANCE BOND

INSTRUCTIONS

1. This form is required for use in connection with the Agreement identified on its face. There shall be no deviation from this form without approval by the County.
2. The full legal name and business address of the Principal shall be inserted in the space designated "Principal" on the face of the form. The bond shall be signed by an authorized person. Where such person is signing in a representative capacity (e.g., an attorney-in-fact), but is not a member of the firm, partnership, or joint venture, or an office of the corporation involved, evidence of this authority must be furnished.
3. Corporation executing the bond as surety must be among those appearing on the U.S. Treasury Department's most current list of approved sureties and must be acting within the amounts and limitations set forth therein.
4. Corporate surety shall be duly authorized by the Commissioner of Insurance of the State of Georgia to transact surety business in the State of Georgia.
5. Do not date this bond. The County will date this bond the same date or later than the date of the Agreement.
6. The Surety shall attach a duly authorized power-of-attorney authorizing signature on its behalf of any attorney-in-fact.
7. Corporations executing the bond shall affix their corporate seals. Individuals shall execute the bond opposite the word "Seal."
8. The name of each person signing this bond shall be typed or printed in the space provided.

PERFORMANCE BOND

"County:" means Fulton County Government; a political subdivision of the State of Georgia (hereinafter called the "Owner").

"Project:" means 23RFP139070K-JAJ Progressive Design/Build Services Campbellton Pump Station & Force Main (Phase 2)

"Principal:" (Legal Name and Business Address), [Insert Name of Contractor (hereinafter called the "Principal")]

Type of Organization ("X" one):
_____ Individual
_____ Partnership
_____ Joint Venture
_____ Corporation

"Surety:" (Name and Business Address)

duly authorized by the Commissioner of Insurance of the State of Georgia to transact surety business in the State of Georgia.

"Contract:" Agreement between Principal and Owner, dated ____ day of _____, 25____, regarding performance of Work relative to the Project.

"Penal Sum:" [100% of contract amount]_____.

KNOW ALL MEN BY THESE PRESENTS, that we, the Principal and Surety hereto, as named above, are held and firmly bound to the Owner in the above Penal Sum for the payment of which well and truly to be made we bind ourselves, our executors, administrators, successors and assigns, jointly and severally.

WHEREAS, the Principal and the Owner entered into a certain written Contract identified above, which is incorporated herein by reference in its entirety (hereinafter called the "Contract"), for construction-type services for the Project identified above;

NOW, THEREFORE, the conditions of this obligation are such that if the Principal shall faithfully and fully comply with, perform and fulfill all of the undertakings, covenants, conditions and all other of the

terms and conditions of said Contract, including any and all duly authorized modifications of such Contract, within the original term of such Contract and any extensions thereof, which shall include, but not be limited to any obligations created by way of warranties and/or guarantees for workmanship and materials which warranty and/or guarantee may extend for a period of time of one year beyond completion of said Contract, this obligation shall be void; otherwise, of full force and effect.

Whenever the Principal shall be, and declared by the Owner to be, in default under the Construction-Type Contract, the Surety shall promptly remedy the default as follows:

1. Complete the Contract in accordance with its terms and conditions; or, at the sole option of the Owner,
2. Obtain a bid or bids for completing the Contract in accordance with its terms and conditions, and upon determination by the Surety and the Owner of the lowest responsible bidder, arrange for a contract between such bidder and Owner and make available as the work progresses (even though there should be a default or succession of defaults under the Contract or contracts of completion arranged under this paragraph) sufficient funds to pay the cost of completion less the balance of the contract price; but not exceeding, including other costs and damages for which the Surety may be liable hereunder, the penal sum set forth in the first paragraph hereof, as may be adjusted, and the Surety shall make available and pay to the Owner the funds required by this Paragraph prior to the payment of the Owner of the balance of the contract price, or any portion thereof. The term "balance of the contract price," as used in this paragraph, shall mean the total amount payable by the Owner to the Contractor under the Contract, and any amendments thereto, less the amount paid by the Owner to the Contractor; or, at the sole option of the Owner,
3. Allow Owner to complete the work and reimburse the Owner for all reasonable costs incurred in completing the work.

