

Water Supply Tunnel System Connection to Chattahoochee Water Treatment Plant

TECHNICAL SPECIFICATIONS

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**SECTION 01005
MISCELLANEOUS REQUIREMENTS**

1.01 GENERAL

- A. The Contractor shall conform to all miscellaneous requirements as herein specified.
- B. (Not Used)

1.02 INTERFERENCE WITH EXISTING WORKS

- A. The Contractor shall at all times conduct his operations so as to interfere as little as possible with existing works. The Contractor shall develop a program, in cooperation with the Engineer and plant personnel, which shall provide for the construction and putting into service of the new works in the most orderly manner possible. This program shall be adhered to except as deviations therefrom are expressly permitted. All work of connecting with, cutting into, and reconstructing existing pipes or structures shall be planned to interfere with the operation of the existing facilities for the shortest possible time when the demands on the facilities best permit such interference, even though it may be necessary to work outside of normal working hours to meet these requirements. Before starting work which will interfere with the operation of existing facilities, the Contractor shall do all possible preparatory work and shall see that all tools, materials, and equipment are made ready and at hand. The Contractor shall have spare tools, materials and equipment readily available in order to limit the amount of time of interference with existing facilities.
- B. The Contractor shall make such minor modifications in the work relating to existing structures as may be necessary, without additional compensation.
- C. The Contractor shall have no claim for additional compensation by reason of delay or inconvenience in adapting his operations to meet the above requirements.

1.03 MAINTAINING SEWAGE WATER, AND STORM WATER FLOWS AND OTHER UTILITIES AND PROCESS FLOWS

- A. It is essential to the operation of the existing facilities system that there shall be no interruption in the flow of aforementioned utilities. To this end, the Contractor shall provide, maintain, and operate all temporary facilities such as dams, pumping equipment, conduits, and all other labor and equipment necessary to intercept these utilities before it reaches the points where it would interfere with his work, carry it past its work, and return it to the existing utility below its work.
- B. Minimum facility usage flow occurs during the night hours and weekends. The Contractor may work on the existing utilities at such times as agreed with the Engineer if he so chooses at no additional cost to the City.

1.04 PHASE CONSTRUCTION

- A. Work under this Contract is to be accomplished in a timely manner and in accordance

with the completion time set forth in the Project Schedule.

B. (Not Used)

1.05 MOTOR AND STARTING EQUIPMENT DATA LIST

- A. Each Contractor shall obtain the necessary data from its equipment suppliers, and shall prepare a complete tabulation of all motors over 1/3 hp. and all electric heaters to be furnished under his Contract.
- B. The motor and heater tabulation shall include firm and accurate information as follows:
1. Name and identification of equipment.
 2. Manufacturer.
 3. Horsepower or kilowatt rating.
 4. Voltage.
 5. Phase.
 6. Speed.
 7. Full load current.
 8. Locked rotor current or code letter.
 9. Type of enclosure (open drip proof, totally enclosed, fan cooled, etc.)
 10. Automatic control equipment used (if applicable).
 11. NEMA size of starter or contactor.
 12. Overload heater size.
 13. Type of starter (full-voltage, reduced-voltage, autotransformer, etc.).
 14. Breaker trip setting or fuse size.
 15. Voltage of starter operating coil.
 16. If starter is at a motor control center, list motor control center number.
- C. The correct submission of starting equipment shop drawings is dependent upon timely submission of the complete motor and electric heater tabulation. To this end, all Contractors shall cooperate fully in the assimilation and dissemination of motor and electric heater data.
- D. Three copies of the tabulation shall be furnished to the Engineer. Two copies shall also be furnished concurrently to the Electrical Sub-Contractor, to use in preparing his/her order for starting equipment. The Electrical Sub-Contractor shall also prepare a composite tabulation of all of these motors and electric heaters, as specified under Section 16000 – ELECTRICAL POWER & SYSTEMS.

1.06 VOLTAGE RATINGS OF MOTORS

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- A. Unless otherwise specified, motors with ratings in excess of 1/3 hp. shall be rated 460-volt (nameplate rating), three-phase, 60-Hertz; motors of 1/3 hp. or less shall be rated 115-volt, single-phase, 60-Hertz.
- B. (Not Used)

1.07 HYDRAULIC UPLIFT OF STRUCTURES

- A. The Contractor shall be responsible for the protection of all structures against hydraulic uplift until such structures have been accepted finally by the Engineer that the structure was completed in accordance with the contract documents and accepted by owner.
- B. (Not Used)

+++ END OF SECTION 01005 +++

**SECTION 01010
SUMMARY OF WORK**

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Summary: This Project consists of the design and construction of a flow controlled connection from the City of Atlanta's existing raw water tunnel and shaft system to the existing Chattahoochee water treatment plant (CWTP). It includes associated yard piping and valve installation, grading, lighting, erosion and sediment controls, and all other items required by the contract documents to complete the Work. It is imperative that all work shall be performed without disrupting the operational ability of the CWTP to receive and process raw water into the plant. The CWTP manager must receive and approve of all activities which could impact the operations of the plant.
- B. Major Portions of the Work consist of, but are not limited to, the following items:
1. Review the bridging documents in a workshop with the City's project management team and Operations staff to assure a full understanding of the project. Project drawings and guide specifications, developed at 50% or more, have been provided in the bridging documents. Final design/construction documents shall be completed by the contracted design-build team and stamped by appropriate State of Georgia registered Professional Engineers and Land Surveyors.
 2. Confirm on-site locations of all existing utilities and tie-in points – yard piping and electrical. Damage to existing infrastructure during the contract could greatly impact operations at both Chattahoochee and Hemphill water treatment plants. Call Before You Dig (811) will not have comprehensive utility information inside the CWTP boundaries, therefore the contractor may need to explore additional location methods.
 3. Continuous WTP operations must be maintained to assure clean and safe drinking water for Atlanta's customers. Any work with associated risk that could result in an impact to normal operations shall be submitted with a work-plan and approved by the plant manager prior to commencement of that task.
 4. Coordination with the City's security department for site access by the Contractor's workforce and requirements to maintain security fencing. The City's project manager will assist with this coordination.
 5. As shown in the bridging document drawings, design, furnish, and install a yard piping connection between the end of the existing tunnel shaft stub-out piping (60-inch) and a tie-in point to the existing 60-inch yard piping entering the CWTP central mix influent. Yard piping for this project

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consists of approximately 350 linear feet (combined total) of 60, 48, and 42-inch pipe with a minimal rating of 150 psi.

6. As shown in the bridging document drawings, the pipe connection shall include ductile iron piping, a control valve, isolation valves, a by-pass valve, a flow meter, an environmentally controlled maintenance friendly accessible vault, and accessories as indicated. All large valves (42-inch and above) shall be within an accessible vault (not direct buried) and operational by electrical actuators with manual backup.
7. The existing 42-inch raw water main coming from the pump station, which is in conflict with the piping connection route to the tunnel, shall be relocated and reconnected, including an air release valve (ARV). Records indicate that the existing 42-inch pipe material is steel.
8. The existing 60-inch raw water main, coming from the pump station, shall be the tie-in point for the tunnel connection piping. The tie-in work shall include a new electrically actuated 60-inch valve, vault, and ARV. A written work-plan for this connection will be required to be submitted and approved prior to construction work on the existing 60-inch pipe.
9. Electrical connections shall be run underground in ductbanks and sourced from existing gear within the CWTP Chemical Application Building. All required electrical and lighting components shall be designed, furnished, and installed by the contractor.
10. The Contractor shall incorporate all valve control and monitoring signals into the CWTP SCADA system – including HMI screens. An operational control strategy shall be developed by the Contractor, in association with the City's staff, at a full day workshop, and incorporated into the SCADA programming. The new tunnel connection infrastructure designed and built under this project, shall provide automated and manual flow control of raw water into the CWTP. In an automated mode, raw water flow should enter the CWTP at an Operator set point and automatically adjust the flow control valve as variable conditions occur, such as if the head pressure in the tunnel shaft changes or if raw water pump station pumps are operating.
11. The Contractor shall provide O&M manuals, Standard Operating Procedures (SOPs) and adequate training for all new equipment. An SOP and at least one day training is required for SCADA operations and maintenance personnel.
12. Site erosion control, traffic control, and site restoration must meet State of Georgia and local requirements and will be monitored carefully during the project. Restoration (grass areas and paving) shall be at or better than existing conditions. Chemical deliveries to the chemical and fluoride buildings are based on need and may occur several times each week. The Contractor shall be responsible to assure there is an entrance/exit path for chemical truck deliveries.

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- C. The Contractor shall furnish and install all labor, materials, equipment and incidentals which are reasonable and properly inferable and necessary for the proper completion of the work, whether specifically indicated in the Contract Documents or not.
- D. The Contractor shall perform the work complete, in place and ready for continuous service and shall include repairs, replacements and restoration required as a result of all damages that occur as a result of construction under this contract.

1.02 PROJECT LOCATION

- A. The equipment and materials to be furnished will be installed at the Chattahoochee WTP location shown on the Project Documents.
- B. (Not Used)

1.03 QUANTITIES

- A. The Owner reserves the right to alter the quantities of work to be performed, extend or shorten the improvements at any time when deemed necessary, and the Contractor shall perform the work as altered, increased or decreased.
- B. (Not Used)

1.04 PARTIAL OWNER OCCUPANCY

- A. The existing facilities to which these improvements are being made must continue operation during the period of construction. The CWTP facility operates 24/7/365 during the year. Any impact to existing operation shall be coordinated with the Owner. This will include access for chemical delivery trucks and emergency equipment should repairs be required.
- B. The existing pipelines to which these improvements are being made or connected to will remain in operation during construction unless otherwise approved via a work-plan submittal.

1.05 QUALITY CONTROL AND ASSURANCE

- A. The Contractor shall provide the Project's Quality Control and Assurance Plan that has been prepared for this project, as well as additional requirements as stated on the Drawings or individual technical specifications governing the Work.

1.06 TEMPORARY FACILITIES

- A. The Contractor shall include provision in the price proposal to provide their own temporary facilities, utility services, onsite material and equipment storage and

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security, etc.

PART 2 – PRODUCTS – (NOT USED)

PART 3 – EXECUTION – (NOT USED)

+++ END OF SECTION 01010 +++

**SECTION 01011
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. Some of the stipulations and requirements are a result of negotiations with various entities and organizations, which have an interest in this Project. Some requirements are based on technical aspects of the Project, which are not otherwise conveyed to the Contractor.
- B. (Not Used)

1.02 EXISTING FACILITY OPERATIONS

- A. The existing facilities must, of necessity, remain in operation while the new construction is in progress. If by any means, the existing utilities are needed to be shut down to perform any work, a lockout/tagout system approved by the City and Engineer shall be utilized.
- B. The Contractor shall coordinate the Work with the City so that the construction will not restrain or hinder the operation of the existing facilities.
- C. After having coordinated the Work with the City, the Contractor shall prepare a submittal to the City detailing the time, time limits, and methods of each connection or alteration and have the approval of the Engineer before any Work is undertaken on the connections or alterations.
- D. Contractor is advised there are numerous pressurized pipes, energized conduits and duct banks, overhead utilities, and gravity flow systems on the intake and Chattahoochee WTP sites. The Contractor is responsible for protecting the existing utility lines and shall be responsible for the repair and damages resulting from his construction activities to these systems. The Contractor is required to verify the actual locations of various buried lines shown in the Drawings by carefully excavated test pits and other direct means before starting Work in any given areas at no additional cost to the City. Special care shall be taken during any excavation to mitigate damage potential in case previously unknown and active systems are encountered. Overhead utilities may require raising or relocation to access site. Warning/caution signs are to be placed at the locations of any existing buried/overhead utilities.

1.03 SEQUENCING

- A. General: The Contractor shall be solely responsible for all construction sequencing. Suggested construction sequencing and limitations/restrictions regarding outage durations for connections to existing infrastructure are included on the Drawings.
- B. Sequence Submittal:
 - 1. Submit a proposed sequence with appropriate times for the start and completion of construction tasks to the City for review.

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2. The Contractor may propose alternatives to the sequencing constraints 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. The City is not obligated to accept any of these alternatives.
3. All work associated with the Chattahoochee WTP connection will need to follow the completion of the 60" Pipe and liner plate tunnel (STA 35+54 to STA 31+50). The existing pipeline will require dewatering in coordination with the Owner operation of the tunnel network. Dewatering the 60" Pipe is the Contractor's responsibility.

1.04 CHATTAHOOCHEE PLANT

- A. Work at the Chattahoochee Plant site shall be performed during regular working hours. Work may be performed 24 hours per day, seven days per week only after submitting a Written Notification and receiving Written Approval of the City.
- B. Parking for Contractor personnel shall be fully contained within the site boundaries. No parking is permitted on any other public roads or on any streets within the neighborhood. If necessary, the Contractor shall make arrangements for remote parking for its personnel, at a site approved by the Engineer, at no additional cost to the City. Contractor personnel parking is not to interfere with the Chattahoochee Complex daily operations.
- C. All traffic must enter and exit the site through the Chattahoochee Complex Entrance Designated on the Drawings, located on the north side of Bolton Road.
- D. Unless shown otherwise on the Drawings, the Contractor shall restore the site to its original grade. Any fill placed at the site used to return it to its original grade shall be controlled fill, approved by the City. The site shall be grassed and strawed.

1.05 DEFINITION OF TERMS

- A. (Not Used)

+++ END OF SECTION 01011 +++

**SECTION 01016
OCCUPANCY**

PART 1 – GENERAL

1.01 PARTIAL OCCUPANCY BY CITY

- A. Whenever, in the opinion of the Engineer, any section or portion of the Work is in suitable condition, it may be put into use upon the written order of the Engineer and such usage will not be held in any way as an acceptance of said work, or any part thereof, or as a waiver of any of the provisions of these Specifications and the Contract. Pending completion and final 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 the Contractor's own expense.
- B. (Not Used)

PART 2 – NOT USED

+++ END OF SECTION 01016 +++

**SECTION 01026
SCHEDULE OF VALUES**

PART 1 - GENERAL

1.01 SCOPE

- A. The work under this Section includes preparation and submittal of a Schedule of Values (SOV).

1.02 GENERAL

- A. Timing of Submittal: Submit to the Prime Contractor, a draft SOV allocated to the various portions of the Work, within 15 days after Notice to Proceed. The Contractor shall submit the Final SOV within 15 days after receipt of Prime Contractor comments.
- B. In the event account values cannot be agreed to between the Prime Contractor and the Contractor, the Prime Contractor shall have the exclusive right to determine the account dollar amounts contained in the Schedule of Values.
- C. Supporting Data: Upon request of the Prime Contractor, support the values with data which will substantiate their correctness.
- D. Use of Schedule: The schedule of values, unless objected to by the Prime Contractor, shall be used only as a basis of the Contractor's Application for Payment. Acceptance of the Contractor's SOV is a condition precedent to processing all applications for payment other than mobilization.

1.03 FORM AND CONTENT OF SCHEDULE OF VALUES

- A. Form and Identification
 - 1. Enter the SOV's account information in SOV format furnished by the Prime Contractor, which will be provided in an Excel spreadsheet.
 - 2. Contractor's standard forms and automated printout may be used.
 - 3. Identify schedule with:
 - a. Title of project and location
 - b. Prime Contractor
 - c. Name and address of Contractor
 - d. Contract designation

- e. Date of submission
- B. Schedule shall list the installed value of the component parts of the Work in sufficient detail to serve as a basis for computing values for progress payments during construction. Breakdown shall be by Pay Item (detailed in Section 01200 Measurement and Payment), then by CSI Format, for ease of field verification of quantities completed in each structure.
- C. Format
 - 1. Follow the Table of Contents of the Contract Documents as the format for listing the component items.
 - 2. Identify each item with the number and title of the respective major section of the Specifications.
- D. For each major line item list sub values of major products or operations under the item.
- E. For the Various Portions of the Work:
 - 1. Each item shall include a directly proportional amount of the Contractor's overhead and profit.
 - 2. For items on which progress payments will be requested for stored materials, break down the value into:
 - a. The cost of the materials, delivered and unloaded, with taxes paid and paid invoice.
 - b. The total installed value, including Contractor's overhead and profit, less item a. above.
 - 3. For each item, the Contractor shall specify which equipment is rented and which is owned, Contractor's labor rates and fringe, crew size and type of personnel, number shifts for each activity, and production rates assumed.
- F. The sum of all values listed in the schedule shall equal the Bid Total.

+++END OF SECTION+++

**SECTION 01040
COORDINATION**

PART 1 GENERAL

1.01 SUMMARY

- A. Coordinate execution of the Work with subcontractors and the Engineer as required to maintain operation of the existing facilities and satisfactory progress of the Work.
- B. The Engineer may require a written explanation of the Contractor's plan for accomplishing separate phases of the Work.

1.02 CONNECTIONS TO EXISTING SYSTEMS

- A. (Not Used)

1.03 RELOCATIONS

- A. The Contractor shall be responsible for the relocation of structures, including but not limited to light poles, signs, sign poles, fences, piping, conduits, and drains that interfere with the positioning of the Work as set out on the Drawings. The cost of all such relocations shall be included in the bid price.
- B. (Not Used)

1.04 EXISTING UNDERGROUND PIPING, STRUCTURES, AND UTILITIES

- A. The attention of the Contractor is drawn to the fact that during excavation, the possibility exists of the Contractor encountering various water, gas, telephone, electrical, or other utility lines not showed on the Drawings. The Contractor shall exercise extreme care before and during excavation to locate and flag these lines so as to avoid damage to the existing lines.
- B. The locations of existing underground piping structures and utilities are shown without express or implied representation, assurance, or guarantee that they are complete or correct or that they represent a true picture of underground piping to be encountered.
- C. The existing piping and utilities that interfere with new construction shall be rerouted as shown, specified, or required. Before any piping and utilities not shown on the Drawings are disturbed, the Contractor shall notify the Engineer of the location of the pipeline or utility and shall reroute or relocate the pipeline or utility as directed.
- D. The Contractor shall exercise care in any excavation to locate all existing piping and utilities. All utilities, which do not interfere with complete work, shall be carefully protected against damage. Any existing utilities damaged in any way by the Contractor shall be restored or replaced by the Contractor at its expense as directed by the Engineer.
- E. The Drawings indicate utilities or obstructions that are known to exist according to the best information available. The Contractor shall call the Utilities Protection Center (UPC) (800-282-7411) as required by Georgia Law (O.C.G.A. Sections 25-9-1 through

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25-9-13) and shall call 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.

- F. Existing Utility Locations: 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. Field utility locations are valid for only 10 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.
 2. Expose the facility, for a distance of at least 200 feet in advance of pipeline construction, to verify its true location and grade. Repair, or have repaired, any damage to utilities resulting from locating or exposing their true location.
 3. Avoid utility damage and interruption by protection with means or methods recommended by the utility owner.
 4. 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. The Contractor shall provide the Engineer an updated copy of the log bi-weekly, or more frequently if required.
- G. 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 water/sewer main does not permit safe installation of the water/sewer main by the use of sheeting, shoring, tying-back, supporting, or temporarily suspending service of the parallel or crossing facility. The Contractor may change the proposed alignment of the water/sewer main to avoid horizontal conflicts if the new alignment remains within the available right-of-way or easement, complies with regulatory agency requirements and after a written request to and subsequent approval by the Engineer. Where such relocation of the water/sewer main is denied by the Engineer, 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 water/sewer main does not permit the crossing without immediate or potential future damage to the utility, main, service, or the water/sewer main. The Contractor may change the proposed grade of the water main to avoid vertical conflicts if the changed grade maintains adequate cover and complies with regulatory agencies requirements after written request to and subsequent approval by the Engineer. Where such relocation of the water/sewer main is denied by the Engineer, the Contractor shall arrange to have the utility, main, or service relocated.
- H. Water and Sewer Separation
1. Water mains should maintain a minimum 10 foot edge-to-edge separation from sewer lines, whether gravity or pressure. If the main cannot be installed in the prescribed easement or right-of-way and provide the 10 foot separation, the separation may be reduced, provided the bottom of the water main is a minimum of 18-inches above the

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- top of the sewer. Should neither of these two separation criteria be possible, the water main shall be installed below the sewer with a minimum vertical separation of 18-inches.
2. The water main, when installed below the sewer, shall be encased in concrete with a minimum 6-inch concrete thickness to the first joint in each direction. Where water mains cross the sewer, the pipe joint adjacent to the pipe crossing the sewer shall be cut to provide maximum separation of the pipe joints from the sewer.
 3. No water main shall pass through, or come in contact with, any part of a sanitary sewer manhole.
- J. Work shall be located substantially as indicated on the Drawings, but the Engineer reserves the right to make such modifications in locations as may be found desirable to avoid interference with existing structures, utilities or for other reasons. Where fittings are noted on the Drawings, such notation is for the Contractor's convenience and does not relieve the Contractor for laying and joining different or additional items where required or when directed by the Engineer.

1.05 COOPERATION WITH OTHER CONTRACTORS AND FORCES

- A. During progress of work under this agreement, it will be necessary for other contractors and persons employed by the City to perform Work in or about the project area. The City reserves the right to put other such Contractors to work and to afford those Contractors access to the site of the Work to be performed hereunder at such times as the City deems appropriate. The Contractor shall not impede or interfere with the Work for such other Contractors engaged in Work or shall so arrange and conduct their Work that such other Contractors may complete their work at the earliest date possible.
- B. When the Contractor and any contractor or sub-contractor performing Work under or pursuant to another City Agreement are employed on related or adjacent work, or are using the same material source, storage area, or disposal area, the Contractor shall be responsible to the other for any inquiry, damage, or loss caused the other by his operations, by his unnecessary delay or hindrance of the others work, or by his failure to complete the Work or any portion delay or hindrance of the other's Work, or by his failure to complete the Work or any portion thereof within the time specified for its completion. The Contractor shall indemnify and save harmless the City and the Engineer, and all officers and employees of the City connected with the Work from all claims, suits, or actions of any injury, damage, or loss.
- C. Contractors Responsibilities under the preceding paragraph shall be not greater as to any injury, damage or loss than those imposed on the Contractor or Sub-contractor under the comparable provision of this Agreement or Subcontract.
- D. The Engineer will decide any disputed questions regarding the performance of the Work, access and cleaning up of the site, and priority in all relations between the Contractor and other contractors in utility companies, and maintenance crews.
- E. The Contractor shall cooperate with all other Contractors requiring access to the Work for the purpose of maintenance of security, temporary facilities, cleaning of the site, and

like matters requiring common effort.

1.06 HAZARDOUS LOCATIONS

- A. The existing wet wells, manholes and related areas are hazardous locations, in that explosive concentrations of sewage gas may be present. The Contractor is cautioned that the above areas, especially the wet well, may be deficient in oxygen. Checks shall be made by the Contractor whenever personnel are working in these areas to determine if adequate oxygen is available.
- B. (Not Used)

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 COORDINATION

- A. The Contractor shall consult with the Engineer on a daily basis while performing demolition, excavation, or any other alteration activity. No water or sewer function, utility or structure shall be altered, shut off or removed unless approved in advance, and in writing, by the Engineer. The Contractor shall give the Engineer at least 48 hours advanced notice, in writing, of the need to alter, shut off or remove such function. Lockout/tagout procedures shall be required.
- B. Coordinate the Work with the Engineer and revise daily activities if needed so as to not adversely affect system operations. Such revisions in the proposed work schedule will be accomplished with no additional compensation to the Contractor.