In addition to performing as required in the above paragraphs, the Surety shall indemnify and hold harmless the Owner from any and all losses, liability and damages, claims, judgments, liens, costs and fees of every description, including reasonable attorney's fees, litigation costs and expert witness fees, which the Owner may incur, sustain or suffer by reason of the failure or default on the part of the Principal in the performance of any or all of the terms, provisions, and requirements of the Contract, including any and all amendments and modifications thereto, or incurred by the Owner in making good any such failure of performance on the part of the Principal.

The Surety shall commence performance of its obligations and undertakings under this Bond promptly and without delay, after written notice from the Owner to the Surety.

The Surety hereby waives notice of any and all modifications, omissions, additions, changes, alterations, extensions of time, changes in payment terms, and any other amendments in or about the Contract, and agrees that the obligations undertaken by this Bond shall not be impaired in any manner by reason of any such modifications, omissions,

additions, changes, alterations, extensions of time, change in payment terms, and amendments.

The Surety hereby agrees that this Bond shall be deemed amended automatically and immediately, without formal or separate amendments hereto, upon any amendment to the Contract, so as to bind the Principal and the Surety to the full and faithful performance of the Contract as so amended or modified, and so as to increase the penal sum to the adjusted Contract Price of the Contract.

No right of action shall accrue on this Bond to or for the use of any person, entity or corporation other than the Owner and any other obligee named herein, or their executors, administrators, successors or assigns.

This Bond is intended to comply with O.C.G.A. Section 36-91-1 et seq. and shall be interpreted so; as to comply with; the minimum requirements thereof. However, in the event the express language of this Bond extends protection to; the Owner beyond that contemplated by O.C.G.A. Section 36-91-1 et seq. and O.C.G.A. Section 13-10-1, as amended, or any other statutory law applicable to this Project, then the additional protection shall be enforced in favor of the Owner, whether or not such protection is found in the applicable statutes.

IN WITNESS WHEREOF, the Principal and the Surety have caused these presents to be duly signed and

sealed this _____ day of _____, 20____.

PRINCIPAL:_____

President/Vice President (Sign)

President/Vice President (Type or Print)

Attested to by:

Secretary/Assistant Secretary (Seal)

SURETY:_____

By: _____
Attorney-in-Fact (Sign)

Attorney-in-Fact (Type or Print)

Certificate Of Completion

Envelope Id: 1E620017-C4AB-4927-BDC3-29E8A21C3DE5

Status: Completed

Subject: Sol Construction, LLC-Progressive D/B Campbellton PS & Force Main- Item #25-0570

Parcel ID:

Employee Name:

Source Envelope:

Document Pages: 1051

Signatures: 5

Envelope Originator:

Certificate Pages: 6

Initials: 0

James Jones

AutoNav: Enabled

Stamps: 1

141 Pryor Street

Envelopeld Stamping: Enabled

Purchasing & Contract Compliance, Suite 1168

Time Zone: (UTC-08:00) Pacific Time (US &

Atlanta, GA 30303

Canada)

james.jones@fultoncountyga.gov

IP Address: 134.231.232.249

Record Tracking

Status: Original

Holder: James Jones

Location: DocuSign

11/6/2025 10:04:14 PM

james.jones@fultoncountyga.gov

Security Appliance Status: Connected

Pool: StateLocal

Storage Appliance Status: Connected

Pool: Fulton County Government

Location: Docusign

Signer Events

Signature

Timestamp

JULIANA GOMEZ

jgomez@solconstructionllc.com

President

Security Level: Email, Account Authentication
(None)

Signed by:

JULIANA GOMEZ

D478F4AF70124A5...

Sent: 11/6/2025 10:24:43 PM

Viewed: 11/7/2025 6:32:08 AM

Signed: 11/11/2025 6:54:11 AM

Signature Adoption: Pre-selected Style

Using IP Address: 173.160.75.153

Electronic Record and Signature Disclosure:

Accepted: 11/18/2021 11:15:52 AM

ID: dc770d26-240e-4fe7-8948-e0c810d436d9

James Jones

james.jones@fultoncountyga.gov

Assistant Purchasing Agent

BROWN & ROOT INDUSTRIAL SERVICESLLC

Security Level: Email, Account Authentication
(None)

Completed

Sent: 11/11/2025 6:54:17 AM

Viewed: 11/12/2025 4:59:56 AM

Signed: 11/12/2025 5:00:04 AM

Using IP Address: 144.125.34.76

Electronic Record and Signature Disclosure:

Not Offered via Docusign

David Clark

david.clark@fultoncountyga.gov

Director

Public Works

Security Level: Email, Account Authentication
(None)

DocuSigned by:

David Clark

65CE1C9FDD834B8...

Sent: 11/12/2025 5:00:10 AM

Viewed: 11/12/2025 7:43:36 AM

Signed: 11/12/2025 7:43:48 AM

Signature Adoption: Pre-selected Style

Using IP Address: 74.174.59.10

Electronic Record and Signature Disclosure:

Accepted: 11/13/2017 10:07:14 AM

ID: 62e0a41e-60ea-4640-a1cb-69bfc2cfa732

David Lowman

david.lowman@fultoncountyga.gov

Security Level: Email, Account Authentication
(None)

Completed

Sent: 11/12/2025 7:43:55 AM

Resent: 11/12/2025 7:59:35 AM

Viewed: 11/12/2025 8:08:02 AM

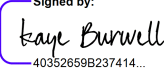
Signed: 11/12/2025 8:32:57 AM

Using IP Address: 74.174.59.4

Electronic Record and Signature Disclosure:

Accepted: 11/12/2025 8:08:02 AM

ID: 1c0d6967-6b9a-47c4-9fe3-92daeb914d03

Signer Events	Signature	Timestamp
Kaye Burwell kaye.burwell@fultoncountyga.gov Deputy County Attorney Security Level: Email, Account Authentication (None) Electronic Record and Signature Disclosure: Accepted: 11/13/2025 6:10:35 AM ID: 6f85a2c2-2723-4160-bad0-b14703a8a587	Signed by:  40352659B237414... Signature Adoption: Pre-selected Style Using IP Address: 104.129.206.76	Sent: 11/12/2025 8:33:03 AM Resent: 11/12/2025 7:24:40 PM Viewed: 11/13/2025 6:10:35 AM Signed: 11/13/2025 6:11:49 AM
Nikki Peterson nikki.peterson@fultoncountyga.gov Chief Deputy Clerk to the Board of Commissioners Fulton County Government Security Level: Email, Account Authentication (None) Electronic Record and Signature Disclosure: Accepted: 11/27/2017 10:39:37 AM ID: b7ce88ee-0c66-4f3a-bfee-705e0af602d8	Completed Using IP Address: 74.174.59.10	Sent: 11/13/2025 6:11:56 AM Resent: 11/14/2025 11:59:07 AM Resent: 11/14/2025 12:02:09 PM Viewed: 11/17/2025 8:45:19 AM Signed: 11/17/2025 8:45:38 AM
Robert L. Pitts harriet.thomas@fultoncountyga.gov Chairman Fulton County Security Level: Email, Account Authentication (None) Electronic Record and Signature Disclosure: Accepted: 11/17/2025 12:27:30 PM ID: 75572161-ddd9-4320-a7ca-e01e07809907	Signed by:  14E1B4AA5F6A44A... Signature Adoption: Pre-selected Style Using IP Address: 74.174.59.10	Sent: 11/17/2025 8:45:45 AM Viewed: 11/17/2025 12:27:30 PM Signed: 11/17/2025 12:27:43 PM
Tonya Grier tonya.grier@fultoncountyga.gov Clerk to the Commission Fulton County Government Security Level: Email, Account Authentication (None)	Signed by:  EEC476C4837648D...  Signature Adoption: Uploaded Signature Image Using IP Address: 134.231.232.249	Sent: 11/17/2025 12:27:51 PM Viewed: 11/17/2025 12:47:20 PM Signed: 11/17/2025 12:47:33 PM
James Jones james.jones@fultoncountyga.gov Assistant Purchasing Agent BROWN & ROOT INDUSTRIAL SERVICESLLC Security Level: Email, Account Authentication (None) Electronic Record and Signature Disclosure: Accepted: 10/27/2025 8:21:47 AM ID: 4889b84d-8ea3-4ba9-bf87-bf4c309e21ab	Completed Using IP Address: 144.125.1.75	Sent: 11/17/2025 12:47:44 PM Viewed: 11/17/2025 12:50:38 PM Signed: 11/17/2025 12:51:05 PM
In Person Signer Events	Signature	Timestamp
Editor Delivery Events	Status	Timestamp
Agent Delivery Events	Status	Timestamp