3.02 OWNER'S RESPONSIBILITIES

- A. All existing raw water system valves shall be located, uncovered as necessary and operated by the Owner.
- B. (Not Used)

3.03 PROTECTION AND RESTORATION OF WORK AREA

- A. General: 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 completed.
 - 1. The Contractor shall plan, coordinate, and prosecute the work such that disruption to personal property and business is held to a practical minimum.
 - 2. All construction areas abutting lawns and yards of residential or commercial property shall be restored promptly. Backfilling of underground facilities, ditches, and disturbed areas shall be accomplished on a daily basis as work is completed. Finishing, dressing,

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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. Care shall be taken to provide positive drainage to avoid ponding or concentration of runoff.

3. 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.
 4. The Engineer shall be authorized to stop all work by the Contractor when restoration and cleanup are unsatisfactory and to require appropriate remedial measures.
- B. Man-made Improvements: Protect, or remove and replace with the Engineer's approval, all fences, walkways, mail boxes, pipe lines, drain culverts, power and telephone lines and cables, property pins and other improvements that may be encountered in the Work.
- C. Cultivated Growth: Do not disturb cultivated trees or shrubbery unless approved by the Engineer. 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. Protect trees that remain in the vicinity of the work from damage from equipment. 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. Repair any damaged tree over 3-inches in diameter, not to be removed, under the direction of an experienced nurseryman. All trees and brush that require removal shall be promptly and completely removed from the work area and disposed of by the Contractor. No stumps, wood piles, or trash piles will be permitted on the work site.
- E. 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.
- F. Swamps and Other Wetlands – (Not Used)
- G. Refer to Section 02920, Site Restoration.

3.04 PIPE DISTRIBUTION – (NOT USED)

3.05 CONSTRUCTION OPERATIONS

- A. The Contractor shall insure that all work areas and roadways are free from excess excavated material, debris, mud, soil, and rocks etc. at the end of each work day. Contractor shall be responsible for sweeping all areas at the end of each work day.
- B. (Not Used)

3.06 WATER FOR CONSTRUCTION PURPOSES

- A. All water required for construction shall be furnished by the Owner. It shall be available

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by connecting to the Owner's water system at a point approved by the Owner. There shall be installed in every connection to the Owner's water supply a water meter with backflow preventer meeting the requirements of the City. The Contractor shall meter all water usage. The Contractor shall notify the City one week in advance prior to connecting to the water system.

- B. A total of the metered water used shall be submitted to the Owner with each monthly application for payment.

+++ END OF SECTION 01040 +++

**SECTION 01045
CUTTING AND PATCHING**

PART 1 GENERAL

1.01 DEFINITIONS

- A. Definition: "Cutting and patching" includes cutting into existing construction to provide for the installation or performance of other work and subsequent fitting and patching required to restore surfaces to their original condition.
 - 1. Cutting and patching is performed for coordination of the work, to uncover work for access or inspection, to obtain samples for testing, to permit alterations to be performed or for other similar purposes.
 - 2. Cutting and patching performed during the manufacture of products, or during the initial fabrication, erection or installation processes is not considered to be "cutting and patching" under this definition. Drilling of holes to install fasteners and similar operations are also not considered to be "cutting and patching".
 - 3. "Demolition" and "Selective Demolition" are recognized as related- but-separate categories of work, which may or may not require cutting and patching as defined in this section; refer to "Demolition" and "Selective Demolition" sections of Division 2.
- B. Refer to other sections of these specifications for specific cutting and patching requirements and limitations applicable to individual units of work.
 - 1. Unless otherwise specified, requirements of this section apply to mechanical and electrical work. Refer to Division-15 and Division-16 sections for additional requirements and limitations on cutting and patching of mechanical and electrical work

1.02 SECTION INCLUDES

- A. This Section specifies administrative and procedural requirements for cutting and patching.
- B. Refer to other sections for specific requirements and limitations applicable to cutting and patching individual parts of the Work.
 - 1. Requirements of this Section apply to mechanical and electrical installations. Refer to Division-15 and Division 16 Sections for other requirements and limitations applicable to cutting and patching mechanical and electrical installations.

1.03 RELATED SECTIONS

- A. Drawings and general provisions of Contract, including; general and Supplementary

Conditions and other Division-1 Specification Sections, apply to this section.

- B. Demolition of selected portions of the building for alterations is included in Section "Selective Demolition".

1.04 QUALITY ASSURANCE

- A. Requirements for Structural Work. Do not cut and patch structural elements in a manner that would reduce their load-carrying capacity or load-deflection ratio. All cutting/coring activities that will be performed on concrete structures must be approved by the Engineer.
 - 1. Obtain approval of the cutting and patching proposal before cutting and patching the following operating elements or safety related systems:
 - a. Primary operational systems and equipment.
 - b. Air or smoke barriers.
 - c. Water, moisture, or vapor barriers.
 - d. Fire Protection Systems.
 - e. Control Systems.
 - f. Communication systems.
 - g. Conveying systems
 - h. Noise and vibration control elements and systems.
- B. Operational and Safety Limitations: Do not cut and patch operating elements or safety related components in a manner that would result in reducing their capacity to perform as intended, or result in increased maintenance, or decrease operational life or safety.
- C. Visual Requirements: Do not cut and patch construction exposed on the exterior or in occupied spaces, in a manner that would, in the Architect's opinion, reduce the building aesthetic qualities, or result in visual evidence of cutting and patching. Remove and replace Work cut and patched in visually unsatisfactory manner.
 - 1. If possible, retain the original installer or fabricator to cut and patch the exposed Work listed below. If it is impossible to engage the original installer or fabricator, engage another recognized experienced and specialized firm.
 - a. Stonework and stone masonry.
 - b. Window wall systems.
 - c. Ornamental metal.
 - d. Firestopping
 - e. Stucco and ornamental plaster.
 - f. Carpeting.
 - g. Wall Coverings.
- D. Before cutting and patching the following categories of work, obtain approval to proceed.
 - 1. Structural steel.
 - 2. Miscellaneous structural metals, including lintels, equipment supports, stair systems and similar categories of work.
 - a. Structural concrete.

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- b. Foundation construction.
 - c. Steel.
 - d. Lintels.
 - e. Bearing and retaining walls.
 - f. Structural decking.
 - g. Exterior curtain wall construction.
 - h. Equipment Supports.
 - i. Piping, ductwork, vessels and equipment.
 - j. Structural systems of special construction, as specified by Division- 13 sections.
 - k. Shoring, bracing, and sheeting.
 - l. Primary operational systems and equipment.
 - m. Water/moisture/vapor/air/smoke barriers, membranes and flashings.
 - n. Noise and vibration control elements and systems.
 - o. Control, communication, conveying, and electrical wiring systems.
- E. Installer Qualifications: Company specializing in performing the work of this section with minimum 5 years of experience.
- F. Products Requiring Electrical Connection: Listed and classified by UL as suitable for the purpose specified and indicated.

1.05 SUBMITTALS

- A. Procedural Proposal for Cutting and Patching: Where prior approval of cutting and patching is required, submit proposed procedures for this work well in advance of the time work will be performed and request approval to proceed. Include the following information, as applicable, in the submittal:
- 1. Describe nature of the work and how it is to be performed, indicating why cutting and patching cannot be avoided. Include a step by step procedure describing the details of the method of work to be employed. Describe anticipated results of the work in terms of changes to existing work, including structural, operational and visual changes as well as other significant elements.
 - 2. List products and mechanical equipment to be used and firms including their qualifications that will perform work.
 - 3. Give dates when work is expected to be performed.
 - 4. List utilities that will be disturbed or otherwise be affected by work, including those that will be relocated and those that will be out-of-service temporarily. Indicate how long utility service will be disrupted.
 - 5. Approval by the Architect to proceed with cutting and patching does not waive the Architect's right to later require complete removal and replacement of unsatisfactory work.
 - 6. When cutting and patching of structural work involves the addition of reinforcement, submit details and engineering calculations to show how that reinforcement is integrated with original structure to satisfy requirements.
 - 7. Describe the safety measures to be employed during the work.

1.06 WARRANTY

- A Existing Warranties: Replace, patch, and repair material and surfaces cut or damaged by methods and with materials in such a manner as not to void any warranties required or existing.

PART 2 PRODUCTS

2.01 MATERIALS

- A. General: Except as otherwise indicated, or as directed by the Contracting Officer, use materials for cutting and patching that are identical to existing materials. If identical materials are not available, or cannot be used, use materials that match existing adjacent surfaces to the fullest extent possible with regard to visual effect. Use materials for cutting and patching that will result in equal-or-better performance characteristics. Materials differing from existing shall be approved by the Engineer through a submitted data sheet.
 - 1. The use of a trade name and suppliers name and address is to indicate a possible source of the product. Products of the same type from other sources shall not be excluded provided they possess like physical and functional characteristics.
- B. Use materials that are identical to existing materials. If identical materials are not available or cannot be used where exposed surfaces are involved, use materials that match existing adjacent surfaces to the fullest extent possible with regard to visual effect. Use materials whose installed performance will equal or surpass that of existing materials.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Before cutting existing surfaces examine surfaces to be cut and patched and conditions under which cutting and patching is to be performed. Take corrective action before proceeding, if unsafe or unsatisfactory conditions are encountered.
- B. Before cutting, examine the surfaces to be cut and patched and the conditions under which the work is to be performed. If unsafe or otherwise unsatisfactory conditions are encountered, take corrective action before proceeding with the work.
 - 1. Before the start of cutting work, meet at the work site with all parties involved in cutting and patching, including mechanical and electrical trades. Review areas of potential interference and conflict between the various trades. Coordinate layout of the work and resolve potential conflicts before proceeding with the work

3.02 PREPARATION

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- A. Temporary Support: Provide temporary support of Work to be cut.
- B. Protection: Protect existing construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of the Project that might be exposed during cutting and patching operations.
- C. Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.
- D. Take precautions necessary to avoid cutting existing pipe conduit, or ductwork serving the building, but schedule to be removed or relocated until provisions have been made to bypass them.

3.03 PERFORMANCE

- A. General: Employ skilled workmen to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time and complete without delay.
- B. Cut existing construction to provide for installation of other components or performance of other construction activities and the subsequent fitting and patching required to restore surfaces to their original conditions.
- C. Cut existing construction using methods least likely to damage elements retained or adjoining construction. Where possible, review proposed procedures with the original installer; comply with the original installer's recommendations.
 - 1. In general, where cutting is required, use hand or small tools designed for sawing or grinding, no hammering and chopping. Cut holes and slots neatly to size required with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
 - 2. To avoid marring existing finish surfaces, cut the exposed or finished side into concealed surfaces.
 - 3. Cut through concrete and masonry using a cutting machine such as a carborundum saw or diamond core drill.
 - 4. Comply with requirements of applicable Sections or Division-2 where cutting and patching require excavating and backfilling.
 - 5. By-pass utility services such as pipe or conduit, before cutting, where services are shown or required to be removed, relocated or abandoned. Cut-off pipe or conduit in walls or partitions to be removed. Cap valve or plug and seal the remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after by-passing and cutting.
- D. Protect and cover elements where putty/stucco is applied to prevent dust layers from forming that would prevent any finished coating from adhering to the surface.

- E. Patching: Patch with durable seams that are as invisible a possible. Comply with specified tolerances.
1. Where feasible, inspect and test patched areas to demonstrate integrity of the installation.
 2. Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
 3. When removal of walls or partitions extends one finish area into another, patch and repair floor and wall surfaces in the new space to provide an even surface of uniform color and appearance. Remove existing floor and wall coverings and replace with new materials, as necessary to achieve uniform color and appearance.
 - a. Where patching occurs in a smooth painted surface, extend final paint coat over entire unbroken area containing the patch, after the patched area has received primer and second coat.
 4. Patch, repair or rehang existing ceiling as necessary to provide an even surface of uniform appearance.

3.04 CLEANING

- A. Thoroughly clean areas and spaces where cutting and patching is performed or used as access. Completely remove paint, mortar, oils, putty, and items of similar nature. Thoroughly clean piping, conduit and similar features before paint or other finishing is applied. Restore damaged pipe covering to its original conditions.
- B. Do not permit traffic over unprotected floor surface.

+++ END OF SECTION 01045 +++

**SECTION 01055
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 Engineer.
- B. The Contractor shall be responsible for the development and implementation of a surveying program capable of satisfying all Project survey and accuracy requirements. This program shall be subject to the review of the Engineer before commencement of the work. The review shall in no way release the Contractor of liabilities associated with or dependent on this part of the Services.
- C. The Contractor shall assume all costs associated with rectifying work constructed in the wrong location.
- D. Work under this Section also includes surveying work required to prepare Record Drawings as specified herein.

1.02 QUALITY ASSURANCE

- A. The Contractor shall hire, at the Contractor's own expense, a Surveyor with current registration in the State of Georgia, and shall be conducted by personnel with documented experience in the specific types of work required. The surveyor must be acceptable to the Owner, to provide project construction staking and confirmation of the vertical and horizontal alignment.
- B. Any deviations from the Drawings shall be confirmed by the Engineer if it falls within the compatible tolerance prior to construction of that portion of the Project.

1.03 SUBMITTALS

- A. Submit name and address of Registered Surveyor along with proof of credentials and experience in similarly scaled projects to the Engineer.
- B. Submit detailed description of proposed survey method, network diagrams and equipment type, accompanied with manufacturer's literature specifying probable accessories, calibration procedures and certificates/logs, requirements and frequencies. On request of Engineer, submit documentation to verify accuracy of construction staking.
- C. Submit record drawings in accordance with PART 3 of the Section.

1.04 Equipment Calibration and Data Accurate Processing

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- A. Calibrate all instruments as per manufacturer's recommendation and keep a log of calibration performance indicating time and individual who performed the calibration.
- B. Data processing shall include, as required, rigorous least squares adjustments. Employ data outlier detection. Determine horizontal and vertical confidence intervals.

1.05 Compliance With Contractor's Offered Field Engineering Services

- A. Report to the engineer any loss or destruction of any of the survey control points. In addition, any discovered discrepancy related to the control points established by the engineer, the latter must be informed within forty-eight (48) hours of the discovery and before starting the work.
- B. Establish, verify and maintain a minimum of three (3) additional survey monuments for the work at each work site. The monuments shall be permanent on site and referenced to the established survey control points. Record locations, with horizontal and vertical data, on Project Record Documents. Monuments will also be checked and verified by the construction verification surveyor. Survey notes relating to the monuments and primary control points shall be submitted to the Engineer.
- C. Establish elevations, lines and levels. Locate and layout by instrumentation and similar appropriate means:
 - 1. Site improvements including pavements; stakes for grading, fill and topsoil placement; utility locations, slopes and invert elevations.
 - 2. Grid or axis for structures.
 - 3. Foundation and wall locations, sloping floor elevations, and embedment centerlines and elevations.

PART 2 (NOT USED)

PART 3 EXECUTION

3.01 PROJECT CONDITIONS

- A. The Drawings provide the location of principal components of the Project. The Engineer 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 Engineer will provide the following:
 - 1. One vertical control point on the Project site with its elevation shown on the Drawings.
 - 2. A minimum of two horizontal control points on the Project site with their coordinates shown on the Drawings.

3.02 GENERAL

- A. From the information shown on the Drawings and the information to be provided as

indicated in paragraph 3.01 above, the Contractor shall:

1. Be responsible for establishing GPS control coordinate control system, setting reference points and/or offsets, establishment of baselines, and all other layout, taking, and all other surveying required for the construction of the Project.
 2. The horizontal position of all points shall be referenced to the North American datum of 1983 (1986 adjustment) in the Georgia State Plane West 1002 Coordinate System.
 3. The vertical position of all points shall be referenced to the North American Vertical datum of 1988.
 4. All coordinate values shall be delivered as grid coordinates in US Survey Feet.
 5. The minimum data accuracy required for all record drawings shall be +/- 0.10 USFT (one tenth of one foot).
 6. Safeguard all reference points, stakes, grade marks, horizontal and vertical control points, and shall bear the cost of re-establishing same if disturbed.
 7. Stake out the limits of construction to ensure that the Work does not deviate from the indicated limits.
 8. Stake out the pipeline horizontal and vertical alignment.
 9. 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.
 10. Maintain a complete, accurate log of all control and survey work as it progresses.
- B. Baselines shall be defined as the line to which the location of the Work is referenced, i.e., edge of pavement, road centerline, property line, right-of-way or survey line.

3.03 STAKING PRECISION

- A. The precision of construction staking shall match the precision of components location indicated on the Drawings. Staking of utilities shall be done in accordance with standard accepted practice for the type of utility.
- B. The precision of construction staking required shall be such that the location of the water main or sewer or storm drain can be established for construction and verified by the Engineer. Where the location of components of the water main or sewer or storm drain, (i.e. fittings, valves, manholes, road crossings, etc.) are not dimensioned, the establishment of the location of these components shall be based upon scaling these locations from the Drawings with relation to readily identifiable land marks, i.e. survey reference points, power poles, manholes etc.
- C. Paved Surfaces: The Contractor shall establish a reference point for establishing and verifying the paving subgrade and finished grade elevations. Any variance with grades shown on the Drawings shall be identified by the Contractor and confirmed by the

Engineer prior to constructing the base.

D. The Contractor's attention is directed to Specification Section 01040, Coordination.

3.04 RECORD DRAWINGS

A. Water Mains

1. The Contractor shall submit record drawings which show the final installed location of the water main and survey data for all installed pipe, valves and fittings, tunnel and casing limits and service connections 3-inches in diameter and greater. Survey data shall consist of final coordinates for all valves, fittings, tunnel and casing limits and main tap locations for service connections 3-inches in diameter and greater and center line of pipe at points every 500 feet along the length of pipe installed.
2. In addition, the location of all valves and fittings and main tap location for service connections 3-inches in diameter and greater shall be indicated by at least 2 ties (measured distances) from permanent fixed objects within the public right of way, as accepted by the Engineer, to allow the Owner to locate the water main and components in the future without the use of GPS instruments.

B. Sewers and Storm Drains

1. The Contractor shall submit record drawings which show the final installed location of storm and sanitary pipes and structures. The information shall include coordinations, pipe and structure size and type, rim elevations, and inverts of each influent and effluent line.
2. Record drawing information provided shall include pipe sizes, slope percentage, and materials. Lateral tie-ins and alignments to the served facilities shall also be included.

C. The record drawings shall also indicate the horizontal and vertical location, dimensions and materials of all utilities encountered during excavation.

D. Record drawings must be georeferenced to the U.S. State Plane Coordinate System, NAD 83 GA West Zone, US Survey Feet. All drawings must contain two reference pins which are labeled and tied to the Fulton County GPS Monument Network.

E. Two full size hard copies of record drawings shall be furnished to the Engineer for review. Each record drawing shall be stamped with the name of the Contractor, signed and dated by the Contractor's Project Manager and signed, sealed and dated by the Surveyor. Record Drawings, once approved by the Engineer, shall be scanned and saved as PDF's.

F. The Contractor shall provide an electronic copy of the record drawings in AutoCAD Civil 3D 2015 (.DWG) format.

G. Final submittal of record drawings shall be provided by two compact disks containing the signed and sealed PDF's and DWG files referenced above.

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+++ END OF SECTION 01055 +++

**SECTION 01060
REGULATORY REQUIREMENTS**

PART 1 GENERAL

1.01 SCOPE

- A. Permits and Responsibilities: The Contractor shall be responsible for complying with all applicable federal, state, county and municipal laws, codes and regulations, in connection with the prosecution of the Work and for obtaining all permits including but not limited to NPDES permits for storm water discharges from the Work site.
- B. Permits and applications for this project are identified in PART 3 of this Section.
- C. The Contractor shall comply with all requirements of the permitting authority, whether permits were obtained by the Contractor or not.

PART 2 PRODUCTS

(NOT USED)

PART 3 EXECUTION

3.01 NPDES PERMITS FOR STORM WATER DISCHARGES

- A. The Contractor shall comply with the provisions of the Authorization to Discharge under the National Pollutant Discharge Elimination System, Storm Water Discharges Associated with Construction Activity for Infrastructure Construction Projects, Georgia Environmental Protection Division General Permit No. GAR 100002, including but not limited to filing permit applications, filing Notice of Intent (NOI), filing Notice of Termination (NOT), performing inspections and monitoring and performing record keeping as required.
- B. (Not Used)

3.02 CITY LANE CLOSURE PERMITS

- A. The Engineer, in conjunction with the Contractor, will submit permit applications to the City's Department of Public Works, Office of Transportation for all lane closures required for completion of the project. Refer to Section 01550, Traffic Regulation.
- B. (Not Used)

3.04 NOISE CONTROL

- A. The Contractor shall take every action possible to minimize the noised caused by their Work.
- B. When required by agencies having jurisdiction, noise-producing Work shall be performed in less sensitive hours of the day or week as directed by the Engineer.

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- C. The Contractor shall provide equipment that operates with the least possible noise. The use of noisy equipment is prohibited. Hoists and compressor plants shall be electronically operated unless otherwise permitted. The air intake of compressors shall be equipped with silencers, and machinery operated by gearing shall be provided with a type of gearing designed to reduce noise to a minimum. Internal combustion engines shall be equipped with mufflers in good order.
- D. Noise generated by mobile construction equipment, stationary construction equipment, and other equipment involved in the construction of the work shall not exceed decibel levels indicated below. Noise generated by the mobile and stationary construction equipment will be measured three (3) to six (6) feet from building lines, and on the A weighing network of Type-2 general purpose sound level meter set at fast response.

Allowable sound levels Mobile Construction Equipment:	Combined Residential and Commercial
From 7:00 a.m. to 10:00 p.m., Monday thru Saturday, Except Legal Holidays	85 dBA
At times other than those listed above	70 dBA
Allowable sound levels Stationary Construction Equipment:	Combined Residential and Commercial
From 7:00 a.m. to 10:00 p.m., Monday thru Saturday, Except Legal Holidays	70 dBA
At times other than those listed above	60 dBA

- E. Contractor shall assure compliance by measuring noise levels as may be required.

3.05 OTHER PERMITS

- A. The Contractor shall submit applications for and obtain all other permits required in conjunction with completion of the Work of the Contact.
- B. (Not Used)

3.06 GENERAL

- A. The Contractor shall pay for all remaining permits, fees and licenses required for construction of the Project.
- B. The Contractor shall examine all permits and conform to the requirements contained therein, including the purchase of additional bonds or insurance as specified therein, and

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such requirements are hereby made a part of these Contract Documents as though the same were set forth herein. Failure to examine the permit and agreement applications will not relieve the Contractor from compliance with the requirements stated therein.

- C. No separate payment shall be made to the Contractor for permits, fees and licenses required for construction of the Project. Provision for such costs is considered incidental and included in the work of the various pay items.

+++ END OF SECTION 01060 +++

**SECTION 01101
SPECIAL PROJECT PROCEDURES**

PART 1 - GENERAL

1.01 CONNECTIONS TO EXISTING SYSTEMS

- A. The Contractor shall perform all work necessary to locate, excavate, and prepare for connections to the terminus of the existing systems as shown on the Drawings. The cost for this work and for the actual connection to the existing systems shall be included in the bid price for the project and shall not result in any additional cost to the City. Connections shall be made only after approval by the City.

1.02 RELOCATIONS

- A. The Contractor shall be responsible for the relocation of structures, including but not limited to light poles, signs, sign poles, fences, piping, conduits, and drains that interfere with the positioning of the Work as set out on the Drawings. The cost of all such relocations shall be included in the bid price.

1.03 EXISTING UNDERGROUND PIPING, STRUCTURES, AND UTILITIES

- A. The attention of the Contractor is drawn to the fact that during excavation, the possibility exists of the Contractor encountering various water, gas, telephone, electrical, or other utility lines not shown on the Drawings. The Contractor shall exercise extreme care before and during excavation to locate and flag these lines so as to avoid damage to the existing lines. Should damage occur to an existing line, the Contractor shall repair the line at no cost to the City.
- B. The locations of existing underground piping structures and utilities are shown without express or implied representation, assurance, or guarantee that they are complete or correct or that they represent a true picture of underground piping to be encountered.
- C. The existing piping and utilities that interfere with new construction shall be rerouted as shown, specified, or required. Before any piping and utilities not shown on the Drawings are disturbed, the Contractor shall notify the City of the location of the pipeline or utility and shall reroute or relocate the pipeline or utility as directed.
- D. The Contractor shall exercise care in any excavation to locate all existing piping and utilities. All utilities, which do not interfere with complete work, shall be carefully protected against damage. Any existing utilities damaged in any way by the Contractor shall be restored or replaced by the Contractor at its expense as directed by the Engineer.

1.04 HAZARDOUS LOCATIONS

- A. The existing wet wells, manholes and related areas are hazardous locations, in that

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explosive concentrations of sewage gas may be present. The Contractor is cautioned that the above areas, especially the wet well, may be deficient in oxygen. Checks shall be made by the Contractor whenever personnel are working in these areas to determine if adequate oxygen is available.

1.05 CONNECTIONS TO WORK BY OTHERS

- A. As shown on the Drawings, pipelines constructed under this Contract are to be connected to pipelines to be built by others.
- B. Pipelines built under this Contract will be connected to pipelines constructed by others by removing the plugs and making the connection.
- C. If the pipelines have not been constructed by others, the pipeline (under this Contract) shall be laid to the required line and grade, terminated with a plugged connection, precisely at the location indicated on the Drawings and then backfilled and marked with a stake.

1.06 WATER FOR CONSTRUCTION PURPOSES

- A. All water for testing, flushing and construction shall be furnished by the City. The City shall have the option of recouping the cost of plant water usage. It may be available by connecting to the City's water system at a point approved by the City. There shall be installed in each and every connection to the City's potable water supply, a meter and a backflow preventer meeting the requirements of the City of Atlanta, Department of Water.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

+++ END OF SECTION 01100 +++

**SECTION 01200
MEASUREMENT AND PAYMENT**

PART 1 – GENERAL

1.01 SCOPE

- A. Work includes furnishing all plant, labor, equipment, tools, materials, and performing all operations required to complete the Work satisfactorily, in-place, as specified and as indicated on the Drawings.
- B. All costs of required items of work and incidentals necessary for the satisfactory completion of the Work shall be considered as included in the Bid. The cost of work not directly described in the pay item descriptions, but necessary to complete the work of the pay item, shall be considered incidental to the contract and no additional compensation shall be allowed.
- C. The Contractor shall take no advantage of any apparent error or omission on the Bridging Drawings or Specifications, and the City shall be permitted to make corrections and interpretations as may be deemed necessary for fulfillment of the intent of the Contract Documents.

1.02 SUBMITTALS

- A. The Contractor shall submit to the City for approval, in the form directed or acceptable to the City, a complete schedule of values of the various portions of the Work, including quantities and unit prices, aggregating the Contract Price, per General Condition GC-38.1. An unbalanced breakdown providing for overpayment to the Contractor on items of Work, which would be performed first, will not be approved.
- B. Submit application for payment on a form approved by the City showing allowances, lump sum schedule of value items, and unit price items in accordance with Section 01026 and Special Condition SC-16.
- C. Final payment quantities shall be determined from the record drawings or as measured in the field during construction by the Project Inspector. The record drawing lengths, dimensions, quantities, etc. shall be determined by a survey after completion of all required work.

1.01 LUMP SUM ITEMS

- A. Payment of the lump sum items established in the Contractor's Bid shall be full compensation for all labor, materials, and equipment required to design, furnish, install, construct, and test the Work covered under the lump sum bid items.
- B. Payment of the lump sum items established in the Contractor's Bid shall also fully compensate the Contractor for any other work which is not specified or shown, but which is necessary to complete the Work.

- C. The lump sum items shall be specifically subdivided by activity, broken-out in the Schedule of Values and as further required by Special Condition SC-16.
- D. Payments for the lump sum items specifically broken-out in the Schedule of Values will be based upon physical progress for each activity in accordance with the breakdown of the Lump Sum prices agreed to in the Schedule of Values.

1.02 MONTHLY PAYMENTS AND MEASUREMENT OF QUANTITIES

- A. Monthly and Final payments will be based on the project Schedule of Values Breakdown approved per General Condition 38.1 and Specification Section 01026. Monthly payments shall be based on quantities shall be determined from progress recorded on project record drawings as approved by the City each month. Record drawings shall be maintained throughout the life of the project. The record drawing lengths, dimensions, quantities, etc. shall be determined by a survey after completion of all required work. The precision of final payment quantities shall match the precision shown for that item in the Bid Schedule or Schedule of Values as required. Measurements will be taken according to the United States standard measurements and in the manner as specified in these Specifications.
- B. General
 - 1. No separate or additional payment shall be made for the requirements contained in the Special Conditions of the Contract Documents. The cost for complying with these requirements shall be included in the prices bid for the items to which they pertain.
 - 2. No separate or additional payment shall be made for the requirements contained in the individual specification sections contained in Division1 – General Requirements of the Technical Specifications. The cost for complying with these requirements shall be included in the prices bid for the items to which they pertain.

1.05 BID ITEMS

- A. ITEM NO .1 – BASE BID, LUMP SUM, COMPLETE.
 - 1. Measurement: Lump sum, Complete.
 - 2. All work (other than the control system covered in Item No. 2) to complete the Project, and which is not included in other Items, shall be included in the lump sum amount for Item No. 1 “Base Bid”. This should include flow connection from existing 60” DIP at STA 31+50 to Chattahoochee WTP: the piping, valving, flow control valve and vault and tie-ins to the existing Chattahoochee WTP water supply piping.
- B. ITEM NO. 2 – BASE BID, LUMP SUM, COMPLETE
 - 1. Measurement: Lump sum, Complete.
 - 2. All work to complete the Project to design, furnish, install, program, and test the control system to operate and monitor the raw water influent flows into the

Chattahoochee Water Treatment Plant.

1.06 ALLOWANCES

- A. The allowances specified in the Bid Schedule are to establish a fund to pay the cost of items for which the City could not establish accurate quantities and/or detailed scope of work. This work shall be completed only at the written direction of the City, and the cost of such work shall be approved prior to performance of the work.
- B. The Contractor shall be responsible for the payment for these services to the appropriate payee providing such service and shall submit evidence of payments to the City prior to its inclusion in the progress payments.
- C. Payment will be made for invoices submitted by the Contractor subject to the conditions and limitations in the Contract Documents.
- D. Allowance allocations shall only be paid to the Contractor for completed work authorized by the City. All allowance dollar amounts not expended shall revert to the City at the completion of the project. Should the final allowance costs be less than the specified amount of the allowance the Contract will be adjusted accordingly by change order. The amount of change order will not recognize any changes in handling costs at the site, labor, overhead, profit and other expenses caused by the adjustment to the allowance item.

+++ END OF SECTION 01200 +++

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SECTION 01260 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 SCOPE

- A. Without invalidating the Contract and without notice to any surety, Owner may, at any time or from time to time, order additions, deletions, or revisions in the Work by a Change Order, or a Work Change Directive. Upon receipt of any such document, Contractor shall promptly proceed with the Work involved which will be performed under the applicable conditions of the Contract Documents (except as otherwise specifically provided).
 - 1. Owner may, in anticipation of possibly ordering an addition, deletion or revision to the Work, request Contractor to prepare a proposal of cost and times to perform Owner's contemplated changes in the Work. Contractor's written proposal shall be transmitted to the City's Authorized Representative promptly, but not later than fourteen calendar days after Contractor's receipt of Owner's written request and shall remain a firm offer for a period not less than sixty days after receipt by Engineer.
 - 2. Contractor is not authorized to proceed on an Owner contemplated change in the Work prior to Contractor's receipt of a Change Order (or Work Change Directive) incorporating such change into the Work.
 - 3. Owner's request for proposal or Contractor's failure to submit such proposal within the required time period will not justify a claim for an adjustment in Contract Price or Contract Time (or Milestones).
 - 4. The Owner shall not be liable to the Contractor for any costs associated with the preparation of proposal associated with the Owner's contemplated changes in the Work.
- B. If Owner and Contractor are unable to agree on entitlement to, or on the amount or extent, if any, of an adjustment in the Contract Price or Contract Times, or both, that should be allowed as a result of a Work Change Directive, a Claim may be made.
- C. Contractor shall not be entitled to an increase in the Contract Price or an extension of the Contract Times with respect to any work performed that is not required by the Contract Documents as amended, modified, or supplemented, except in the case of an emergency or in the case of uncovering Work.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 EXECUTION OF CHANGE ORDERS

- A. Owner and Contractor shall execute appropriate Change Orders recommended by the City's Authorized Representative covering:
 - 1. changes in the Work which are: (i) ordered by Owner, (ii) required because of acceptance of defective Work or Owner's correction of defective Work, or (iii) agreed to by the parties;

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2. changes in the Contract Price or Contract Times which are agreed to by the parties, including any undisputed sum or amount of time for Work actually performed in accordance with a Work Change Directive; and
3. changes in the Contract Price or Contract Times which embody the substance of any written
4. decision rendered by Engineer; provided that, in lieu of executing any such Change Order, an appeal may be taken from any such decision in accordance with the provisions of the Contract Documents and applicable Laws and
5. Regulations, but during any such appeal, Contractor shall carry on the Work and adhere to the Progress Schedule.

B. In signing a Change Order, the Owner and Contractor acknowledge and agree that:

1. The stipulated compensation (Contract Price or Contract Time, or both) set forth in the Change Order includes payment for:
 - a. the Cost of the Work covered by the Change Order,
 - b. Contractor's fee for overhead and profit,
 - c. interruption of Progress Schedules,
 - d. delay and impact, including cumulative impact, on other work under the Contract Documents, and extended home office and jobsite overhead;
2. the Change Order constitutes full mutual accord and satisfaction for the change to the Work;
3. No reservation of rights to pursue subsequent claims on the Change Order will be made by either party; and
4. No subsequent claim or amendment of the Contract Documents will arise out of or as a result of the Change Order.

C. Notification of Surety:

If the provisions of any bond require notice to be given to a surety of any change affecting the general scope of the Work or the provisions of the Contract Documents (including, but not limited to, Contract Price or Contract Times), the giving of any such notice will be Contractor's responsibility. The amount of each applicable bond will be adjusted to reflect the effect of any such change.

D. Claims and Disputes:

1. City's Authorized Representative's Decision Required: All Claims shall be referred to the City's Authorized Representative for decision. A decision by the City's Authorized Representative shall be required as a condition precedent to any exercise by the Contractor of any rights or remedies they may otherwise have under the Contract Documents or by Laws and Regulations in respect of such Claims.
2. Notice: Written notice stating the general nature of each Claim shall be delivered by the claimant to City's Authorized Representative to the Contract promptly (but in no event later than 30 calendar days after the start of the event giving rise thereto). The responsibility to substantiate a Claim shall rest with the party making the Claim. Notice of the amount or extent of the Claim, with written supporting data shall be delivered to the City's Authorized Representative within 60 calendar days (and monthly thereafter for continuing events) after the start of such event.
3. City's Authorized Representative may allow additional time for claimant to submit additional or more accurate data in support of such Claim. A Claim for an adjustment in Contract Price shall be prepared in accordance with the provisions of Paragraph 3.02.A.2. A Claim for an adjustment in Contract Times shall be prepared in accordance with the provisions of Paragraph 3.02.B.2. Each Claim shall be accompanied by claimant's written statement that the adjustment claimed is the entire adjustment to which the claimant

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- believes it is entitled as a result of said event. The opposing party shall submit any response to the City's Authorized Representative and the claimant within 30 days after receipt of the claimant's last submittal (unless City's Authorized Representative allows additional time).
4. City's Authorized Representative Action: City's Authorized Representative will review each Claim and, within 30 calendar days after receipt of the last submittal of the claimant, if any, and take one of the following actions in writing:
 5. deny the Claim in whole or in part;
 6. approve the Claim; or
 7. notify the party that the City's Authorized Representative is unable to resolve the Claim if, in the City Authorized Representative's sole discretion, it would be inappropriate for the City's Authorized Representative to do so. For purposes of further resolution of the Claim, such notice shall be deemed a denial.
 8. In the event that the City's Authorized Representative does not take action on a Claim within said 30 days, the Claim shall be deemed denied.
 9. City's Authorized Representative's written action will be final and binding.
 10. No Claim for an adjustment in Contract Price or Contract Times will be valid if not submitted in accordance with this specification.

3.2 CHANGE OF CONTRACT PRICE

A. Change of Contract Price:

1. The Contract Price may only be changed by a Change Order. Any Claim for an adjustment in the Contract Price shall be based on written notice submitted by the party making the Claim to the City's Authorized Representative.
2. The value of any Work covered by a Change Order or of any Claim for an adjustment in the Contract Price will be determined as follows:
 - a. where the Work involved is covered by unit prices contained in the Contract Documents, by application of such unit prices to the quantities of the items involved; or
 - b. where the Work involved is not covered by unit prices contained in the Contract Documents, by a mutually agreed lump sum value fixed by the Owner or by unit price values fixed by the Owner (which may include an allowance for overhead and profit); or
 - c. where the Work involved is not covered by unit prices contained in the Contract Documents and agreement to a lump sum is not reached on the basis of the Cost of the Work plus a Contractor's fee for overhead and profit.
3. Contractor's Fee: The Contractor's fee for overhead and profit shall be determined as follows:
 - a. a mutually acceptable fixed fee; or
 - b. if a fixed fee is not agreed upon, then a fee based on the Section 01200 Measurement and Payment, Item - Time and Materials.

B. Change of Contract Times:

1. The Contract Times may only be changed by a Change Order. Any Claim for an adjustment in the Contract Times shall be based on written notice submitted by the party making the Claim to the Engineer and the other party to the Contract.
2. Any adjustment of the Contract Times covered by a Change Order or any Claim for an adjustment in the Contract Times will be determined in accordance with the provisions of this specification.

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C. Delays:

1. Where Contractor is prevented from completing any part of the Work within the Contract Times due to delay beyond the control of Contractor, the Contract Times will may be extended in an amount equal to the time lost due to such delay if a Claim is made therefor. Delays beyond the control of Contractor shall include, but not be limited to, acts or neglect by Owner, acts or neglect of utility owners or other contractors performing other work as contemplated, fires, floods, epidemics, abnormal weather conditions, quarantine restrictions, strikes, freight embargoes, acts of war (declared or not declared), or acts of God.
2. If Owner or other contractors or utility owners performing other work for Owner, or anyone for whom Owner is responsible, delays, disrupts, or interferes with the performance or progress of the Work, then Contractor shall be entitled to an equitable adjustment in the Contract Price or the Contract Times, or both. Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times.
3. If Contractor is delayed in the performance or progress of the Work by fire, flood, epidemic, abnormal weather conditions, acts of God, acts or failures to act of utility owners not under the control of Owner, or other causes not the fault of and beyond control of Owner and Contractor, then Contractor may be entitled to an equitable adjustment in Contract Times, if such adjustment is essential to Contractor's ability to complete the Work within the Contract Times. Such an adjustment shall be Contractor's sole and exclusive remedy for the delays.
4. Owner, Engineer, and their officers, directors, members, partners, employees, agents, consultants, or subcontractors shall not be liable to Contractor for any claims, costs, losses, or damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) sustained by Contractor on or in connection with any other project or anticipated project.
5. Contractor shall not be entitled to an adjustment in Contract Price or Contract Times for delays within the control of Contractor. Delays attributable to and within the control of a Subcontractor or Supplier shall be deemed to be delays within the control of Contractor.

END OF SECTION 01260

SECTION 01297 - APPLICATIONS FOR PAYMENT

PART 1 - GENERAL

1.1 REQUIREMENTS INCLUDED

- A. Submit Applications for Payment to the City's Authorized Representative in accordance with the schedule established by Conditions of the Contract and Agreement Between City and Contractor.

1.2 RELATED REQUIREMENTS

- A. Agreement Between City and Contractor.
- B. Conditions of the Contract: Progress Payments, Retainages and Final Payment.
- C. Section 01350 Project Document Tracking and Control System
- D. Section 01720: Project Record Documents.

1.3 FORMAT AND DATA REQUIRED

- A. Submit applications in E-builder software.
- B. Provide itemized data on continuation sheet:
Format, schedules, line items and values: Those of the Schedule of Values accepted by the City's Authorized Representative.

1.4 PREPARATION OF APPLICATION FOR EACH PROGRESS PAYMENT

- A. Application Form:
 - 1. Fill in required information, including that for Change Orders executed prior to date of submittal of application.
 - 2. Fill in summary of dollar values to agree with respective totals indicated on continuation sheets.
 - 3. Execute certification with signature of a responsible officer of Contract firm.
 - 4. Application shall be incorporated into the latest version of E-builder software.
- B. Continuation Sheets:
 - 1. Fill in total list of all scheduled component items of Work, with item number and scheduled dollar value for each item.
 - 2. Fill in dollar value in each column for each scheduled line item when work has been performed or products stored.
 - 3. Round off values to nearest dollar, or as specified for Schedule of Values.
 - 4. List each Change Order executed prior to date of submission, at the end of the continuation sheets.
 - 5. List by Change Order Number, and description, as for an original component item of work.

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6. To receive approval for payment on component material stored on site, submit copies of the original invoices with the application for payment first made for these materials. Copies of paid invoices must be submitted for all materials stored longer than sixty (60) days to continue to receive approval for payment on the materials. If paid invoices are not submitted for materials in storage longer than sixty (60) days, those materials shall not be considered in the Application for Payment.

1.5 SUBSTANTIATING DATA FOR PROGRESS PAYMENTS

- A. When the City's Authorized Representative requires substantiating data; Contractor shall submit suitable information, with a cover letter identifying:
 1. Project.
 2. Application number and date.
 3. Detailed list of enclosures.
 4. For stored products:
 - a. Item number and identification as shown on application.
 - b. Description of specific material.
- B. Submit one copy of data and cover letter for each copy of application.
- C. As a prerequisite for payment, Contractor is to submit a "Surety Acknowledgment of Payment" letter showing amount of progress payment, which the Contractor is requesting.
- D. The Contractor is to maintain an updated set of drawings to be used as record drawings in accordance with Section 01720 Record Documents. As a prerequisite for monthly progress payments, the Contractor is to exhibit the updated Record Drawings for review by the City's Authorized Representative.
- E. The Contractor shall submit all applicable test reports of installed products in order to request payment for that product.
- F. The Contractor shall maintain an updated construction schedule. As a prerequisite for monthly progress payments, Contractor shall submit the updated construction schedule with the applications for progress payments. If the Contractor fails to submit the required updated schedule within the time prescribed, the City's Authorized Representative may withhold approval of progress payment estimates until such time as the Contractor submits the required updated schedule. Submit one copy for each copy of the application.
- G. The Contractor shall demonstrate, as a prerequisite for monthly progress payments, compliance with all requirements specified in Erosion and Sedimentation Control requirements of this project to the City. If the Contractor fails to demonstrate compliance with the applicable Erosion and Sedimentation Control requirements, the City may withhold approval of progress payment estimates until such time as the Contractor demonstrates to the City's Authorized Representative full compliance with the approved erosion and sedimentation control permit.
- H. The Contractor shall provide, as a prerequisite for monthly progress payments, an accumulating cost curve (tabular and diagram), indicating schedule, forecast and actual progress.

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1.6 PREPARATION OF APPLICATION FOR FINAL PAYMENT

- A. Fill in Application form as specified for progress payments.
- B. Use continuation sheet for presenting the final statement of accounting.

1.7 SUBMITTAL PROCEDURE

- A. Submit Applications for Payment to the City at the times stipulated in the Agreement. Application for Payment request shall be submitted through eBuilder.
- B. Number: Five copies of each Application.
- C. When the City's Authorized Representative finds Application properly completed and correct, he/she will transmit certificate for payment to City for approval and processing.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 01297

SECTION 01300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This Section specifies the general methods and requirements of submissions applicable to the following work-related Submittals: Shop Drawings, Product Data, Samples, Requests For Information, Construction Schedules, Work Plan, and Submittal Schedules as defined in 01020 Definitions. Detailed submittal requirements are specified in the technical specifications sections. All submittals shall be clearly identified by reference to Specification Section, Paragraph, Drawing No. or Detail as applicable. Submittals shall be clear and legible and of sufficient size for sufficient presentation of data.

1.2 GENERAL PROCEDURES FOR SUBMITTALS

- A. Coordination of Submittal Times: Prepare and transmit each submittal sufficiently in advance of performing the related work or other applicable activities, or within the time specified in the individual work sections of the Specifications, so that the installation will not be delayed by processing times including disapproval and resubmittal (if required), coordination with other submittals, testing, purchasing, fabrication, delivery and similar sequenced activities. No extension of time will be authorized because of the Contractor's failure to transmit submittals sufficiently in advance of the Work. Submittal entries to be input into E-builder or as directed by the City's Authorized Representative.

1.3 SHOP DRAWINGS, WORKING DRAWINGS, PRODUCT DATA, SAMPLES, PRECONSTRUCTION VIDEO

- A. Shop Drawings:
 - 1. Shop drawings, as defined above, and as specified in individual work Sections include, but are not necessarily limited to, custom prepared data such as fabrication and erection/installation (working) drawings, scheduled information, setting diagrams, actual shop work manufacturing instructions, custom templates, special wiring diagrams, coordination drawings, individual system or equipment inspection and test reports including performance curves and certifications, as applicable to the Work.
 - 2. All shop drawings submitted by subcontractors for approval shall be sent directly to the Contractor for checking. The Contractor shall be responsible for their submission at the proper time so as to prevent delays in delivery of materials.
 - 3. The Contractor shall check all subcontractors' shop drawings regarding measurements, size of members, materials, and details to satisfy himself/herself that they conform to the intent of the Drawings and Specifications. Shop drawings found to be inaccurate or otherwise in error shall be returned to the subcontractors for correction before submission thereof.
 - 4. All details on shop drawings submitted for approval shall show clearly the relation of the various parts to the main members and lines of the structure, and where correct fabrication of the work depends upon field measurements, such measurements shall be made and noted on the drawings before being submitted for approval.