Intermediary Delivery Events	Status	Timestamp
Certified Delivery Events	Status	Timestamp
Carbon Copy Events	Status	Timestamp
Andrenette Whitlow andrenettewhitlow@fultoncountyga.gov Security Level: Email, Account Authentication (None) Electronic Record and Signature Disclosure: Not Offered via DocuSign	COPIED	Sent: 11/17/2025 12:51:13 PM
Dian DeVaughn dian.devaughn@fultoncountyga.gov Security Level: Email, Account Authentication (None) Electronic Record and Signature Disclosure: Not Offered via DocuSign	COPIED	Sent: 11/17/2025 12:51:14 PM Viewed: 11/17/2025 1:26:45 PM
James Jones james.jones@fultoncountyga.gov Assistant Purchasing Agent BROWN & ROOT INDUSTRIAL SERVICESLLC Security Level: Email, Account Authentication (None) Electronic Record and Signature Disclosure: Not Offered via DocuSign	COPIED	Sent: 11/17/2025 12:51:16 PM Resent: 11/17/2025 12:51:32 PM
Witness Events	Signature	Timestamp
Notary Events	Signature	Timestamp
Envelope Summary Events	Status	Timestamps
Envelope Sent	Hashed/Encrypted	11/6/2025 10:24:43 PM
Envelope Updated	Security Checked	11/7/2025 1:29:18 AM
Envelope Updated	Security Checked	11/7/2025 1:29:18 AM
Envelope Updated	Security Checked	11/12/2025 4:58:57 AM
Envelope Updated	Security Checked	11/12/2025 7:59:34 AM
Envelope Updated	Security Checked	11/12/2025 7:59:34 AM
Envelope Updated	Security Checked	11/12/2025 1:03:51 PM
Envelope Updated	Security Checked	11/12/2025 1:03:51 PM
Envelope Updated	Security Checked	11/12/2025 1:18:28 PM
Envelope Updated	Security Checked	11/12/2025 1:18:28 PM
Envelope Updated	Security Checked	11/12/2025 1:18:28 PM
Certified Delivered	Security Checked	11/17/2025 12:50:38 PM
Signing Complete	Security Checked	11/17/2025 12:51:05 PM
Completed	Security Checked	11/17/2025 12:51:16 PM
Payment Events	Status	Timestamps
Electronic Record and Signature Disclosure		

CONSUMER DISCLOSURE

From time to time, Carahsoft OBO Fulton County, Georgia (we, us or Company) may be required by law to provide to you certain written notices or disclosures. Described below are the terms and conditions for providing to you such notices and disclosures electronically through the DocuSign, Inc. (DocuSign) electronic signing system. Please read the information below carefully and thoroughly, and if you can access this information electronically to your satisfaction and agree to these terms and conditions, please confirm your agreement by clicking the 'I agree' button at the bottom of this document.

Getting paper copies

At any time, you may request from us a paper copy of any record provided or made available electronically to you by us. You will have the ability to download and print documents we send to you through the DocuSign system during and immediately after signing session and, if you elect to create a DocuSign signer account, you may access them for a limited period of time (usually 30 days) after such documents are first sent to you. You may request delivery of such paper copies from us by following the procedure described below.

Withdrawing your consent

If you decide to receive notices and disclosures from us electronically, you may at any time change your mind and tell us that thereafter you want to receive required notices and disclosures only in paper format. How you must inform us of your decision to receive future notices and disclosure in paper format and withdraw your consent to receive notices and disclosures electronically is described below.

Consequences of changing your mind

If you elect to receive required notices and disclosures only in paper format, it will slow the speed at which we can complete certain steps in transactions with you and delivering services to you because we will need first to send the required notices or disclosures to you in paper format, and then wait until we receive back from you your acknowledgment of your receipt of such paper notices or disclosures. To indicate to us that you are changing your mind, you must withdraw your consent using the DocuSign 'Withdraw Consent' form on the signing page of a DocuSign envelope instead of signing it. This will indicate to us that you have withdrawn your consent to receive required notices and disclosures electronically from us and you will no longer be able to use the DocuSign system to receive required notices and consents electronically from us or to sign electronically documents from us.