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5. For electronic submittals, drawings and the necessary data shall be submitted electronically to the Owner or Owner's Representative as specified below.
 - a. Submittal documents shall be in color to facilitate use of red line markups. All electronic files shall be in Portable Document Format (PDF) as generated by Adobe Acrobat Professional Version 7.0 or higher. The PDF file(s) shall be fully indexed using the Table of Contents, searchable with thumbnails generated. PDF images must be at a readable resolution. For most documents, they should be scanned or generated at 300 dots per inch (dpi). Use of higher resolution is acceptable with the Owner or Owner's Representative approval.
 - b. Optical Character Recognition (OCR) capture must be performed on these images so that text can be searched, selected and copied from the generated PDF file.
 - c. The PDF documents shall have a bookmark created in the navigation frame for each major entry ("Section" or "Chapter") in the Table of Contents. Thumbnails shall be generated for each page or graphic in the PDF file.
 6. The opening view for each PDF document shall be as follows:
 - a. Initial View: Bookmarks and Page
 - b. Magnification: Fit In Window
 - c. The file shall open to Contractor's transmittal letter, with bookmarks to the left. The first bookmark shall be linked to the Table of Contents.
 - d. PDF document properties shall include the submittal number for the document title and Contractor's name for the author.
 - e. Electronic submittal file sizes shall be limited to 10 MB. When multiple files are required for a submittal the least number of files possible shall be created.
 - f. Contractor shall post submittals and retrieve the Owner or Owner's Representative's submittal review comments through the Project website accessible through the Internet. Instruction on procedures for posting and retrieving submittals will be provided after award of the Contract.
- B. Product Data:
1. Product data as defined above, and as specified in individual Sections, include, but are not necessarily limited to, standard prepared data for manufactured products (sometimes referred to as catalog data), such as the manufacturer's product specification and installation instructions, availability of colors and patterns, manufacturer's printed statements of compliances and applicability, roughing in diagrams and templates, catalog cuts, product photographs, standard wiring diagrams, printed performance curves and operational range diagrams, production or quality control inspection and test reports and certifications, mill reports, product operating and maintenance instructions and recommended spare parts listing and printed product warranties, as applicable to the Work.
- C. Working Drawings:
1. When used in the Contract Documents, the term "working drawings" shall be considered to mean the Contractor's plans for temporary structures such as temporary bulkheads, support of open cut excavation, support of utilities, ground water control systems, pedestrian bridges, temporary traffic and signage plans, forming and false work; and for such other work as may be required for construction but does not become an integral part of the Project.
 2. Working drawings shall be prepared and sealed by a registered Professional Engineer, currently licensed to practice in the State of Georgia. The Contractor shall submit a letter of certification from the Professional Engineer stating that he/she has prepared the designs and has verified that the materials/ equipment have been installed as designed. No working

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drawings or calculations/computations relating to the working drawings shall be submitted to the City's Authorized Representative unless specifically requested in writing.

- D. Samples:
 - 1. Samples as defined above and as specified in individual Sections, include, but are not necessarily limited to, physical examples of the work such as sections of manufactured or fabricated work, small cuts or containers of materials, complete units of repetitively used products, color/texture/pattern swatches and range sets, specimens for coordination of visual effect, graphic symbols and units of work to be used by the City's Authorized Representative or Owner for independent inspection and testing, as applicable to the Work.
- E. Pre-Construction Photos/Video Recording:
 - 1. Submit Pre-Construction Photos/Video Recording per Section 01320 Construction Photography.
- F. Test Reports:
 - 1. Submit test reports to City's Authorized Representative and follow all requirements per Section 01410 Testing and Testing Laboratory Services.
- G. Record Drawings:
 - 1. Submit Record Drawings per Section 01720 Record Documents.

1.4 CONTRACTOR'S RESPONSIBILITIES

- A. The Contractor shall review shop drawings, product data and samples, including those by subcontractors, prior to submission to determine and verify the following:
 - 1. Field measurements
 - 2. Field construction criteria
 - 3. Catalog numbers and similar data
 - 4. Conformance with the Specifications
- B. Each shop drawing, sample and product data submitted by the Contractor shall have affixed to it the following Certification Statement including the Contractor's Company name and signed by the Contractor: "Certification Statement: By this submittal, I hereby represent that I have determined and verified all field measurements, field construction criteria, materials, dimensions, catalog numbers and similar data and I have checked and coordinated each item with other applicable approved shop drawings and all Contract requirements." Shop drawings and product data sheets 11 in x 17 in and smaller shall be bound together in an orderly fashion and bear the above Certification Statement on the cover sheet. The cover sheet shall fully describe the packaged data and include a listing of all items within the package. Provide to the City's Authorized Representative a copy of each submittal transmittal sheet for shop drawings, product data and samples at the time of submittal of said drawings, product data and samples to the City and/or City's Authorized Representative.
- C. Each submittal shall be transmitted by a standard transmittal sheet which shall fully describe the transmitted data and include a listing of all items within the submittal.
- D. The Contractor shall utilize a 10-character submittal identification numbering system in the following manner:

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1. The first character shall be a D, S, P, M, or R, which represents Shop/Working Drawing and other Product Data (D), Sample (S), Preliminary Submittal (P), Operating/Maintenance Manual (M), or Request for Information (R).
2. The next five digits shall be the applicable Specification Section Number.
3. The next three digits shall be the numbers 001 999 to sequentially number each initial separate item or drawing submitted under each specific Section number.
4. The last character shall be a letter, A Z, indicating the submission, or resubmission of the same Drawing, i.e., "A=1st submission, B=2nd submission, C=3d submission, etc. A typical submittal number would be as follows:

D 03300 008 B

D = Shop Drawing
03300 = Specification Section for Concrete
008 = The eighth initial submittal under this specification section
B = The second submission (first resubmission) of that particular shop drawing

- E. Notify the City and/or City's Authorized Representative in writing, at the time of submittal, of any deviations in the submittals from the requirements of the Contract Documents.
- F. The review and approval of shop drawings, samples or product data by the City and/or City's Authorized Representative shall not relieve the Contractor from his/her responsibility with regard to the fulfillment of the terms of the Contract. All risks of error and omission are assumed by the Contractor and the City's Authorized Representative will have no responsibility therefore.
- G. No portion of the work requiring a shop drawing, sample, or product data shall be started nor shall any materials be fabricated or installed prior to the approval or qualified approval of such item. Fabrication performed, materials purchased or on-site construction accomplished which does not conform to approved shop drawings and data shall be at the Contractor's risk. The City will not be liable for any expense or delay due to corrections or remedies required to accomplish conformity.
- H. Project work, materials, fabrication, and installation shall conform with approved shop drawings, applicable samples, and product data.

1.5 SUBMISSION REQUIREMENTS

- A. Make submittals promptly in accordance with approved schedule, and in such sequence as to cause no delay in the Work or in the work of any other contractor.
- B. Each submittal, appropriately coded, will be returned within 30 calendar days following receipt of submittal by the City and/or City's Authorized Representative.
- C. Number of submittals required:
 1. Shop Drawings as defined in Paragraph 1.02 A: Five copies.
 2. Product Data as defined in Paragraph 1.02 B: Five copies.
 3. Samples: Submit the number stated in the respective Specification Sections.
- D. Submittals shall contain:
 1. The date of submission and the dates of any previous submissions.

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2. The Project title and number.
3. Contractor identification.
4. The names of:
 - a. Contractor
 - b. Supplier
 - c. Manufacturer
5. Identification of the product, with the specification section number, page and paragraph(s).
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. Contractor certification statement and identification of deviations from Contract Documents.
10. Identification of revisions on resubmittals.
11. An 8 in x 3 in blank space for Contractor and City stamps.

E. Facsimiles or copies of facsimiles will not be accepted as submittals.

F. After review of shop and working drawings, City and/or City's Authorized Representative will return four copies of the submittal to the Contractor.

1.6 REVIEW OF SHOP DRAWINGS, PRODUCT DATA, WORKING DRAWINGS AND SAMPLES

A. The review of shop drawings, data, and samples will be for general conformance with the design concept and Contract Documents. They shall not be construed:

1. As permitting any departure from the Contract requirements;
2. As relieving the Contractor of responsibility for any errors, including details, dimensions, and materials;
3. As approving departures from details furnished by the City and/or City's Authorized Representative, except as otherwise provided herein.

B. The Contractor remains responsible for details and accuracy, for coordinating the work with all other associated work and trades, for selecting fabrication processes, for techniques of assembly, and for performing work in a safe manner.

C. If the shop drawings, data or samples as submitted describe variations and show a departure from the Contract requirements which City and/or City's Authorized Representative finds to be in the interest of the City and to be so minor as not to involve a change in Contract Price or time for performance, the City and/or City's Authorized Representative may return the reviewed drawings without noting an exception.

D. Submittals will be returned to the Contractor under one of the following codes.

Code 1 "APPROVED" is assigned when there are no notations or comments on the submittal. When returned under this code the Contractor may release the equipment and/or material for manufacture.

Code 2 "APPROVED AS NOTED". This code is assigned when a confirmation of the notations and comments IS NOT required by the Contractor. The Contractor may release the equipment or

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material for manufacture; however, all notations and comments must be incorporated into the final product.

Code 3 "APPROVED AS NOTED/CONFIRM". This combination of codes is assigned when a confirmation of the notations and comments IS required by the Contractor. The Contractor may release the equipment or material for manufacture; however, all notations and comments must be incorporated into the final product. This confirmation shall specifically address each omission and nonconforming item that was noted. Confirmation is to be received by the City's Authorized Representative within 15 calendar days of the date of the City's Authorized Representative's transmittal requiring the confirmation.

Code 4 "APPROVED AS NOTED/RESUBMIT". This combination of codes is assigned when notations and comments are extensive enough to require a resubmittal of the package. This resubmittal is to address all comments, omissions and non-conforming items that were noted. Resubmittal is to be received by the City's Authorized Representative within 15 calendar days of the date of the City's Authorized Representative's transmittal requiring the resubmittal.

Code 5 "NOT APPROVED" is assigned when the submittal does not meet the intent of the Contract Documents. The Contractor must resubmit the entire package revised to bring the submittal into conformance. It may be necessary to resubmit using a different manufacturer/vendor to meet the Contract Documents.

Code 6 "COMMENTS ATTACHED" is assigned where there are comments attached to the returned submittal which provide additional data to aid the Contractor.

Code 7 - "RECEIPT ACKNOWLEDGED" is assigned to acknowledge receipt of a submittal that is not subject to the City's Authorized Representative's review and approval, and is being filed for informational purposes only. This code is generally used in acknowledging receipt of means and methods of construction work plans, field conformance test reports, and health and safety plans.

Codes 1 through 5 designate the status of the reviewed submittal with Code 6 showing there has been an attachment of additional data. Code 7 will be used as may be necessary.

- E. Resubmittals will be handled in the same manner as the initial submittals. On resubmittals, the Contractor shall direct specific attention, in writing on the letter of transmittal and on resubmitted shop drawings by use of revision triangles or other similar methods, to revisions other than the corrections requested by the City's Authorized Representative, on previous submissions. Any such revisions which are not clearly identified shall be made at the risk of the Contractor. The Contractor shall make corrections to any work done because of this type of revision that is not in accordance to the Contract Documents as may be required by the City's Authorized Representative.
- F. Partial submittals will not be reviewed. The City's Authorized Representative will be the only judge as to the completeness of a submittal. Submittals not complete will be returned to the Contractor, and will be considered "Not Approved" until resubmitted. The City's Authorized Representative may, at his/her option, provide a list or mark the submittal directing the Contractor to the areas that are incomplete.
- G. Repetitive Review:

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1. Shop drawings and other submittals will be reviewed no more than twice at the City's expense. All subsequent reviews will be performed at times convenient to the City's Authorized Representative and at the Contractor's expense, based on the City and/or City's Authorized Representatives then prevailing rates. The Contractor shall reimburse the City for all such fees invoiced to the City by the City's Authorized Representative. Submittals are required until approved.
 2. Any need for more than one resubmission, or any other delay in obtaining City's Authorized Representative's review of submittals, will not entitle Contractor to extension of the Contract Time.
- H. If the Contractor considers any correction indicated on the shop drawings to constitute a change to the Contract Documents, the Contractor shall give written notice thereof to the City's Authorized Representative at least seven working days prior to release for manufacture.
- I. When the shop drawings have been completed to the satisfaction of the City's Authorized Representative, the Contractor shall carry out the construction in accordance therewith and shall make no further changes therein except upon written instructions from the City's Authorized Representative.
- J. Request for Information (RFI) shall be submitted on a standard form provided by the City's Authorized Representative. RFI's shall indicate their importance to the timely completion of the project. RFI's will be processed as a shop drawing with 7 days allowed for review time.

1.7 DISTRIBUTION

- A. Distribute reproductions of approved shop drawings and copies of approved product data and samples, where required, to the job site file and elsewhere as directed by the City's Authorized Representative. Number of copies shall be as directed by the City's Authorized Representative but shall not exceed six (6).

1.8 SCHEDULES

- A. Provide all schedules required in 01310 Scheduling the Work.

1.9 PROFESSIONAL ENGINEER (P.E.) CERTIFICATION FORM

- A. If specifically required in other Sections of these Specifications, the Contractor shall submit an Engineering Certification issued by a Professional Engineer licensed in the State of Georgia for each item required, in the form attached to this Section, completely filled in and stamped.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

(P.E. CERTIFICATION FORM ATTACHED)

END OF SECTION 01300

P.E. CERTIFICATION FORM

The undersigned hereby certifies that he/she is a Professional Engineer registered in the State of Georgia and that he/she has been employed by (Name of Contractor) _____

_____ to design _____

in accordance with Specification Section _____ for the (Name of Project) _____

_____. The undersigned further certifies that

he/she has performed the design of the _____

_____, that said design is in conformance with all applicable local, state and federal codes, rules, and regulations, and that his/her signature and P.E. stamp have been affixed to all calculations and drawings used in, and resulting from, the design.

The undersigned hereby agrees to make all original design drawings and calculations available to the

(Insert Name of City) _____

_____ or City's representative within the immediate five working days following written request by the City.

P.E. Name

Signature

Address

Contractor's Name

Signature

Title

Address

SECTION 01310

SCHEDULING THE WORK

PART 1 - GENERAL

1.1 SCOPE

- A. This section describes the scheduling and progress reporting requirements of the Contract. The primary objectives of the requirements of this Section are:
 - 1. To assist the City and Engineer in evaluating the progress of the Work.
 - 2. To provide for optimum coordination and sequencing of the Work by the City, Contractor, and any related work or services provided by other parties which may affect the Project.
 - 3. To permit the timely prediction or detection of events or occurrences that might affect the timely prosecution of the Work.

1.2 GENERAL SCHEDULING REQUIREMENTS

- A. The Work of this Contract shall be planned, scheduled, executed, and reported using the critical path method (CPM). Through the Mobilization / Project Management / Demobilization bid item, the Contractor shall purchase and use the following software program to develop its Schedule Submittal:
 - 1. Primavera Engineering and Construction, version to be specified by the Engineer
- B. A comprehensive schedule shall be developed by the Contractor and submitted to the Engineer for review prior to commencement of said work. Upon acceptance by the Engineer, the schedule will be merged into the City's overall schedule.
- C. At a minimum, the schedule shall include the activities for each asset as deemed appropriate to clearly illustrate and document the Work. The activities listed below are repetitive for the same type of rehabilitation when organized on an asset basis and generally considered standard industry practice. This set of standard activities will be used to harmonize multiple rehabilitation contracts by the City and shall not be revised or in text or grouping without approval from the Engineer.

Planning & Administrative Activities by Contract Type:

Description	Contract Type
Bond & Insurance Submittal	ALL
Product Submittals	ALL

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Permits	ALL
Right of Entry Acquisition	N/A
72 Hour Disruption Notice	ALL
Door Hanger Notification	N/A
Application for Payment Submission	ALL
Application for Payment Review	ALL
Project Record Submittals	ALL
Project Closeout Document Submittals	ALL

Construction Activities by Rehabilitation Type:

Description	Rehab Type
Pre-Construction Survey	ALL
Locate Existing Utilities	ALL
Install Access Road	ALL
Install/ Maintain/ Remove Traffic Control	N/A
Install/ Maintain/ Remove Bypass Pumping	N/A
Pre-CCTV Existing Pipeline	N/A
Rehabilitate Service Laterals	N/A
Precondition Existing Pipeline	N/A
Install Liner/ Reinstate Services	N/A
Install Launch Pit/ PB / Reinstate Services	N/A
Install New Pipeline/ Reinstate Services	N/A
Post CCTV Review	N/A
Post CCTV Submission to COA	N/A
Manhole Rehabilitation	N/A
Test New Installation	ALL
Site Restoration	ALL
Pavement Replacement	ALL
Asphalt Pavement Milling & Topping	N/A

Milestones by Contract Type:

Description	Contract Type
Contract Execution	ALL
Notice to Proceed	ALL
Pre-construction Meeting	ALL
(" ") Public Information Meeting	ALL
Trial Test Methodology Acceptance	ALL
Storm drainage basin (" ") Substantial Completion	ALL
Storm drainage basin (" ") Final Completion	ALL
Contract Substantial Completion	ALL
Contract Final Completion	ALL

- D. The Schedule Submittal, as defined herein, shall represent the Contractor's commitment and intended plan for completion of the Work in compliance with the Contract completion date and interim milestone dates specified.

The Schedule Submittal shall take into account all foreseeable activities to be accomplished by any separate consultants or the City, and interface dates with utility companies, the City's operations, and others. The Schedule Submittal shall anticipate all necessary manpower and resources to complete the Work within the dates set forth.

- E. Once reviewed and accepted by the Engineer, the Schedule Submittal will become the Schedule of Record.
- F. The Contractor is responsible for determining the sequence of activities, the time estimates of the detailed reconnaissance/investigative and rehabilitation activities, as well as the means, methods, techniques and procedures to be employed. The schedule shall clearly indicate the proposed sequence of work. The Schedule of Record shall represent the Contractor's best judgement of how it will execute the Work in compliance with the Contract requirements. The Contractor shall ensure that Schedule of Record is current and accurate and is properly and timely monitored, updated and revised as Project conditions and the Contract Documents may require.
- G. The City will work with the Contractor to assign and schedule the work in a logical and efficient manner. However, all items in this contract shall be priced such that each item can be assigned independently or combined at the City's sole discretion, in regard to both quantity and scope. There shall be no consideration of any claim for extra payment arising from a decision by the City to assign potential work items under this contract in any combination or in combination with another contract utilizing alternate technologies.

1.3 SCHEDULE SUBMITTALS

- A. The Contractor shall submit the qualifications of the scheduler(s) proposed to be used on the project immediately after NTP. The scheduler(s) is subject to the approval of the Engineer. The Contractor shall use the services of a scheduler(s) who has verifiable training and credentials in preparing and maintaining a computerized CPM Construction Schedule using Primavera software as specified herein. The qualifications of the scheduler(s) should be a minimum of 4 years' experience in project scheduling for civil, structural, architectural, or related engineering disciplines. The scheduler(s) should have direct experience developing, maintaining, updating, modifying project schedules utilizing Primavera products, ideally Primavera Engineering and Construction. The cost for providing a qualified scheduler(s) shall be included in the Project Control Tools bid item.
- B. Within 45 days from receipt of Notice to Proceed, a baseline / comprehensive schedule shall be submitted by the Contractor to the Engineer for approval. The Contractor shall submit the complete schedule in electronic

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format as directed by the Engineer. At a minimum, the schedule output shall include the following:

1. Activities with attributes or codes
2. Estimated activity durations in working days. (Not to exceed 15 working days for the construction activities.)
3. All logic ties
4. The critical path activities differentiated from other activities
5. All activities for submittal of shop and working drawings, videos, test results, procurement, fabrication, delivery, installation and testing of critical materials.
6. Related activities shall be grouped on the network diagram
7. A time scale located at the top and/or bottom of the network diagram showing calendar days and months
8. Earliest start date
9. Earliest finish date
10. Actual start date
11. Actual finish date
12. Latest start date
13. Latest finish date
14. Calendar Definition
15. Total float
16. All constraints
17. Lag – No lag is allowed in the baseline/ comprehensive schedule
18. Monetary value of activity (from Schedule of Values)

C. The Contractor shall participate in a review and evaluation of the baseline schedule with the Engineer. Any revisions necessary as a result of this review shall be resubmitted to the Engineer within 10 calendar days after the conference. The mutually acceptable schedule shall then be used by the Contractor for planning, organizing and directing the work and for reporting progress. If the Contractor desires to make changes in its method of performing the Work, he shall notify the Engineer in writing stating the reason for the changes.

D. The Contractor shall demonstrate competence in the use of CPM scheduling through the submission of a fully compliant CPM Construction Schedule with the initial CPM submission. In the event the Contractor fails to provide a baseline schedule in a timely manner or fails to demonstrate competence in the CPM scheduling, the Engineer may direct the Contractor to employ the services of a Scheduling Firm that can demonstrate competence. The Contractor shall comply with such directive at no additional cost to the City.

E. Each activity shall use the following format:

xxxx.yyyyyy

Where xxxx is the last four digits of the contract number (FC #), and yyyyyy is for the Contractor's use according to a template provided by the Engineer at the pre-construction conference.

- F. Activities and milestones to appear on the Schedule Submittal shall include, but not be limited to, City reviews that impact the Work, obtaining required permits, dewatering and dredging, sitework, paving, submittals, coordination requirements, and dates of Substantial and Final Completion.
- G. The Engineer shall have the right to require the Contractor to modify any portion of the Contractor's Schedule Submittal, or Recovery Schedule, as herein required, (including cost loading) with the Contractor bearing the expense thereof, which the Engineer reasonably determines to be:
 - 1. Impractical or unreasonable
 - 2. Based upon erroneous calculations or estimates
 - 3. Required to ensure proper coordination by the Contractor of the Work of its subconsultants and with the work or services being provided by any separate consultants
 - 4. Necessary to avoid undue interference with the City's operations
 - 5. Necessary to ensure completion of the Work by the milestone and completion dates set forth in the Contract Documents
 - 6. Required in order for the Contractor to comply with the requirements of this Section or any other requirements of the Contract Documents
 - 7. Not in accordance with the Contractor's actual operations
- H. The electronic version of the schedule shall be submitted on a CD, in a form and format acceptable to the Engineer, including all required submission information resident in the computer system and containing all of the files associated with the schedule.
- I. Each week the Contractor will provide the Engineer and Public Information (PI) Office with a detailed two-week look-ahead schedule. The schedule must be in the format required by the PI Office.

1.4 UPDATING OF THE SCHEDULE / PROGRESS REPORTS

- A. The Engineer shall review the Contractor's report of actual progress at each progress meeting. Prepared by the Contractor, said report shall set forth up-to-date and accurate progress. The Contractor in consultation with all principal subconsultants shall prepare said report. The Contractor will perform a complete schedule update on a monthly basis or at the discretion of the Engineer.
 - 1. The Contractor shall submit the updated schedule in electronic format as directed by the Engineer. The Contractor shall submit hard copies of the schedule output including, but not limited to:

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- a. 30-day Look-ahead Report including but not limited to planned activities within the next thirty days
 - b. Milestones to be completed
 2. The Contractor shall provide written explanation of all changes in activity durations, relationships, and constraints with the schedule output. Changes will require written approval by the Engineer.
- B. The Schedule Report of the Contractor shall show the activities, or portions of activities, completed during the reporting period, the actual start and finish dates for these activities, remaining duration and estimated completion dates for activities currently in progress.
- C. At the progress meeting a total review of the Project will take place including but not limited to, the following:
1. Current update of the Schedule of Record in format as prescribed by Engineer
 2. Anticipated detailed construction activities for the subsequent report period
 3. Critical items pending
 4. Contractor requested changes to the Schedule of Record
- D. The Contractor shall submit a narrative with the progress report which shall include, but not be limited to, a narrative describing actual Work accomplished during the reporting period, a description of problem areas, current and anticipated delaying factors and their impact, explanations of corrective actions taken or planned, any proposed newly planned activities or changes in sequence, and proposed logic for a Recovery Schedule, if required, as further described herein.
- E. No invoice for payment shall be submitted and no payment whatsoever will be made to the Contractor until the Schedule of Record, and narrative reports as defined herein, are updated.

1.5 SCHEDULE REVISIONS

- A. Should the Contractor desire to or be otherwise required under the Contract Documents to make modifications or changes in its method of operation, its sequence of Work or the duration of the activities in the Schedule of Record, it shall do so in accordance with the requirements of this Specification Section and the Contract Documents. The approved Schedule of Record may only be revised by written approval of the Engineer as provided herein.
- B. The Contractor shall submit requests for revisions to the Schedule of Record to the Engineer using the Schedule Revision Form provided by the Engineer. The Contractor shall identify revisions and description of logic

for rescheduling work and substantiate that the milestone and completion dates will be met as listed in the Contract Documents. Proposed revisions acceptable to the Engineer and City will be approved in writing and incorporated into the Schedule of Record.

- C. Requests for revision will be accompanied by evidence acceptable to the Engineer that the Contractor's subcontractors are in agreement with the proposed revisions.
- D. If there are separate consultants on the Project, the approval of the separate consultants shall be obtained to make the proposed schedule revisions. If accepted by the Engineer and City, the revisions shall be binding upon the Contractor and all separate consultants on the Project.
- E. The impact of all change orders to this Contract shall be included in the project schedule.

1.6 RECOVERY SCHEDULE

- A. Should the updated Schedule of Record, at any time during the Contractor's performance, show that, in the sole opinion of the Engineer, the Contractor is behind schedule for any milestone or completion date for any location or category of work, the Contractor, at the request of the Engineer, shall prepare a Schedule Revision for the purpose of displaying recovery. The revision shall identify how the Contractor intends to reschedule its Work in order to regain compliance with the Schedule of Record within thirty (30) calendar days.
- B. The Contractor shall prepare and submit to the Engineer a one month maximum duration Recovery Schedule, incorporating the best available information from subconsultants, subcontractors and others which will permit a return to the Schedule of Record at the earliest possible time. The Contractor shall prepare a Recovery Schedule to the same level of detail as the Schedule of Record. The Recovery Schedule shall be prepared in coordination with other separate consultants on the Project.
- C. Within two (2) calendar days after submission of the Recovery Schedule to the Engineer, the Contractor shall participate in a conference with the Engineer to review and evaluate the Recovery Schedule. Within two (2) calendar days of the conference, the Contractor shall submit the revisions necessitated by the review for the Engineer's review and acceptance. The Contractor shall use the accepted Recovery Schedule as its plan for returning to the Schedule of Record.

- D. The Contractor shall confer continuously with the Engineer to assess the effectiveness of the Recovery Schedule. As a result of these conferences, the Engineer will direct the Contractor as follows:
 - 1. If the Engineer determines the Contractor continues behind schedule, the Engineer will direct the Contractor to prepare a Schedule Revision and comply with all of the requirements of a Schedule Revision as stated herein and the other requirements of the Contract Documents; provided, however, that nothing herein shall limit in any way the rights and remedies of the City and Engineer as provided elsewhere in the Contract Documents; or
 - 2. If the Engineer determines the Contractor has successfully complied with provisions of the Recovery Schedule, the Engineer will direct the Contractor to return to the use of the approved Schedule of Record.

1.7 FLOAT TIME

- A. Float or slack time shown on the currently approved Schedule of Record is not for exclusive use or benefit of either the City or the Contractor and is available for use by either of them according to whichever first needs the benefit of the float to facilitate the effective use of available resources and to minimize the impact of Project problems, delays, impact, acceleration or changes in the Work which may arise during performance. The Contractor specifically agrees that float time may be used by the City in conjunction with their review activities or to resolve Project problems. The Contractor agrees that there will be no basis for any modification of the milestone or completion dates or an extension of the Contract Time, or a claim for additional compensation as a result of any Project problem, delay, impact, acceleration, or change order which only results in the loss of available float on the currently approved Schedule of Record. Unless otherwise stated herein, float as referenced in these documents, is total float. Total float is the period of time measured by the number of working days each non-critical path activity may be delayed before it and its succeeding activities become part of the critical path. If a non-critical path activity is delayed beyond its float period, that activity then becomes part of the critical path and controls the end date of the project. Thus, the delay of the non-critical path activity beyond its float period will cause delay to the project itself.
- B. Float time shown on the Schedule of Record shall not be used arbitrarily by the Contractor in a manner which, in the opinion of the Engineer, unnecessarily delays separate subcontractors from proceeding with their work in a way which is detrimental to the interests of the City. Liability for delay of the project completion date rests with the party actually causing delay to the project completion date. For example, if Party A uses some, but not all of the float time and Party B later uses the remainder of the float

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time as well as additional time beyond the float time, Party B shall be liable for the costs associated with the time that represents a delay to the project's completion date. Party A would not be responsible for any costs since it did not consume all of the float time and additional float time remained, therefore, the project's completion date was unaffected.

+++ END OF SECTION 01310 +++

**SECTION 01320
CONSTRUCTION PHOTOGRAPHY**

PART 1 GENERAL

1.01 SCOPE

- A. The Contractor shall furnish all labor, equipment and materials required to provide the Owner with digital construction photography of the Project as specified herein.
- B. The Contractor shall provide for professional videos and photographs to be made prior to and after construction to provide documentation of conditions and aid in any damage claims assessment. All conditions which might later be subject to disagreement shall be shown in sufficient detail to provide a basis for decisions.
- C. Video and photo files shall become the property of the Owner and none of the video or photographs herein shall be published without express permission of the Owner.

1.02 PRE AND POST CONSTRUCTION PHOTOGRAPHY

- A. Prior to the beginning of any work, the Contractor shall provide for professional videos and photographs of the work area to record existing conditions.
 - 1. The Contractor shall furnish a complete videotaped record of the pump station sites, ductbanks, substation, driveway/access roads, and pipeline routes. The video tape shall include the date of taping and shall contain audio commentary to emphasize existing conditions along the entire route.
 - 2. The routes and sites shall be videotaped prior to beginning of construction. The Contractor shall furnish three sets of compact discs containing the videotaped data to the Engineer.
 - 3. The route shall also be videotaped at the completion of construction when directed by the Engineer. The video tape shall show the same areas and features as in the preconstruction videos. The Contractor shall furnish three sets of compact discs containing the videotaped data to the Engineer.
- B. The pre-construction videos shall be submitted to the Engineer within 15 calendar days after receipt of construction Notice to Proceed by the Contractor. Post construction videos and photographs shall be provided prior to final acceptance of the project.

1.03 PROGRESS PHOTOGRAPHS

- A. Photographs shall be taken to record the general progress of the Project during each pay period. Photographs shall be representative of the primary work being performed at the time.

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- B. All photographs shall be taken with a digital camera. The photographs shall include the date and time marking in the digital record. All photographs shall be labeled on a tab connected to the bottom of the photo to indicate date and description of work shown.

PART 2 PRODUCTS

2.01 PHOTOGRAPHS

- A. Photography and video files shall be provided in CD-ROM format.
- B. Photographs shall also be provided in hard copy format. The photographs shall include the date and time marking on the photograph. All photographs shall be labeled on a tab connected to the bottom of the photograph. Tab label shall contain:
 - 1. Project name.
 - 2. Orientation of view.
 - 3. Description of work shown.
- C. All compact disks (CDs) furnished under this section shall be suitable for viewing with Windows Media Player.

PART 3 EXECUTION

3.01 SUBMITTALS

- A. No construction shall start until pre-construction photography has been completed and accepted by the Engineer.
- B. A minimum of ten 8 x10-inch progress photographs shall be submitted with each application for payment. The view selection will be as determined by the Engineer. Photographs shall be submitted in Print File Archival Preservers, 8 1/2 x 11-inch plastic sleeves pre-punched for a 3-ring binder.
- C. Construction photographs shall be submitted with each payment request. Failure to include photographs may be cause for rejection of the payment request.
- D. The Contractor shall be responsible for all discrepancies not documented in the pre-construction videos and photography.

+++ END OF SECTION 01320 +++

SECTION 01350
PROJECT DOCUMENT TRACKING AND CONTROL SYSTEMS

PART 1 – GENERAL

1.01 SCOPE

- A. The Contractor shall utilize the City of Atlanta’s Project Document Tracking and Control System (DTCS). The primary function of the system is to facilitate timely processing and approval of all contract documentation in coordination with the overall Project Schedule established by these Specifications and the Contractor. This system will utilize e-Builder software for document tracking and control, or other software as determined by the City of Atlanta. The e-Builder software will:
1. Facilitate communication among the Owner, Engineer and Contractor.
 2. Facilitate turn-around time with regard to responses and approvals.
 3. Provide a central location for all Project information to facilitate all Project participants in performing their tasks based on the latest Project data.
 4. Provide a standard system of project administration with accountability.
- B. The Contractor shall be required to utilize the web based DTCS system to generate documents in the proper format for submission to the City. The Contractor shall access the system through the internet using a compatible webbrowser.
- C. The Contractor shall be required to generate Project documents and records utilizing the aforementioned system. The Contractor shall be required to transmit and submit the Project documents within the system to the City.
- D. The Contractor shall utilize a high-capacity scanner capable of scanning 11 x 17 documents, double sided, on site for the entire duration of the Project. All documents must be scanned in and attached to the appropriate document, including submittals, shop drawings, O&M’s and all other documents requested by the Engineer.
- E. The Contractor shall utilize the DTCS to create and maintain Project documents, including, but not limited to the following:
1. Company Directory: Addresses, Phone Numbers, Personnel Contacts, etc.
 2. Drawings Log: Current Drawing revision log

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3. Submittals (Integrated with Project Schedule through Activity codes)
 4. Transmittals
 5. Requests for Information and Answers (RFIs)
 6. Change Documents, Including:
 - a. Requests for Proposal (RFPs)
 - b. Work Authorizations (WAs)
 - c. Change Order Requests (CORs)
 - d. Change Orders (CO)
 - e. Design Clarifications (DC)
 7. Field Decisions & Clarification Memos
 8. Notice of Non-Compliance
 9. Construction Issue Memos
 10. Punchlists
 11. Meeting Minutes & Agendas
 12. Correspondence
 13. Work Plans
 15. Start-up Plans
 16. Equipment Operation and Maintenance Training
- F. The Contractor shall utilize the complete capabilities of the DTCS to meet the requirements of this Section. The Contractor shall provide a highly trained and experienced construction project controls person knowledgeable in construction work sequencing, productivity, scheduling and invoicing. This person, along with the Contractor's management team, shall work closely with the City to deliver the documents outlined in this Section
- G. Software Provision and Training
1. The City of Atlanta shall provide to the contractor a license of or access to

the DTCS software at no cost. The City of Atlanta will provide training in the use of the DTCS software to at least one Contractor's employee at no cost. It shall be the responsibility of the Contractor to ensure that staff attend City-provided training and are afterwards proficient in the use of the DTCS software.

2. The Contractor shall be required to establish an internet connection using DSL or better to connect to the DTCS to permit the forwarding and receipt of documents.
 - I. The Contractor shall meet with the City within 15 days after the Contract is awarded to discuss access requirements and the Contractor's plan to utilize DTCS and execute the document control functions herein.
 - J. Access through the internet to the DTCS shall be operational within 30 days following the pre-construction meeting date.

1.02 COMPANY DIRECTORY

- A. The Contractor and the City will monitor and manage the Company Directory. The directory must include Company name, Company abbreviation, contact names, address, phone numbers and e-mail addresses.

1.03 DRAWING LOG

The City will maintain a log of initial "issued for construction" drawings in the DTCS. Information shall include drawing number, title and revision number. In addition to logging the initial project drawing list, the City will maintain a log on the DTCS of all subsequent revisions to these drawings and any sketches resulting from clarification memos, RFIs, field orders and Change Orders. It is the Contractor's responsibility to utilize the latest drawings and sketches in the performance of the work.

1.04 SUBMITTALS/SHOP DRAWINGS

- A. Requirements: This section specifies supplemental requirements to General Conditions related to the processing of submittals and shop drawings. The Contractor will utilize the DTCS to log and track submittals, as well as generate associated transmittal letters.
- B. Submittals & Product Data: A list of all required submittals will be entered into the DTCS by the Contractor. Submittals shall be incorporated into packages, with the submittal numbering format to be provided by the COA's engineer. The Contractor will log and track all submittals utilizing the DTCS. Each review

cycle shall be entered into the DTCS. The Contractor shall identify as activities in the CPM schedule, to include all data submittals, as well as those involving complex reviews and long lead deliveries, and all procurement items required for construction activities. Submittal schedule information shall be updated monthly with the Contractor's updated project CPM schedule.

- C. Samples: A list of all required sample submittals will be entered into the DTCS by the Contractor. Sample submittals shall be identified as individual submittals within the submittal packages with numbering as specified above.
- D. Guarantees/Warranties: A list of all required Guarantee/Warranty submittals will be entered into the DTCS by the Contractor. These submittals shall be identified as individual submittals within the submittal packages with numbering as specified above.
- E. Work Plans, Start-up Plans, O&M Submittals and Spare Parts: All testing, Start-up and O&M submittals will be entered into the DTCS by the Contractor. These submittals shall be identified as individual submittals within the submittal packages identified with numbering as specified above.
- F. Submittal Procedures: The Contractor shall prepare all submittal packages utilizing the submittal numbering system, description and packaging conventions described above. Submittals prepared by the Contractor, which fail to follow the conventions described above, will be returned "amend and resubmit". Should the Contractor determine that a submittal is required and is not covered by the listing within the DTCS, consultation with the City to determine the submittal number, description and packaging will be required.

1.05 CORRESPONDENCE

The City shall monitor and manage the correspondence, Non-Compliance Notices, Field Decisions & Clarification Memos and Construction Issue Memo logs. The Contractor is responsible for generating Project correspondence within the DTCS, and forwarding the correspondence to the City.

1.06 TRANSMITTAL LOG

The Contractor and the City will monitor and manage the transmittal log. All Project transmittals shall be created electronically, automatically sequentially numbered and logged into the DTCS system as they are created. The Contractor is responsible for utilizing the system to create transmittals for items transmitted to the Owner, Engineer, Resident Inspection Staff and other Contractors.

1.07 REQUEST FOR INFORMATION & ANSWERS

The Contractor shall be responsible for generating RFIs on the DTCS system.

The Contractor shall notify the City when an RFI is submitted. The City will monitor and manage the RFI log. The City will generate an Answer document in response to each RFI and forward them to the Contractor. The DTCS will track “Ball in Court” for all RFIs and Answers, as well as date of original generation and response date. In addition, the RFIs will reference the relative Specification Section and Drawings. The DTCS will identify the date of the request and the originator, responsible party for a response and the date of the response.

1.08 CHANGE DOCUMENTS

Change documents include Request for Proposals (RFPs), Work Authorization Requests (WARs), Work Authorizations (WAs), Change Orders Requests (CORs), Design Clarifications (DCs), and Change Orders (COs). All change documents will be monitored and managed by the City utilizing the DTCS. The DTCS will track “Ball in Court” status of all change documents.

1.10 PUNCHLISTS

The City will monitor and manage Punchlists, and will create Punchlists to be forwarded to the Contractor. The Contractor shall address the punchlist items that have been assigned to the Contractor and forward updates to the City. Once accepted as complete, the City will access the punchlist in the DTCS and close it out.

1.11 MEETING MINUTES AND AGENDA

The City shall monitor and manage the meeting minute process. The City will forward meeting minutes to the Contractor electronically. The City will log the meeting minute items into the DTCS within 3 days of the meeting date.

1.12 PROGRESS PAYMENTS /REQUISITIONS FOR PAYMENT

The Contractor is responsible for creating progress payment applications directly from the DTCS software and then forwarding them to the City electronically along with hard copies by 4:00 p.m. at the end of each update/billing period. All Progress Payments and schedule of values shall be developed as defined in the Special Conditions. Required information within the Pay Application shall be coordinated with the City’s Project Manager. Failure of a Contractor to maintain project record documents, maintain current and properly prepared daily reports or to submit the project schedule will be just cause for withholding of the monthly or final payment.

+++ END OF SECTION 01350 +++
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SECTION 1351

PUBLIC RELATIONS AND COMMUNICATIONS

PART 1 - GENERAL

1.01 SCOPE

- A. The Contractor shall provide all personnel, services, and materials as specified under this Section necessary to meet the requirements and responsibilities related to the Public Involvement and Public Relations and Outreach as specified hereinafter, during performance of Work under the Agreement by the Contractor.
- B. Unless specifically stated otherwise within the Agreement, no separate payment will be made for satisfying Public Outreach requirements.

1.02 STAFFING

- 1.2.01. The City shall assign one (1) full time Public Information Officer (PIO) whose specific duties and job shall be to perform customer service-related functions and to continuously coordinate with the Contractor on the City's behalf to provide information and services as required by the City's Office of Communications and Community Relations and other City staff as necessary.
- 1.2.02. The City shall also designate a Public Information Manager (PIM) whose specific duties and job shall be to perform customer service-related functions and to continuously coordinate with the Contractor and PIO as necessary.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 PUBLIC INFORMATION KICK-OFF MEETING

Prior to commencement of Work under the Agreement and following the Preconstruction Meeting, the Contractor, the Project Manager (PM), Construction Manager (CM), Public Information Manager (PIM), Public Information Officer (PIO), and the City's Engineer will be required to attend a public information meeting hosted by the DWM Office of Communications and Community Relations. At this meeting the Contractor's

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responsibilities will be discussed, the relationship with the OCCR, the City's Engineer and/or designated representative of the City. The Contractor and staff will also be advised as to the expectations of the City regarding citizen relations and inquiries, as well as public notification protocols.

3.02 DOOR-HANGERS

- A. The Contractor shall produce door hangers required for notice to customers/citizens and residents from the template provided by the City's PIM as specified hereinabove in paragraph 3.02. Door hangers shall be utilized for notification in the event of, but not limited to, the following events:
1. Planned service disruption/outages
 2. Road closures/detours/traffic pattern changes
 3. Access/entrance to property
 4. Work start-up
 5. CCTV
 6. Smoke Testing
 7. Dye Testing

3.03 IMPACTED AREA ADDRESS DATABASE

- A. The Contractor shall provide the Office of Communications and Community Relations with a database of addresses and phone numbers (and names if available) of all project impacted residences, businesses and facilities at least three (3) weeks prior to project start-up. The database will be used by the City's PIO for regular citizen communications and notifications.
- B. The Contractor and Engineer shall copy the City's PIO on all correspondence with citizens and property owners.

3.04 CUSTOMER SERVICE TRACKING SOFTWARE

- A. The Contractor shall use the City's Project Management Software to track and enter information from customers/citizens regarding complaints, claims and inquiries. All related information shall be updated on a daily basis. Tracking information and responses shall be coordinated with the City's PIO. Reports shall be provided as weekly updates on all activities and on specific cases within twenty-four (24) hours when requested.
- B. Information recorded shall include but not be limited to the following:

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1. Date complaint/claim/inquiry received.
2. Name, address and telephone number of individual filing complaint/claim/inquiry.
3. Nature of complaint/claim/inquiry.
4. Address where problem is located if different than above.
5. Action required, date, action taken, date action completed.
6. Follow-up with person who filed under 2 above to verify satisfaction or status.
7. Documents associated with actions taken.
8. Any information regarding resolution with the Contractor's, Subcontractor's or Vendor's Insurance Company shall be fully documented.

3.06 IDENTIFICATION BADGES AND SECURITY

- A. All members of the Contractor's staff and his subcontractor's permanent staff at or above the level of foreman who will be working on-site will be issued an ID badge by the City. The ID badge will list the worker's name and company Affiliation and will include a picture.
- B. A template will be provided by the PIM and shall be returned to the Office of Security and Safety when updated with the above information for signature by the Director of Security and Safety.
- C. It shall be the Contractor's responsibility to collect the ID badges from any employee who is discharged or resigns prior to completion of the project as well as at completion of the project. The Contractor shall return all ID badges to the Office of Security and Safety within 48 hours of their collection. The Contractor will be charged a fee of **\$25.00** per badge for any badge not returned at completion of the project. For any ID badges lost during the term of the project that must be reissued, there will be a charge of **\$15.00** per ID badge. The Contractor shall deduct these charges from his periodic or closeout payment request or the City will deduct.
- D. Since lower-level personnel of the Contractor, Subcontractor or Vendor will not be issued ID badges, the Contractor must maintain a daily sign-in sheet for daily workers under his supervision. The Superintendent must be able to identify any employee on the site as a bona fide worker if asked and if not able to identify, the Engineer will direct the Superintendent to remove the individual from the site. The Contractor and Subs or Vendors will provide a program of temporary ID badges and/or laminated on-site passes that must be cross-referenced to each day's

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employee timecard/payroll sheet with unique employees' numbers. Any employee that will be on the Project over thirty (30) days will be issued a picture ID with the employee number prominently shown. Any employee possessing an ID badge must wear that badge visibly at all times on the Project. The Contractor is responsible for maintaining a safe "drug-free" work environment.