All notices and disclosures will be sent to you electronically

Unless you tell us otherwise in accordance with the procedures described herein, we will provide electronically to you through the DocuSign system all required notices, disclosures, authorizations, acknowledgements, and other documents that are required to be provided or made available to you during the course of our relationship with you. To reduce the chance of you inadvertently not receiving any notice or disclosure, we prefer to provide all of the required notices and disclosures to you by the same method and to the same address that you have given us. Thus, you can receive all the disclosures and notices electronically or in paper format through the paper mail delivery system. If you do not agree with this process, please let us know as described below. Please also see the paragraph immediately above that describes the consequences of your electing not to receive delivery of the notices and disclosures electronically from us.

How to contact Carahsoft OBO Fulton County, Georgia:

You may contact us to let us know of your changes as to how we may contact you electronically, to request paper copies of certain information from us, and to withdraw your prior consent to receive notices and disclosures electronically as follows:

To contact us by email send messages to: glenn.king@fultoncountyga.gov

To advise Carahsoft OBO Fulton County, Georgia of your new e-mail address

To let us know of a change in your e-mail address where we should send notices and disclosures electronically to you, you must send an email message to us at glenn.king@fultoncountyga.gov and in the body of such request you must state: your previous e-mail address, your new e-mail address. We do not require any other information from you to change your email address..

In addition, you must notify DocuSign, Inc. to arrange for your new email address to be reflected in your DocuSign account by following the process for changing e-mail in the DocuSign system.

To request paper copies from Carahsoft OBO Fulton County, Georgia

To request delivery from us of paper copies of the notices and disclosures previously provided by us to you electronically, you must send us an e-mail to glenn.king@fultoncountyga.gov and in the body of such request you must state your e-mail address, full name, US Postal address, and telephone number. We will bill you for any fees at that time, if any.

To withdraw your consent with Carahsoft OBO Fulton County, Georgia

To inform us that you no longer want to receive future notices and disclosures in electronic format you may:

- i. decline to sign a document from within your DocuSign session, and on the subsequent page, select the check-box indicating you wish to withdraw your consent, or you may;
- ii. send us an e-mail to glenn.king@fultoncountyga.gov and in the body of such request you must state your e-mail, full name, US Postal Address, and telephone number. We do not need any other information from you to withdraw consent.. The consequences of your withdrawing consent for online documents will be that transactions may take a longer time to process..

Required hardware and software

Operating Systems:	Windows® 2000, Windows® XP, Windows Vista®; Mac OS® X
Browsers:	Final release versions of Internet Explorer® 6.0 or above (Windows only); Mozilla Firefox 2.0 or above (Windows and Mac); Safari™ 3.0 or above (Mac only)
PDF Reader:	Acrobat® or similar software may be required to view and print PDF files
Screen Resolution:	800 x 600 minimum
Enabled Security Settings:	Allow per session cookies

** These minimum requirements are subject to change. If these requirements change, you will be asked to re-accept the disclosure. Pre-release (e.g. beta) versions of operating systems and browsers are not supported.

Acknowledging your access and consent to receive materials electronically

To confirm to us that you can access this information electronically, which will be similar to other electronic notices and disclosures that we will provide to you, please verify that you were

able to read this electronic disclosure and that you also were able to print on paper or electronically save this page for your future reference and access or that you were able to e-mail this disclosure and consent to an address where you will be able to print on paper or save it for your future reference and access. Further, if you consent to receiving notices and disclosures exclusively in electronic format on the terms and conditions described above, please let us know by clicking the 'I agree' button below.

By checking the 'I agree' box, I confirm that:

- I can access and read this Electronic CONSENT TO ELECTRONIC RECEIPT OF ELECTRONIC CONSUMER DISCLOSURES document; and
- I can print on paper the disclosure or save or send the disclosure to a place where I can print it, for future reference and access; and
- Until or unless I notify Carahsoft OBO Fulton County, Georgia as described above, I consent to receive from exclusively through electronic means all notices, disclosures, authorizations, acknowledgements, and other documents that are required to be provided or made available to me by Carahsoft OBO Fulton County, Georgia during the course of my relationship with you.