- E. The Contractor shall develop a Security Plan for use on the job site during construction. The Plan shall encompass as a minimum such topics as the use of pre-employment background checks for specific project staff, drug tests, crime prevention and anti-theft procedures, workplace violence and methods to secure project documents. All staff working on the site shall be familiar with the requirements of the Security Plan.
- F. City Ordinances prohibit the carrying of weapons on City streets. The City of Atlanta Police Department will be notified of any person bringing weapons to the jobsite; they will be removed immediately and prosecuted.
- G. All of the Contractor's staff at or above the level of foreman shall attend a 4-hour mandatory CMG Security Training session conducted by the Office of Security and Safety. Multiple training sessions will be offered, and staff must complete the training at least within 1 month of commencing work on the jobsite. All costs associated with the training will be considered as incidental to the Contract.
- H. Persons on the jobsite shall report any suspicious activity by workers or by others at the jobsite area first to the Project Management, and/or Atlanta Police Department by calling 911 and immediately to the Director of Security and Safety.
- I. Non-invasive temperature screenings will be conducted prior to allowing access to the jobsite. Screening includes:
 - Answering questions about symptoms prior to entering worksite
 - Temperature check

Results of any screenings will be confidential and will only be recorded in the event the individual is denied entry into the job site.

3.07 SCHEDULE

- A. The Contractor shall provide the City's PIO with a copy of the detailed project schedule following approval by the Engineer.
- B. Bi-weekly, the Contractor shall provide a list of properties:
 1. That will be affected by the Contractor's activities within the upcoming 4 weeks;

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2. Where work is ongoing in the right of way in front or in the back of the property;
 3. Where site restoration activities are ongoing.
- C. The Contractor shall inform the City's PIO through the weekly progress meetings and in writing of any project schedule changes or changes in "disruptive work" such as blasting, road closures, etc., that would have significant impact on citizens or require prior citizen notification. The Contractor shall notify the City's PIO of any "disruptive" activities affecting the public that occur on the jobsite within 4 hours of their occurrence.

3.08 MAPS

The Contractor will provide the assigned City's PIO with a map of each project area assigned by task order, including the proposed and existing sewer overlays. The map will include property lines and addresses, so the Contractor can identify the areas of impacted properties.

3.09 MEDIA RELATIONS AND JOB SITE INQUIRIES

- A. As specified above in paragraph 3.01, only authorized persons shall release any information to media inquiries. The Contractor's field personnel shall at all times have project information cards available that will be provided to media and citizens if inquiries are made on-site. All inquiries shall be directed to the person referred to on the card and citizens shall be referred to the DWM Project Hotline telephone number (404-546-3200) and the www.Atlantawatershed.org website
- B. Project information cards shall be produced by the Contractor from the template provided by the DWM Office of Communications and Community Relations. Final language to be included on the Project Information Card will be provided.

3.10 TRAINING

- 3.10.01. All of the Contractor's staff at or below the level of superintendent shall attend a mandatory Public Relations Training and Protocol Procedures Training. The purpose of this training is to teach construction crews on how to deal with citizens, the media, etc. and how to conduct themselves on the jobsite. This training is approximately one (1) hour in length and will be facilitated by City staff at a designated City facility. Training will be provided at no cost to the Contractor.

3.2 VEHICLES SIGNS & PROJECT SITE SIGNAGE

- A. The Contractor shall place the COA logo, project name, help line number, and website address on all magnetic vehicle signs specified in Specification Section 01580, Project Identification and Signs. Vehicle signs shall be installed on all vehicles used for Work on

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this project. A signage template will be provided by the DWM Office of Communications and Community Relations and produced by the Contractor.

- B. Note: The cost for the production, installation and maintenance of the signs will be paid for through the respective unit price bid items, in accordance with specification Section 01580, Project Identification and Signs.
- C. All project sites shall have pre-approved project signs which read in accordance with the Template provided as part of the Special Conditions Signs shall be produced by the Contractor. Some of the signs shall be mounted on moveable skids so they can be relocated as the project progresses on various streets in the basin. Sizes will vary, but all will be smaller than the 96"x 48" size project signs shown. Size shall be as directed by the Engineer. Contractor shall provide a minimum of 25 project signs. These signs are required in addition to the four City of Atlanta Project signs identified in the Special Conditions.

3.2.01 NOTIFICATIONS

- A. The Contractor shall provide the following notifications to the City's PIO and the City's PIM to facilitate communication to affected citizens through automated phone message or mailers:
 - 1. Anticipated work start date-must be three (3) weeks prior so the City's PIO may send out two (2) week notice mailer.
 - 2. Service disruptions-notify the City's PIO at least 72 hours in advance so that 48-hour notice automated phone message notice may be issued.
 - 3. Street Closure or Partial Closure-notify the City's PIO at least 72 hours in advance to permit 48-hour automated phone message.
 - 4. Significant work in neighborhood- blasting, directional drilling, trenchless installation, smoke testing, dye testing, open cut, etc.-notify the City's PIO at least 72 hours in advance to permit 48-hour automated phone message.
- B. The Contractor shall provide the following door hanger notifications and the manpower to deliver them at a minimum:
 - 1. Service disruptions- notice to citizens 24 hours prior to disruption.
 - 2. Street Closure or Partial Closure - notify fire, police other emergency services and other authorities 24 hours prior to street closure.
 - 3. Significant work in neighborhood- blasting, directional drilling, trenchless installation, open cut, etc.-notify citizens via door hangers 24 hours in advance.

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- C. The Contractor shall be fully responsible for notification to all emergency related services for detours, closures (partial or full) or traffic pattern changes and as such they must be detailed in their traffic control plan and implemented through the Contractor's Traffic Control Manager and per all permitting requirements.
- D. The Contractor shall be fully responsible for distributing all notifications a minimum of 48 hours in advance of service outages for schools, nursing homes, hospitals, medical clinics, assisted living facilities or other types of facilities. Contractor shall also make personal contact with facility representatives no later than 60 minutes prior to the outage.
- E. The Contractor shall at all times coordinate with the City's Office of Communications and Community Relations and Call Center to provide detailed schedules and street locations for service disruptions or street closures to ensure that Call Center is well equipped to provide adequate response to citizen inquiries.

3.2.02 RESPONSES AND RESOLUTION OF CITIZEN INQUIRIES

- A. Customer Service Tracking Software: The Contractor shall use the City's Project Management Software to enter status information and track inquiries related to the project. The City Call Center attendant shall create the initial file and enter information for resident and property owner complaints and/or claims. This information shall be updated on daily bases. Tracking information and responses shall be coordinated with the Contractor and City's PIO.
- B. When a City of Atlanta's Call Center attendant informs the Contractor of a citizen inquiry or complaint, the Contractor shall respond immediately to the call center if the inquiry is related to an emergency situation. If the inquiry is general, the contractor's response is required within 24 hours to the call center with an update on the resolution status. The citizen's name date and time of call and complaint shall be documented and tracked by the Contractor using the City's Project Management Software database, which will assign a complaint tracking number. The complaint information will be transmitted to the Contractor and PIO within 24 to 48 hours. The citizen will receive a follow-up call from the call center with the status information on the resolution of the problem within 24 hours, and additional follow-up calls until the problem is resolved.
- C. Unresolved inquiries will be reviewed at project progress meetings. At this time, the City's PIO will review open inquiries and the Contractor's Representative will facilitate follow-up on resolution.

3.2.03 RESOLUTION OF COMPLAINTS AND CLAIMS

Failure of the Contractor to resolve any legitimate complaint or claim filed resulting from the work performed under this contract, following notice in accordance with the contract agreement, may result in resolution of the complaint or claim by the City. The Contractor will be charged for the associated cost in accordance with the applicable sections of the

contract. No additional payment will be made to the Contractor for any costs associated with complaint or claim resolution, same being incidental to the various contract items which are bid. Failure to manage the issues and items adequately to minimize public complaints and impacts will be cause for increasing the retainage, withholding payment and/or Notice and Termination of the Contractor cause if more than 10% of the noticed complaints or claims age past 30 days without decisive resolution and scheduling of recovery work.

3.2.04 PROJECT UPDATES

The Contractor will provide monthly project updates regarding significant progress, notable changes, and any consent decree milestones to be used by the DWM Office of Communications and Community Relations staff to update the Atlantawatershed.org website, project materials, monthly and quarterly reports.

3.2.05 RIGHTS OF ENTRY AND ACCESS TO PRIVATE PROPERTY

- A. The Contractor is required to coordinate with the Office of Engineering Services Land and Easement Group regarding any agreements with the property owner(s) to access or work outside of the City's existing easements or rights of way or any agreements related to property restoration, as may be necessary for the Work or at the convenience of the Contractor. Such coordination shall include the following:
1. Maintaining a contact log with, but not limited to, all: contact names, addresses and phone numbers; all attempts (with date, name, and notes of conversation) via telephone, in person, or via written correspondence. The Contractor must maintain copies of all written correspondence with the property owner(s) and/or tenant(s), and provide the City with Copies, if directed by the City or already required as part of this Section;
 2. Assuming responsibility relating to the private property access and any agreements reached between the Contractor and the Property Owner;
 3. Taking any other steps as reasonably necessary to adequately protect the interests of Contractor, the private property owner and the City with respect to the accessing the City's existing easement areas;
- B. The Contractor is required to work within the City's existing easement areas and rights of way at all times; however, at the Contractor's convenience and if agreed upon between the Contractor and the Property Owner the Contractor may follow a route other than along the City's right of way alignment. In such case, the Contractor must have a written agreement with the Property Owner to document the terms and conditions of the Work and/or property

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restoration, which shall be subject to the City's review and approval. Any such agreement shall be at the Contractor's expense.

- C. The Contractor must identify all parcels requiring access or Work associated with the project, including parcels owned by: CSX, Norfolk Southern, Georgia Power, Fulton County, DeKalb County, Atlanta Housing Authority, MARTA, Schools, or City owned parcels under the purview of another department, within the first 30 days after the NTP has been officially delivered to the Contractor. Permits and agreements with such property owners to perform Work may be required as a condition of commencement of Work on properties owned by such entities. As such, Contractor shall cooperate with the City to negotiate and enter into appropriate agreements with such property owners to prior to commencement of Work in a form acceptable to the City.
- D. The Contractor must identify all areas where the Contractor believes it is physically impossible to perform the work in the existing easement area within the first 30 days after the NTP has been officially delivered to the Contractor. If any such area exists, the Contractor must state in writing the property information (address and tax PIN), the work to be performed, and the reason they believe it is impossible to work within the easement area. If the City deems it is impossible to perform the work in the City's existing easement area and/or rights of way, the City will proceed with the acquisition of required temporary construction easement or other interests necessary to perform the Work. The City will make the ultimate decision regarding the ability or inability of the work to be performed within the existing easement area and shall provide such determinations in writing to the Contractor. In the instances for which formal acquisition processes must occur, Contractor shall take all available steps to prioritize work in other areas to avoid delays in overall project work. The City shall not be responsible for unapproved damage to private properties or deviations from the rights of way and/or easement areas for the convenience of the Contractor.
- F. Contractor must, in all dealings with private property owners concerning this type of access to their property, advise that the Contractor is an independent contractor and is not seeking or obtaining access to private property on behalf of the City. Contractor must include this advisement in all written communications with any private property owner, as well as all documents evidencing or relating to agreed access to private property. Contractor may at any time during the course of performing the Work request clarification of the City's existing easements and/or rights of way through an RFI process.

ATTACHMENT A

Citizens Comments Response

PROJECT #

PROJECT NAME:

Basic Data

Contact ID:

First Name	Last Name	Council District / NPU			
<input type="text"/>	<input type="text"/>	<input type="text"/>			
Address	Number	Street Name	St, Ave, etc.	Apt. #	Zip
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
Home Phone	() -	Work Phone	() -		
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>		
Email :	<input type="text"/>			Outside Project Area	Y___ N___
<input type="text"/>				<input type="text"/>	<input type="text"/>
Notes:	<input type="text"/>				
<input type="text"/>					

Comments / Complaints / Request

Comment Date	<input type="text"/>	Engineer needs	Y___ N___
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
Comment / Complaint:	<input type="text"/>		
<input type="text"/>			

Response

Response Date	<input type="text"/>	Is Follow-up Required	Y___ N___
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
Who Responded	<input type="text"/>		
<input type="text"/>			
Response Given:	<input type="text"/>		
<input type="text"/>			

SECTION 01400
QUALITY ASSURANCE/QUALITY CONTROL

PART 1 GENERAL

1.01 SCOPE

- A. This section includes requirements for the implementation of the Contractor's quality assurance and quality control program.
- B. (Not Used)

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 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 Architect, 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 Architect or Construction Manager.
- 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 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 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 of Sub-subcontractor, to perform a particular construction operation, including installation, erection, application and similar operations.
 - 1. Use of trade-specified 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 scope of 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 requirements. Refer conflicting requirements that are different, but apparently equal to Engineer for 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 quality or quantity 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 Engineer for a decision before proceeding

1.05 SUBMITTALS

- A. Contractor’s Quality-Control Plan: For quality assurance and quality-control activities and responsibilities.

- B. Qualification Data: For testing agencies specified in “Quality Assurance” Article to determine 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.
- C. 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 SITE INVESTIGATION AND CONTROL

- A. Contractor shall check and verify all dimensions and conditions in the field continuously during construction. Contractor shall be solely responsible for any inaccuracies built into the Work due to Contractor’s and subcontractor’s failure to comply with this requirement.
- B. Contractor shall inspect related and appurtenant Work and report in writing to the Engineer any conditions that will prevent proper completion of the Work. Failure to report any such conditions shall constitute acceptance of all Site conditions, and any required removal, repair, or replacement caused by unsuitable conditions shall be performed by the Contractor solely and entirely at Contractor’s expense.

1.07 INSPECTION OF THE WORK

- A. All work performed by the Contractor and subcontractors shall be inspected by the Contractor and non-conforming Work and any safety hazards in the work area shall be noted and promptly corrected. The Contractor is responsible for the Work to be performed safely and in conformance to the Contract Documents.
- B. The Work shall be conducted under the general observation of the Engineer and is subject to inspection by representatives of the City acting on behalf of the City to ensure strict compliance with the requirements of the Contract Documents. Such inspection may include mill, plant, shop, or field inspection, as required. The Engineer or any inspector(s) shall be permitted access to all parts of the Work, including plants where materials or equipment are manufactured or fabricated.
- C. The presence of the Engineer, or any inspector(s), however, shall not relieve the Contractor of the responsibility for the proper execution of the Work in accordance with all requirements of the Contract Documents. Compliance is the responsibility of the Contractor. No act or omission on the part of the Engineer, or any inspector(s) shall be

construed as relieving Contractor of this responsibility. Inspection of Work later determined to be non-conforming shall not be cause or excuse for acceptance of the non-conforming Work. The City may accept non-conforming Work when adequate compensation is offered, and it is in the City's best interest as determined by the City.

- D. All materials and articles furnished by the Contractor or subcontractors shall be subject to rigid documented inspection, by qualified personnel, and no materials or articles shall be used in the Work until they have been inspected and accepted by the Contractor's Quality Control representative and the Engineer or other designated representative. No Work shall be backfilled, buried, cast in concrete, covered, or otherwise hidden until it has been inspected. Any Work covered in the absence of inspection shall be subject to uncovering. Where uninspected Work cannot be easily uncovered, such as in concrete cast over reinforcing steel, all such Work shall be subject to demolition, removal, and reconstruction under proper inspection at the Contractor's expense.
- E. All materials, equipment and/or articles furnished to the Contractor by the City shall be subject to rigid inspection by the Contractor's Quality Control representative before being used or placed by the Contractor. The Contractor shall inform the Engineer, in writing, of the results of said inspections within one working day after completion of inspection. In the event the Contractor believes any material or articles provided by the City to be of insufficient quality for use in the Work, the Contractor shall immediately notify the Engineer.

1.08 TIME OF INSPECTION AND TESTS

- A. Samples and test specimens required under these Specifications shall be furnished and prepared for testing in ample time for the completion of the necessary tests and analyses before said articles or materials are to be used. The Contractor shall furnish and prepare all required test specimens at Contractor's own expense.
- B. Whenever the Contractor is ready to backfill, bury, cast in concrete, hide, or otherwise cover any Work under this Contract, the Engineer shall be notified not less than three workdays in advance to request inspection before beginning any such Work of covering. Failure of the Contractor to notify the Engineer at least three workdays in advance of any such inspections shall be reasonable cause for the Engineer to order a sufficient delay in the Contractor's schedule to allow time for such inspection. The costs of any remedial or corrective work required, and all costs of such delays, including its impact on other portions of the Work, shall be borne by the Contractor.

1.09 SAMPLING AND TESTING

- A. The Contractor shall retain and pay for an independent materials testing agency approved by the Engineer and the City of Atlanta as required by the General Conditions. This independent testing agency will develop and submit a testing plan for quality assurance on each type of work activity. The testing agency will document the processes and procedures utilized to verify and maintain quality work. When not otherwise specified, all

sampling and testing shall be in accordance with the methods prescribed in the most current standards, as applicable to the class and nature of the article or materials considered. However, the Engineer reserves the right to use any generally accepted system of inspection which, in the opinion of the Engineer, will ensure the Engineer that the quality of the workmanship is in full accord with the Contract Documents.

- B. The City reserves the right to abbreviate, modify the frequency of or waive tests or quality assurance measures, but waiver of any specific testing or other quality assurance measure, whether or not such waiver is accompanied by a guarantee of substantial performance as a relief from the specified testing or other quality assurance requirements as originally specified, and whether or not such guarantee is accompanied by a performance bond to assure execution of any necessary corrective or remedial work, shall not be construed as a waiver of any technical or qualitative requirements of the Contract Documents.
- C. Notwithstanding the existence of such waiver, the City shall reserve the right to make independent investigations and tests as specified in the following paragraph and failure of any portion of the Work to meet any of the qualitative requirements of the Contract Documents, shall be reasonable cause for the City to require the removal or correction and reconstruction of any such Work.
- D. In addition to any other inspection or quality assurance provisions that may be specified, the City shall have the right to independently select, test, and analyze, at the expense of the City, additional test specimens of any or all of the materials to be used. Results of such tests and analyses shall be considered along with the tests or analyses made by the Contractor to determine compliance with the applicable specifications for the materials so tested or analyzed provided that wherever any portion of the Work is discovered, as a result of such independent testing or investigation by the Engineer, which fails to meet the requirements of the Contract Documents, all costs of such independent inspection and investigation and all costs of removal, correction, reconstruction, or repair of any such Work shall be borne by the Contractor.

1.10 CONTRACTOR'S QUALITY CONTROL REQUIREMENTS

- A. The Contractor shall establish and execute a Quality Control (QC) program for the services that are being procured from the Contractor. The program shall provide the Contractor with adequate measures for verification and conformance to defined requirements by the Contractor's personnel and subcontractors (including fabricators and suppliers). This program shall be described in a Plan responsive to this Section. It shall utilize the services of an independent testing agency/company that is industry certified to provide quality assurance and compliance with the standards specified.
- B. The Contractor shall furnish the Engineer a project specific QC Plan. The Plan shall contain a comprehensive account of Contractor's QC procedures as applicable to this job. The Contractor shall furnish for review by the Engineer, no later than 14 days after receipt of notice to proceed, the QC plan proposed to be implemented. The plan shall

identify personnel, procedures, control, instructions, tests, records, and forms to be used. Construction will be permitted to begin only after acceptance of the QC Plan. The detailed requirements for this Plan are delineated in the following paragraphs. No payments will be made to the Contractor until the QC Plan is fully accepted by the Engineer.

- C. The QC Plan shall describe and define the personnel requirements described herein. The Contractor shall employ a full-time on-site QC Manager to manage, address and resolve all quality control issues.
1. The QC Manager shall be as identified by the Contractor and approved by the City. The QC Manager shall have a minimum of five (5) years of construction experience in pipeline installation. The QC Manager shall be onsite at all times while work is being performed by the contractor, to remedy and demonstrate that work is being performed properly and to make multiple observations of all Work in progress. This individual shall be dedicated solely to QC activities and shall have no supervisory or managerial responsibility over the work force. The QC Manager shall not be assigned any other duties or roles by the Contractor.
 2. The Contractor shall provide additional personnel who are assigned to assist the QQC Manager as required to fulfill the requirements of the QC Plan. The Contractor shall provide a copy of the letter to the QC Manager signed by an authorized official of the firm which describes the responsibilities and delegates sufficient authorities to adequately perform the functions of the QC Manager, including authority to stop work which is not in compliance with the contract. The QC Manager shall issue letters of direction to all other various quality control representatives outlining duties, authorities, and responsibilities. Copies of these letters shall also be furnished to the Engineer.
- D. The Contractor's QC program shall ensure the achievement of adequate quality throughout all applicable areas of the Project. A customized QC Plan shall be developed that discusses each type of work that the Contractor is responsible for within the Project. The QC Plan shall describe the program and include procedures, work instructions and records and a description of the quality control organization.
1. The description of the quality control organization shall include a chart showing lines of authority staffing plan and acknowledgment that the QC staff shall implement the system for all aspects of the work specified. The staffing plan shall identify the name, qualifications (in resume format), duties, responsibilities, and authorities of each person assigned a QC function including the QC Manager.
 2. In addition, the Plan shall describe methods relating to areas that require special testing and procedures as noted in the specifications.

- E. Identification and Control of Items and Materials: Procedures to ensure that items or materials that have been accepted at the site are properly used and installed shall be described in the QC Plan.
- F. The procedures shall provide for proper identification and storage and prevent the use of incorrect or defective materials.
- G. Inspection and Tests: The Contractor shall have written procedures defining a program for control of inspections performed and these procedures shall be described in the QC Plan. The QC Plan shall include a comprehensive schedule of Work requiring
 - 1. Inspections and tests shall be performed and documented by qualified individuals. At a minimum, "qualified" shall mean having performed similar QC functions on similar type projects for a minimum of five (5) years and possession of industry standards certification and license. Records of personnel experience, training and qualifications shall be submitted to the Engineer for review and approval.
 - 2. The Contractor shall maintain and provide to the Engineer, within two working days of completion of each inspection and test, adequate records of all such inspections and tests. Inspection and test results shall be documented and evaluated to ensure that requirements have been satisfied.
 - 3. The QC Plan shall be a comprehensive schedule of Work requiring testing or inspection, including the following:
 - a. Contractor-performed tests and inspections including subcontractor-performed tests and inspections. Include required tests and inspections and Contractor-elected tests and inspections. Contractor-performed tests and inspections cannot be performed by the Special Inspector.
 - b. Special inspections required by authorities having jurisdiction and indicated on the "Statement of Special Inspections."
 - c. Owner-performed tests and inspections indicated in the Contract Documents
- 3. Procedures shall include:
 - a. Specific instructions defining procedures for observing all Work in process and comparing this Work with the Contract requirements (organized by specification section).
 - b. Maintaining and providing daily QC inspection reports. Such reports shall, at a minimum, include the following:
 - i. Dated list of Item(s) inspected
 - ii. Project title and number

- iii. Name, address and telephone number of testing agency
 - iv. Dates and location of the test sample(s)
 - v. Names of individuals making tests and inspections
 - vi. Identification of product and Specification Section
 - vii. Logs, detailed locational drawings and confirmation reports
 - viii. Record of temperature and weather conditions at time of sample taking and testing and inspecting
 - ix. Quality characteristics in compliance
 - x. Quality characteristics not in compliance
 - xi. Corrective/remedial actions taken
 - xii. Statement of certification
 - xiii. QC Manager's signature
- c. Specific instructions for recording all observations and requirements for demonstrating through the reports that the Work observed was in compliance or a deficiency was noted and action to be taken.
 - d. Procedures to preclude the covering of deficient or rejected Work.
 - e. Procedures for halting or rejecting Work.
 - f. Procedures for resolution of differences between the QC representative(s) and the production representative(s).
 - g. Method of documenting QC process and results including:
 - i. Automatic exception reporting
 - ii. Resolution tracking
 - iii. Quality Confirmation Test reports
 - iv. Sample retention index and storage
4. The QC Plan shall identify all contractual hold/inspection points as well as any Contractor imposed hold/inspections points.
5. The QC Plan shall include procedures to provide verification and control of all testing provided by the Contractor including:
- a. Individual test records containing the following information:
 - i. Item tested –item number and description
 - ii. Test results
 - iii. Test designation
 - iv. Test work sheet including location sample was obtained
 - v. Acceptance or rejection
 - vi. Date sample was obtained
 - vii. Retest information, if applicable

- viii. Control requirements
 - ix. Tester signature
 - x. Testing QC staff initials
 - b. Maintaining and providing to the Engineer daily testing records. Such records shall, at a minimum, contain the following:
 - i. Dated list of Item(s) inspected
 - ii. Location of the test sample(s)
 - iii. Logs, detailed location drawings and confirmation reports
 - iv. Quality characteristics in compliance
 - v. Quality characteristics not in compliance
 - vi. Corrective/remedial actions taken
 - vii. Statement of certification
 - c. QC Manager's signature providing for location maps/drawings (i.e. lift drawings, laying schedules, etc.) for all tests performed or location of Work covered by the tests.
 - d. Maintaining copies of all test results.
 - e. Ensuring Engineer receives independent copy of all tests.
 - f. Ensuring testing lab(s) are functioning independently and in accordance with the specifications.
 - g. Ensuring re-tests are properly taken and documented.
- H. Control of Measuring and Test Equipment: Measuring and/or testing instruments shall be adequately maintained, calibrated, certified and adjusted to maintain accuracy within prescribed limits. Calibration shall be performed at specified periods against valid standards traceable to nationally recognized standards and documented.
- I. Supplier Quality Assurance: The QC Plan shall include procedures to ensure that procured products and services conform to the requirements of the Specifications. Requirements of these procedures shall be applied, as appropriate, to subcontractors and suppliers. QA/QC inspections and certifications shall not be deferred to the Contractor's subcontractors or suppliers.
- J. Deficient, Defective and Non-conforming Work and Corrective Action
- 1. The QC Plan shall include procedures for handling of deficiencies and non-conformances. Deficiencies and non-conformances are defined as documentation, drawings, material, and equipment or Work not conforming to the specified requirements or procedures. The procedures shall prevent non-conformances by identification, documentation, evaluation, separation, disposition and corrective

action to prevent recurrence. Conditions having adverse effects on quality shall be promptly identified and reported to the senior level management. The cause of conditions adverse to quality shall be determined and documented and measures implemented to prevent recurrence. In addition, at a minimum, this procedure shall address:

- a. Personnel responsible for identifying deficient and non-complying items within the work.
 - b. How and by whom deficient and non-compliant items are documented “in the field”.
 - c. The personnel and process utilized for logging deficient and non-compliant work at the end of each day onto a Deficiency Log.
 - d. Tracking processes and tracking documentation for Deficient and Non-Compliant items.
 - e. Personnel responsible for achieving resolution of outstanding deficiencies.
 - f. Once resolved, how are the resolutions documented and by whom.
2. (Not Used)

K. Special Processes and Personnel Qualifications

1. The QC Plan shall include detailed procedures for the performance and control of special process (e.g. welding, soldering, heat treating, cleaning, plating, nondestructive examination, etc.).
2. Personnel performing special process tasks shall have the experience, training and certifications commensurate with the scope, complexity, or nature of the activity. They shall be approved by the Engineer before the start of Work on the Project.

L. Audits

1. The Contractor’s QC program shall provide for documented audits to verify that QC procedures are being fully implemented by the Contractor as well as its subcontractors. Audit records shall be made available to the Engineer upon request.
2. The Contractor shall provide to the City, a quarterly report indicating any outstanding and unresolved exceptions to the QC program or contract documents. The report will include documentation on any standards modifications, corrections, failed tests and a review of field procedures and checks and balances effectiveness.

M. Documented Control/Quality Records

1. The Contractor shall establish methods for control of Contract Documents that describe how Drawings and Specifications are received and distributed to assure the correct issue of the document being used. The methods shall also describe how as-built data are documented and furnished to the Engineer.
 2. The Contractor shall maintain evidence of activities affecting quality, including operating logs, records of inspections and tests, audit reports, material analyses, personnel qualification and certification records, procedures, and document review records.
 3. Quality records shall be maintained in a manner that provides for timely retrieval, and traceability. Quality records shall be protected from deterioration, damage, and destruction. The Contractor shall maintain an automated exceptions list of any non-conforming or defective or substandard work.
 4. The Contractor shall provide a list with specific records as specified in the Contract Documents which will be furnished to the Engineer at the completion of activities and in conjunction with logs and location drawings.
- N. Acceptance of QC Plan: The Engineer's review and acceptance of the Contractor's QC Plan shall not relieve the Contractor from any of its obligations for the performance of the Work. The Contractor's QC staffing is subject to the Engineer's review and continued acceptance. The City, at its sole option, without cause, may direct the Contractor to remove and replace the QC representative. No Work covered by the QC Plan shall start until the Engineer's acceptance of Contractor's QC plan has been obtained.
- O. The Engineer may perform independent quality assurance audits to verify that actions specified in Contractor's QC Plan have been implemented. No Engineer audit finding, or report shall in any way relieve Contractor from any requirements of this Contract.

1.11 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
 8. Complete test or inspection data
 9. Test and inspection results and an interpretation of test results
 10. Record temperature and weather conditions at time of sample taking and testing and inspecting

11. Comments or professional opinions on whether tested or inspected Work complies with the Contract Document requirements
 12. Name and signature of laboratory inspector
 13. Recommendations on retesting and reinspection
- 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 representatives 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 reports
 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.

1.12 QUALITY ASSURANCE

- A. General: Qualification 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. Fabricators 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. Install 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 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, mockups, and laboratory mockups to adequately demonstrate capability of products to comply with performance requirements.
 - d. Build site-assembled test assemblies and mockups using installers who will perform same tasks for Project.
 - e. Build laboratory mockups at testing facility using personnel, products, and methods of construction indicated for the completed Work.
 - a. f. When testing is complete, remove test specimens, assemblies, mockups, and laboratory mockups; 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 Architect and Owner, with copy to Contractor and to authorities having jurisdiction. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.
- K. Special Inspector: Special Inspectors shall meet the more stringent of the qualifications listed in this section and the requirements listed in the Statement of Special Inspections submitted to the Authority Having Jurisdiction on this site or otherwise required by the Authority Having Jurisdiction.

1.13 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:
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.
 3. Costs for retesting and reinspection 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 "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/Reinspection: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspection, for construction that replaced Work that failed to comply with the Contract Documents.
- F. Testing Agency Responsibility: Cooperate with Engineer, Architect and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
1. Notify Architect 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, Architect, testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

1.14 SPECIAL TESTS AND INSPECTIONS

- A. Special Tests and Inspection: It will be the owner's responsibility to contract for special inspections to conduct special tests and inspections required by authorities having jurisdiction as follows:
1. Verifying manufacturer's certification by submittal of documentation.
 2. Notifying Architect, Owner 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 Architect and Owner, with copy to Contractor and to authorities having jurisdiction.
 4. Interpreting tests and inspections and stating in each report whether tested and inspected work complies with or deviates from the Contract Documents.
 5. Retesting and reinspection corrected work.
 6. Submitting a final report of special tests and inspections at Substantial Completion, which shall include descriptions of satisfactory resolutions achieved for all previously reported deficiencies.

1.15 TESTING SERVICES

- A. All tests which require the services of a laboratory to determine compliance with the Contract Documents shall be performed by an independent commercial testing firm acceptable to Engineer. The testing firm's laboratory shall be staffed with experienced technicians, properly equipped and fully qualified to perform the tests in accordance with the specified standards. All standard quality assurance testing and installation verification testing will be at the expense of the Contractor.
- B. Testing, when required, will be in accordance with all pertinent codes and regulations and with procedures and requirements of the American Society for Testing and Materials (ASTM).
- C. The Engineer shall have the right to inspect work performed by the independent testing laboratory both at the project and at the laboratory. This shall include inspection of the manual, equipment calibrations, proficiency sample performance, etc.).
- D. Testing services provided by the City, if any, are for the sole benefit of the City; however, test results shall be available to the Contractor. Testing necessary to satisfy Contractor's internal quality control procedures shall be the sole responsibility of Contractor.
- E. Testing Services Provided by the Contractor
 - 1. Unless otherwise specified, and in conjunction with, all other specified testing requirements, the Contractor shall provide the following testing services, and submit a detailed testing plan for each along with proposed forms for Engineer's review:
 - 2. Moisture-density and relative density tests on embankment, fill, and backfill materials.
 - 3. In-place field density test on embankments, fills and backfill.
 - 4. QC testing of all precast and/or pre-stressed concrete
 - 5. All other tests and engineering data required for the Engineer's review of materials and equipment proposed to be used in the Work
 - 6. In addition, the following QC tests shall be performed by the Contractor:
 - a. Holiday testing of pipeline and all other coatings systems applied to surfaces as required by the Engineer
 - b. Slumps, air bucket tests, compression tests and other confirmation tests

- c. Air testing of field-welded joints for steel pipe or pipe cylinders and fabricated specials.
 - d. All testing and inspection of welding work including, but not limited to, welding procedure qualifications, welder operator qualifications, all work performed by the certified welding inspector, all appropriate nondestructive testing of welds and all repair and retest of weld defects.
7. Testing, including sampling, shall be performed by the Contractor's testing firm's laboratory personnel, in the manner and frequency indicated in the Specifications. The Engineer shall have the right to stipulate the location of the confirmation tests. The Contractor shall provide preliminary representative samples of materials to be tested, to the testing firm's laboratory, in required quantities.
 8. The testing firm's laboratory shall perform all laboratory tests within a reasonable time consistent with the specified standards and will furnish a written report of each test.
 9. Where such inspection and testing are to be conducted by an independent laboratory agency, the sample or samples shall be selected by such laboratory or agency or the Engineer and shipped to the laboratory by the Contractor at Contractor's expense.
 10. Notify laboratory sufficiently in advance of operation to allow for the assignment of personnel and schedules of tests.

F. Transmittal of Test Reports:

1. Written reports of tests and engineering data furnished by Contractor for Engineer's review of materials and equipment proposed to be used in the Work shall be submitted as specified for Shop Drawings. Final transmittal of all Project testing records will be required as a final close-out submittal for the release of retainage.
2. 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 progress of the Work.

PART 2 PRODUCTS

(NOT USED)

PART 3 EXECUTION

3.01 REPAIR AND PROTECTION

Water Supply Tunnel Connection to Chattahoochee Water Treatment Plant

- 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. Comply with the Contract Document requirements for cutting and patching.
 2. Protect construction exposed by or for quality-control service activities.
 3. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

+++ END OF SECTION 01400 +++

**SECTION 01410
TESTING LABORATORY SERVICES**

PART 1 - GENERAL

1.01 SCOPE

- A. From time to time during progress of the Work, the Engineer may require that testing be performed to determine that materials provided for the Work meet the specified requirements, in accordance with the requirements of the Specifications. Such testing includes, but is not necessarily limited to:
 - 1. Cement
 - 2. Aggregate
 - 3. Concrete
 - 4. Concrete block
 - 5. Pipe
 - 6. Steel and metals
 - 7. Welding
 - 8. Soil compaction
 - 9. Bituminous pavement
- B. Requirements for testing may be described in various sections of these Specifications; where no testing requirements are described but the Engineer decides that testing is required to demonstrate compliance with specified material or performance standards, the Engineer may require testing to be performed under current pertinent standards for testing.
- C. Employment of a testing laboratory shall in no way relieve the Contractor of Contractor's obligation to perform work meeting the requirements of the Contract.
- D. The independent testing laboratory shall be selected and paid by the Contractor and approved in writing by the Engineer before any testing services are performed.
- E. The Contractor shall pay directly for the services of the independent testing laboratory, approved by the Engineer, for all testing required under this Contract.

1.02 LABORATORY DUTIES

- A. Cooperate with Engineer and Contractor.
- B. Provide qualified personnel promptly on notice.
- C. Perform specified inspections, sampling and testing of materials and methods of construction.
 - 1. Comply with specified standards, ASTM, other recognized authorities and as

specified.

2. Ascertain compliance with requirements of Contract Documents.
- D. Promptly notify Engineer and Contractor of irregularity or deficiency of work which are observed during performance of services.
- E. Promptly submit three (3) copies (two (2) copies to Engineer and one (1) copy to Contractor of report of inspections and tests in addition to those additional copies required by the Contractor including:
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 Contract Documents
- F. Perform additional services as required.
- G. Laboratory is not authorized to:
1. Release, revoke, alter or enlarge on requirements of Contract Documents.
 2. Approve or accept any portion of Work.

1.03 CONTRACTOR RESPONSIBILITIES

- A. Cooperate with laboratory personnel, provide access to Work and/or manufacturer's requirements.
- B. Provide to laboratory, preliminary representative samples, in required quantities, of materials to be tested.
- C. Furnish copies of mill test reports.
- D. Furnish required labor and facilities.
 1. To provide access to Work to be tested
 2. To obtain and handle samples at the site

Water Supply Tunnel Connection to Chattahoochee Water Treatment Plant

3. To facilitate inspections and tests
 4. Build or furnish a holding box for concrete cylinders or other samples as required by the laboratory.
- E. Notify 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 or samples 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.

1.04 QUALITY ASSURANCE

- A. Testing, when required, will be in accordance with all pertinent codes and regulations and with procedures and requirements of the American Society for Testing and Materials (ASTM).
- B. (Not Used)

1.05 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 progress of the Work.
- B. (Not Used)

1.06 FURNISHING MATERIALS

- A. The Contractor shall be responsible for furnishing all materials necessary for testing.
- B. (Not Used)

1.07 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.
- B. (Not Used)

1.08 CONTRACTOR'S CONVENIENCE TESTING

- A. Inspection or testing performed exclusively for the Contractor's convenience shall be

the sole responsibility of the Contractor.

B. (Not Used)

1.09 SCHEDULES FOR TESTING

A. Establishing Schedule

1. The Contractor shall, by advance discussion with the testing laboratory 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.
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.

1.10 TEST AND CERTIFICATIONS

A. General: As a minimum, the following tests shall be performed and the following certifications provided:

1. Cement: Certified test results by cement manufacturer or by independent laboratory shall be furnished as required by the Engineer.
2. Aggregate and Mortar Sand: Certified test results by aggregate producer or by independent laboratory shall be furnished as required by the Engineer.
3. Concrete
 - a. At least five (5) standard 6-inch cylinders shall be taken each day for each 100 cubic yard or fraction thereof for each class of concrete used.
 - b. The number of cylinders, the point of sampling, and the method of securing the samples shall be determined by the Engineer.
 - c. The five (5) samples shall be taken to the testing laboratory for laboratory curing.
 - d. Two (2) of the laboratory cured samples shall be tested at 7 days, two (2) samples tested at 28 days; one (1) sample in reserve.
 - e. Test all concrete in accordance with ASTM C31-69, C39-71 and C-172.
4. Slump Tests
 - a. Perform slump tests on the job in accordance with ASTM standards.
 - 1) One (1) slump test shall be performed for each 25 cubic yards of concrete.
 - 2) More slump tests shall be performed if deemed necessary by the Engineer.

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- b. Perform air entrainment tests in accordance with the following standards:
 - 1) Field tests - ASTM C 173
 - 2) Laboratory tests - ASTM C 231
- B. Precast and Concrete Block for Buildings
 - 1. Concrete mixes used for precast items are subject to review and approve by the Engineer before casting and delivery of the items to the site.
 - 2. Block and precast may be visually inspected on the site by the Engineer. The mix design used in forming concrete or masonry block is also subject to review and approval by the Engineer.
 - 3. The Engineer reserves the right to have the concrete block tested by an independent laboratory.
- C. Steel and Miscellaneous Metal: Reinforcing steel, structural steel and miscellaneous metal may be inspected visually on the site by the Engineer.
- D. Welding: Per Structural Specification requirements.
- E. Compaction of Earthwork
 - 1. The compaction shall be tested by the Engineer or by an independent laboratory.
 - 2. The testing shall be performed in a manner in accordance with these Specifications.
- F. Bituminous Concrete: The material testing for the bituminous concrete shall be performed by an independent laboratory as deemed necessary by the Engineer.

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.
- B. (Not Used)

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.
- B. (Not Used)

+++ END OF SECTION 01410 +++

**SECTION 01500
FIELD OFFICES AND SHEDS**

PART 1 GENERAL

1.01 DESCRIPTION

- A. The Contractor shall provide all field offices and sheds as necessary for completion of the Work as specified herein.
- B. The Contractor shall maintain offices and sheds in proper and safe condition through the progress of the Work. In the event of loss or damage, the Contractor shall immediately make all repairs and replacements necessary subject to approval of the Engineer and at no additional cost to City. At completion of the Work, the Contractor shall remove all offices and sheds as directed by the Engineer.
- C. The ownership of the trailers for Engineer's facilities shall remain with the Contractor. Office furnishings and equipment provided by Contractor may be rented or purchased by the Contractor and are not required to be turned over to the City at the completion of the project.

1.02 SUBMITTALS

- A. Submittals shall be made in accordance with the requirements of the General Conditions of the Contract Documents.
- B. Engineer's Field Office: Submit a plan of the office layout to Engineer for mark-up and approval within 10 days after the Notice to Proceed. Submittal shall depict:
 - 1. Field trailer dimensions, including dimensions for each room.
 - 2. Furnishings and equipment sizing, layouts, and locations inside the trailer.
 - 3. Locations of wall outlets.
 - 4. Porch layouts exterior to the trailer.
 - 5. Routing for temporary utility connections to the trailer (water, sewer, electrical, internet, etc.)
 - 6. Security system details.
 - 7. Rain and outside thermometer locations.
- C. Telephone System: Not required.
- D. Submit a site utilization plan for review and approval by the Engineer. The plan will generally need to show locations of trailers, storage sheds, Contractor's parking, temporary utility line routing, equipment and material storage and staging, etc.
 - 1. Note that as there are other Contractors engaged at the site, the Owner and Engineer will participate in coordinating the site utilization plan with other Contractors at the site to minimize work and access conflicts.

2. The Owner generally anticipates that the trailers and parking areas will be located outside the motorized gate to facilitate temporary utility connections

1.03 REQUIREMENTS

B. General

1. The materials, equipment, and furnishings provided under this Section shall be new and shall meet all the applicable codes and regulations.
2. Make all provisions, and pay all costs of furnishing, installation, maintenance, professional services, permit fees, and site work for the temporary facilities.

B. Construction

1. Temporary buildings shall be structurally sound, weather tight, with floors raised above ground. All mobile/modular buildings shall comply with GA-DCA/SBCC/ADA requirements and shall be Williams-Scottsman or equal.
2. Temporary buildings shall have temperature transmission resistance compatible with occupancy and storage requirements.

PART 2 PRODUCTS

2.01 CONTRACTOR'S FACILITIES

- A. Contractor's Plant: Contractor's plant, for purposes of this Section, is defined to include but not limited to Contractor's field offices, first aid station, storage facilities, shops, and major equipment. Sufficient construction plant shall be provided and maintained at all points where work is in progress to meet adequately demands of the Work and with ample margin for emergencies or overload.
- B. The plant shall be of sufficient capacity and reliability to permit a rate of progress, which will insure completion of the Work within the time stipulated in the Contract. Insufficient, inadequate and improper plant or equipment shall be brought to acceptable condition or shall be removed from the site.
- C. The location of stationary and mobile equipment shall be subject to the Engineer's approval.
- D. First Aid Station: Contractor shall provide a suitable first aid station at the work site. The station shall be equipped with all facilities and medical supplies necessary to administer emergency first aid treatment. Contractor shall have standing arrangements for the removal and hospital treatment of any injured person. The information reflecting this arrangement shall be clearly posted for easy visibility. All first aid facilities and emergency ambulance service shall be made available by the Contractor to the City's and Engineer's personnel.

2.02 ENGINEER'S FACILITIES

A. General

1. The Contractor shall be responsible for all office setup and removal costs, furnishing and installing all furniture and equipment as specified herein, and all maintenance costs for the Engineer's field office. The facilities for the field staff shall be in place within 30 days following issuance of the Notice to Proceed.
2. All facilities and equipment listed below are to be provided as specified for exclusive use by the City's and Engineer's project staff during the entire duration of the contract plus six additional months after completion of all punch list items or total project closeout whichever occurs last. The Contractor shall maintain ownership of the office trailer, furniture, and equipment provided with the Engineer's field trailer.

B. Engineer's Field Office

1. The Contractor shall furnish one new single or double wide trailer to serve as the Engineer's field office for the Engineer's and City's field staff. The interior of the trailer shall be divided by wall partitions with doors and have a minimum of three offices, conference room, men's restroom, women's restroom, communications/electrical breaker equipment closet, break area, janitor's closet and storage closet. The floor plan shall be submitted to the Engineer for approval as specified in Paragraph 1.02B of this Section.
2. The field office shall have a minimum of two exterior entrances with solid core doors with deadbolts. The trailer shall be furnished with a white, fiberglass shingle, 20-year warranty roof, color coordinated plastic or PVC skirting with access door and porch with landing, steps and full aluminum canopy at each exterior door. Porch shall be 8-foot wide by 6-foot deep, minimum. Aluminum canopy shall be as manufactured by Ray-O-Lite South East, Inc. or approved equal.
3. The field office shall be equipped with approximately, 1-foot wide, perforated aluminum soffits on all four sides and continuous ridge vent.
4. Electrical outlets shall be no more than 6 feet apart, with a minimum two outlets per wall. All outlets shall be surge protected. Provide four duplex surge protected outlets at 42-inches above finished floor (AFF) in the communications equipment closet.
6. All walls shall be vinyl covered sheetrock. All exterior and all interior walls shall be fully insulated.
7. Floors shall be double 3/4-inch CDX plywood minimum with vinyl tile floor covering and color coordinated vinyl base cove throughout.

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8. Provide a minimum of twelve 48-inch by 30-inch minimum sliding, lockable, double pane insulated windows with insect screens and metal mini-blinds.
9. Provide 4-foot fluorescent lighting fixtures with diffuser covers to provide 100-foot candles of illumination for all areas. Provide 18-inch fluorescent lighting fixture in bathrooms.
10. Each restroom shall be furnished with:
 - a. An elongated ceramic commode.
 - b. Ceramic sink with faucets
 - c. Vinyl coated wire shelf for supplies, 12-inches deep by 24-inches wide, minimum.
 - d. Medicine cabinet with mirror doors.
 - e. Paper towel dispenser.
 - f. Toilet paper holder.
 - g. Liquid soap dispenser.
11. Break area shall be furnished with:
 - a. Wall cabinets with shelves
 - b. Laminated counter with stainless steel sink and faucet
 - c. Base cabinet with shelves
 - d. Microwave oven – Minimum size 1.1 cu.ft.
 - e. Coffeemaker – 12-cup commercial metal coffee maker with two decanters, filters, 12-ounce styrofoam cups, stirrers and supplies, including regular coffee, decaffeinated coffee, tea bags, sugar, nondairy creamer and artificial sweetener for the duration of the Contract.
 - f. Refrigerator – minimum 10 cu.ft freezer-refrigerator unit with ice maker and filtered water dispenser.
12. Provide 40-gallon hot water heater (to serve both restrooms and break area).
13. Exterior doors shall be insulated heavy-duty steel with pneumatic/hydraulic closures and Best lock sets and double cylinder deadbolts. Locksets on all interior doors except restrooms shall be keyed privacy type, Kwikset, or approved equal.

14. Interior doors shall be prehung stained solid core wood with wood trim and shall be furnished with integral locks. Provide chrome coat hook on the back of all interior doors.
15. Sound attenuation/insulation in all interior walls shall be required.
16. Communication/electrical equipment closet with door shall have painted plywood walls. Provide up to 24 J-boxes with conduit stubbed to under trailer for use in communications installation. Provide stainless steel switch plates and outlet covers. Include master circuit surge protector. Lights and receptacles shall be on separate circuits. Provide minimum 10 separate circuits for offices, HVAC, water heater, outlets, copiers, etc. and emergency lights and lighted exit signs.
17. Provide a 10-pound Type A-B-C fire extinguisher at each exit and in break area.
18. Provide a high-pressure sodium photocell controlled light at each exterior entrance.
19. Provide freeze protection for all water system piping.
20. Provide a HVAC system. HVAC system shall include:
 - a. Dual heat pump units.
 - b. In duct heat strips as required; piped condensate drains to eliminate surface evaporation, including dry well if needed; single programmable thermostat to control both units simultaneously; accessible filter locations; individual returns and supplies for all rooms and spaces including hallways.
 - c. Locate units at center of each side of trailer for optimum and equal air distribution.
 - d. Two vertical chases to be s located on interior walls, behind doors.
 - e. HEPA air filtration system including manufacturer's recommended maintenance instructions.
21. Furnish and install the following office furniture:
 - a. Per Office:
 - i. One desk, 36-inches by 60-inches, double pedestal with mahogany colored laminated top.
 - ii. One 36" x 96" bookshelf, mahogany colored laminate.
 - iii. One credenza, mahogany colored laminate, with kneehole and keyboard drawer.
 - iv. One Swivel Chair with Black Frame.
 - v. One wall mounted dry erase board, min. size 36" x 48".
 - vi. Two guest chairs with black frame.

- vii. One lockable fire proof file cabinet.
- viii. Trash can.

b. Conference Room:

- a. Table, 48-inches by 168-inches with mahogany colored laminated top.
- b. Swivel chairs with black frames, minimum 6.
- c. One minimum size 65-inch HDTV, wall mounted, wifi capable, with HDMI cables for connecting laptops.
- d. One wall mounted dry erase board, min. size 48" x 96".
- e. Trash Can.
- f. Layout/work table, 30" x 60", with mahogany colored laminated tops.

22. Furnish and install the following office equipment and supplies:

- a. One copier machine capable of color and black and white prints, faxing, scanning, sorting/collating/stapling multi-page documents, equipped with automatic document feeder and copy sorter, and have single and double sided printing, copying and scanning capabilities. Copier shall have multiple paper supply trays for sizes 8-1/2 x 11, 8-1/2 x 14, and 11 x 17 paper sizes. Scanner shall be capable of scanning up to 11x17 page sizes. Machine shall be capable of wifi network connections to computers for printing, and shall email scanned documents to addresses as input by users.
- b. The Contractor shall provide a maintenance service contract and copy paper, toner/ink cartridges, etc., for both machines during the Contract period.

2.03 TELEPHONE AND INTERNET SERVICES

- A. Telephone service not required to be provided in the Engineer's Trailer.
- B. Provide cable modem and wifi wireless network capable of high speed internet connections and download speeds not less than 1 gbps. This network shall be for the Engineer's and City's exclusive use and separate from other network(s) provided for the Contractor's use.

2.04 SECURITY SYSTEM

- A. During other than normal daytime office working hours provide a totally separate electronic security system monitored by a security agency for the Engineer's facilities. All offices shall be equipped with exterior security flood lights automatically activated by darkness and in sufficient number and placement to provide adequate lighting of the office and the parking areas
- B. Arrange for installation and provide security system for Engineer's field office during construction. Pay for purchase and installation and all monthly charges.

2.05 TEMPORARY UTILITIES

- A. Determine the need for temporary utility services, including utility services for Engineer's facilities and first aid stations, and make all arrangements with utility companies and governmental agencies to secure such services. Such services shall be provided at no additional cost to the City. Temporary utility services shall be furnished, installed, connected, and maintained by Contractor in a manner satisfactory to the Engineer, and shall be removed in like manner prior to final acceptance.
- B. Power
 - 1. The Contractor shall determine the type and capacity required and shall make the necessary arrangements for obtaining temporary power metering equipment, pay for all installation costs and usage costs.
 - 2. All temporary electric power installations shall meet the safety requirements of all federal, state, and local codes and regulations.
 - 3. Cost of electric power used in testing will be borne by the Contractor.
- C. Lighting: Provide temporary site lighting to meet all applicable safety requirements to allow erection, application or installation of materials and equipment, and observation or inspection of the Work.
- D. Heating, Cooling, and Ventilating
 - 1. Provide as required to maintain adequate environmental conditions to facilitate progress of the Work, to meet specified minimum conditions for the installation of materials, and to protect materials, equipment, and finishes from damage due to temperature or humidity. Costs for temporary heat shall be borne by the Contractor.
 - 2. Provide adequate forced air ventilation of enclosed areas to cure installed materials, to dispense humidity, and to prevent hazardous accumulations of dust, fumes, vapors, or gases.
 - 3. Pay all costs of installation, maintenance, operation, removal, and fuel consumed.
 - 4. Provide portable unit heaters, complete with controls, oil or gas-fired, and vented to the outside as required for protection of health and property.
 - 5. If permanent natural gas piping is used for temporary heating units, do not modify or reroute gas piping without approval of utility company. Provide separate gas metering as required by utility.
- E. Water

1. The Contractor shall be allowed to connect to the existing City water system at a point approved by the Engineer. The connection point shall serve as a source for water for construction purposes. The Contractor shall provide temporary facilities and piping required to bring water to the point of use at each site, and remove them when no longer needed.
2. Refer to Section 01040 for requirements related to utilization of water for construction purposes.

F. Sanitary and Personnel Facilities

1. Provide and maintain facilities for Contractor's employees, Subcontractors, and all other onsite employer's employees. Service, clean, and maintain facilities and enclosures.
2. Use of City's existing sanitary facilities by construction personnel will not be allowed.

G. Fire Protection: Furnish and maintain on the site adequate firefighting equipment capable of extinguishing incipient fires. Comply with applicable parts of the National Fire Prevention Standard for Safeguarding Building Construction Operations (NFPA No. 241).

2.06 PARKING FACILITIES

- A. The civil plans for the project provide for parking during construction.

PART 3 EXECUTION

3.01 PREPARATION

- A. Fill and grade sites for temporary structures to provide surface drainage.
- B. (Not Used)

3.02 INSTALLATION

- A. Coordinate office locations with the City and/or the City's representatives.
- B. Construct temporary field offices, first aid stations, and storage facilities on proper foundations and provide connections for utility all services.
1. Secure portable or mobile buildings when used.
 2. Provide tie-downs for 100 mile per hour gusts and winds.
- C. Provide and mount thermometer at convenient outside location, not in direct sunlight.

- D. Provide and mount rain gauge in accessible open area.

3.03 MAINTENANCE AND CLEANING

- A. Repair and clean the offices, parking areas and access routes and provide complete professional janitorial services in the Engineer's facilities for the duration of the project. Cleaning shall be done on a daily basis, to the satisfaction of the Engineer, during other than normal daytime office working hours. These daily services shall include sweeping, vacuuming, dusting, emptying of trash, cleaning of washbasins, bathroom facilities and mopping of all vinyl floors.
- B. Provide approved containers for collection and disposal of waste materials, debris and rubbish. Dispose of such waste materials, debris, and rubbish offsite. Trash containers shall be lined with trash bags.
- C. Contractor shall provide for monthly waxing of all vinyl floors.
- D. Contractor shall provide for monthly exterminating services of the offices.
- E. The Contractor shall provide floor mats at exterior entrances (inside and outside of door) and all cleaning supplies, toilet tissue and paper towels, liquid soap, air fresheners, etc.

3.04 REMOVAL

- A. Remove temporary field offices, contents, temporary utilities and services at a time when no longer needed.
- B. Remove foundations and debris; grade site to required elevations; clean and restore areas as specified in Section 02920, Site Restoration.

+++ END OF SECTION 01500 +++

**SECTION 01540
SECURITY AND SAFETY**

PART 1 GENERAL

1.01 REFERENCES

- A. Refer to and comply with the Prime Contractor Site Safety and Security Plan.
- B. (Not Used)

1.02 SECURITY PROGRAM

- A. The Contractor shall protect the Work, including all field offices and temporary facilities and their contents from theft, vandalism and unauthorized entry.
- B. The Contractor shall initiate a site security program at the time of mobilization onto the worksite, which provides adequate security for site stored and installed material.
- C. The Contractor shall maintain the security program throughout the Contract duration.
- D. The Contractor shall be wholly responsible for the security of their storage and lay down areas and for all their plant, material, equipment and tools at all times.
- E. The Contractor shall provide the Engineer with a list of 24 hour emergency phone numbers including chain of command.
- F. The Contractor shall provide a designated security guard at the entrance to the pump station site during normal working hours and any other time the Contractor is onsite performing work outside of normal working hours. The designated security guard shall coordinate site access at the existing motorized entry gate with the City Lab Building Staff to facilitate site access. Contractor shall also coordinate as needed with the City's existing security guard staff at the RM Clayton site entrance as needed for activities to be performed within the City's secured area.

1.03 ENTRY CONTROL

- A. The Contractor shall restrict entry of unauthorized personnel and vehicles onto the Project site.
- B. The Contractor shall allow entry only to authorized persons with proper identification as established by the Prime Contractor's Site Safety and Security Plan.
- C. The Contractor shall maintain an Employee Log and Visitor Log and make the log available to the City upon request. The log shall be submitted to the Engineer bi-weekly or as necessary. Sample logs are included at the end of this section.

- D. The Contractor shall require all visitors to sign the Visitor Acknowledgment of the Program Site Rules/Visitor Log, which includes a release form. Copies of these forms shall be submitted to the Engineer bi-weekly and maintained in the Contractor's security files on-site.
- E. The Contractor shall require all employees to sign the Employee Acknowledgment of Project Site Rules Log included at the end of this Section. All employees, subcontractor employees and lower tier contractor employees will receive a new employee orientation. Signing the Employee Log by the employee is certifying that the orientation training has been received.
- F. The Engineer has the right to refuse access to the site or request that a person or vehicle be removed from the site if found violating any of the Project safety, security conduct rules.

1.04 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. 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.
- B. The Contractor will be held responsible for all damage to the work and any resulting injuries 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. The Contractor's responsibility for the maintenance of barricades, signs and lights shall not cease until the Project has been accepted by the City.

1.05 RESTRICTIONS

- A. The Contractor shall not allow cameras on site or photographs taken except with approval of the City or the Engineer.
- B. (Not Used)

1.06 CONTRACTOR SAFETY/HEALTH AND SECURITY PLAN

- A. Prior to the performance of any work the Contractor will prepare a contract specific Safety/Health and Security Plan signed by an officer of the Contractor's organization. Adequacy of the plan shall be the responsibility of the Contractor.
- B. The Engineer will not review the Contractor's safety plan for the adequacy of the plan. The plan shall:
 - 1. Identify the person(s) responsible for implementation and enforcement of Safety/Health and Security rules and regulations for this Project.

2. Generally address safe work procedures for the activities within the subcontractor's scope of work.
 3. Included a new employee orientation program, which addresses job and site specific rules, regulations and hazards.
 4. Include the subcontractor's Drug Free Work Place Policy including substance abuse prevention and testing program.
 5. Include provisions to protect all of the Contractor's employees, other persons and organizations who may be affected by the work from injury, damage or loss.
 6. Comply with current Fed/OSHA, Safety/Health and Security Plan, facility safety program (when applicable), and locally accepted safety codes, regulations and practices.
 7. Include a site specific emergency action and evacuation plan.
 8. Include Hazard Communication/Right To Know Program.
 9. Include security procedures for the Contractor's work, tools, and equipment.
 10. Include the capability of providing the Engineer with documentation to show compliance with their plan, plus accidents and investigation reports.
 11. Address any other specific contract requirements.
- C. Provide a Job Safety Analysis (JSA) for the scope of work, prior to the start of work.
- D. Review of the Contractor's Safety Plan by the Engineer shall not impose any duty or responsibility upon the Engineer for the Contractor's performance of the work in a safe manner.
- E. The Contractor shall be fully responsible for the safety and health of its employees, its subcontractors and lower tier contractors during performance of its work.
- F. The Contractor shall provide the Engineer with all safety reports, training records, competent person list, and accident reports prepared in compliance with Fed/OSHA and the Project Safety/Health and Security Plan.

1.07 PROJECT SAFETY COORDINATOR

- A. The Contractor shall be responsible for the safety of the Contractor's and the City's personnel and all other personnel at the site of the Work. The Contractor shall have a Project Safety Coordinator on the job site. The Project Safety Coordinator shall maintain and keep available safety records and up-to-date copies of all pertinent safety rules and regulations.
- B. The Project Safety Coordinator shall:
1. Ensure compliance with all applicable health and safety requirements of all governing legislation.

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2. Schedule and conduct safety meetings and safety training programs as required by law for all personnel engaged in the work.
3. Post all appropriate notices regarding safety and health regulations at locations that afford maximum exposure to all personnel at the job site.
4. Post the name, address and hours of the nearest medical doctor; names and addresses of nearby clinics and hospitals; and the telephone numbers of the fire and police departments.
5. Post appropriate instructions and warning signs with regard to all hazardous areas or conditions.
6. Have proper safety and rescue equipment adequately maintained and readily available for any contingency. This equipment shall include such applicable items as: proper fire extinguishers, first aid kits, safety ropes and harnesses, stretcher, life savers, oxygen breathing apparatus, resuscitators, gas detectors, oxygen deficiency indicators, explosion meters, and any other equipment mandated by law.
7. Make inspections at least once daily in accordance with an inspection checklist report form to ensure that all machines, tools and equipment are in safe operating condition; that all work methods are not dangerous; and that all work methods are free of hazards.
8. Submit to the Engineer upon request copies of all inspection checklist report forms, safety records and all safety inspection reports and certifications from regulating agencies and insurance companies.
9. Notify the Engineer of a serious accident immediately, followed by a detailed written report within twenty-four (24) hours. A “serious accident” is defined as an accident requiring an absence from work of more than 2 days and/or hospitalization.
10. Notify the Engineer immediately in the event of a fatal accident.
11. Notify Engineer of any accident claim against the Contractor or any sub-contractor immediately, followed up by a detailed written report on the claim and its resolution.
12. Review safety aspects of the Contractor’s submittals as applicable.

VISITOR ACKNOWLEDGMENT OF THE PROJECT SITE RULES

By signing this Visitor's Log, I acknowledge that I understand and agree to abide by the project rules outlined below.

In consideration of my receipt of a visitor's pass as issued by the Engineer directly or indirectly for the City of Atlanta, I waive on behalf of myself, my heirs, employer, legal representatives and assigns and hereby release and discharge the City, Engineer, Designer, and their subcontractors and consultants and each of their directors, officers, employees, representatives and agents from any and all claims, actions, causes of action or any charge of any kind whatsoever which may arise or could arise in the future as a result of my being present at the facility including injury, death or property damage whether or not caused by the fault or negligence of any of the parties released hereunder.

I further acknowledge that I have been briefed on specific hazards, hazardous substances that are on site and the site emergency action procedure.

PROHIBITED ACTIVITIES

- Unauthorized removal or theft of City's property
- Violation of safety or security rules or procedures
- Possession of firearms or lethal weapons on jobsite
- Acts of sabotage
- Destruction or defacing City's property
- Failure to use sanitary facilities
- Failure to report accidents or job related injuries
- Being under the apparent influence of drugs, alcohol or other intoxicants or in possession of drugs, alcohol or other intoxicants on the property
- Wearing shorts or tennis shoes on the jobsite
- Failure to wear a hardhat/safety glasses.
- Gambling at any time on the project
- Fighting, threatening behavior, or engaging in horseplay on the project
- Smoking in unauthorized areas on the project
- Open fire cooking or making unauthorized fires on project property
- Selling items or raffles without authorization
- Use of unauthorized cameras on the project
- Use of radio or television in the construction area
- Failure to park personal vehicle in authorized parking area
- Failure to wear designated identification [Site Specific]
- Failure to use designated gates

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I have read, understand and agree to abide by the PROJECT SITE RULES. Furthermore, I understand failure to abide by these rules is grounds for being denied access to the project site. I have received a personal copy for my use and reference.

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VISITOR LOG

THE SIGNING OF THIS LOG ACKNOWLEDGES I HAVE READ AND UNDERSTAND AND AGREE TO ABIDE BE THE PROJECT RULES OUTLINE ABOVE. THIS IS NOT A VEHICLE ACCESS PERMIT.

VISITOR'S NAME PRINT	SIGNATURE	COMPANY VISITED	DATE	IN	OUT

EMPLOYEE ACKNOWLEDGMENT OF THE PROJECT SITE RULES

By signing this Employee Log, I acknowledge that I understand and agree to abide by the project rules outlined below.

PROHIBITED ACTIVITIES

- Unauthorized removal or theft of City's property
- Violation of safety or security rules or procedures
- Possession of firearms or lethal weapons on jobsite
- Acts of sabotage
- Destruction or defacing City's property
- Failure to use sanitary facilities
- Failure to report accidents or job related injuries
- Under the apparent influence of drugs, alcohol or other intoxicants or in possession of drugs, alcohol or other intoxicants on the property
- Wearing shorts or tennis shoes on the jobsite
- Failure to wear a hardhat
- Gambling at any time on the project
- Fighting, threatening behavior, or engaging in horseplay on the project
- Smoking in unauthorized areas on the project
- Open fire cooking or making unauthorized fires on project property
- Selling items or raffles without authorization
- Use of unauthorized cameras on the project
- Use of radio or television in the construction area
- Failure to park personal vehicle in authorized parking area
- Failure to wear designated identification [Site Specific]
- Failure to use designated gates

I have read, understand and agree to abide by the PROJECT SITE RULES. Furthermore, I understand failure to abide by these rules is grounds for being denied access to the project site. I have received a personal copy for my use and reference.

EMPLOYEE LOG

BY SIGNING THIS LOG ACKNOWLEDGMENT I HAVE READ AND UNDERSTAND AND AGREE TO ABIDE BY THE PROJECT RULES OUTLINED ABOVE AND ALL STATE, FEDERAL, LOCAL OR ANY OTHER CONTRACT OBLIGATIONS THAT MAY APPLY. I FURTHER ACKNOWLEDGE THAT I HAVE BEEN ORIENTATED AS TO THE SITE SPECIFIC HAZARDS, ANY HAZARDOUS SUBSTANCES I MAY BE EXPOSED TO WHILE ON THE SITE AND THE SITE/COMPANY EMERGENCY ACTION PROCEDURES, BY A REPRESENTATIVE OF THE COMPANY.

EMPLOYEE NAME (PRINT)	SIGNATURE	COMPANY NAME	DATE
Signature of Company Representative		Date Signed	

PART 2 PRODUCTS

(NOT USED)

PART3 EXECUTION

(NOT USED)

+++ END OF SECTION 01540 +++

**SECTION 01550
TRAFFIC REGULATION**

PART 1 GENERAL

1.01 SCOPE

- A. The work specified in this section includes the provision of products, permits, services, procedures and personnel by the Contractor to effect traffic control during the Work.
- B. (Not Used)

1.02 TRAFFIC CONTROL MANAGER

- A. The Contractor shall designate a qualified individual as the Traffic Control Manager (TCM) who shall be responsible for selecting, installing and maintaining all traffic control devices in accordance with the Drawings and Specifications and the Manual of Uniform Traffic Control Devices (MUTCD).
- B. The Contractor shall provide, erect, maintain, and finally remove all barricades, danger warning and detour signs necessary to properly protect and divert traffic. Contractor shall provide, erect, maintain, and finally remove all barricades, danger warning and detour signs necessary to properly protect and divert traffic. All barricades and signs, including detour signs, shall be illuminated at night or when visibility is reduced. The Contractor will be held responsible for all damage to the Services due to failure of the signs and barricades to properly protect the Services from traffic, pedestrians, animals, and from all other sources, and whenever evidence of any such traffic is found upon the Services the Engineer will order that the Work, if in his opinion it is damaged, be immediately removed and replaced by the Contractor at no additional cost to the City. The devices used will be in accordance with the manual of Uniform Traffic Control Devices for Streets and Highways compiled by the State Department of Transportation. Access to City streets and roads will be limited and will require the use of flagmen or the installation of traffic control signals, or both. The City must approve haul routes.
- C. City of Atlanta Substitute Ordinance adopted March 13, 1978 requires that Contractors obtain a permit for work involving blockage of a public street. Open pits, trenches, unpaved streets, debris, or other obstructions due to construction that will prevent the normal flow of traffic during an extended construction stoppage for any reason, will not be permitted. In the event an extended construction stoppage is found to be necessary, Contractor shall, at his own expense, provide normal traffic flow during extended construction stoppage. Extended stoppage will be defined by the City.
- D. A written resume documenting the experience and credentials of the TCM shall be submitted and accepted by the Engineer prior to beginning any work that involves traffic control.
- E. The TCM shall be available on a twenty-four (24) hour basis to perform his duties. If the work requires traffic control activities to be performed during the daylight and nighttime

hours it may be necessary for the Contractor to designate alternate TCMs. An alternate TCM must meet the same requirements and qualifications as the primary TCM and be accepted by the Engineer prior to beginning any traffic control duties.

- F. The Traffic Control Manager's traffic control responsibilities shall have priority over all other assigned duties.
- G. As the representative of the Contractor, the TCM shall have full authority to act on behalf of the Contractor in administering the Traffic Control Plan. The TCM shall have appropriate training in safe traffic control practices in accordance with Part VI of the MUTCD. In addition to the TCM all other individuals making decisions regarding traffic control shall meet the training requirements of the Part VI of the MUTCD.
- H. The TCMs shall supervise the initial installation of traffic control devices. The Engineer prior to the beginning of construction will review the initial installation. Modifications to traffic control devices as required by sequence of operations or staged construction shall be reviewed by the TCMs.

PART 2 PRODUCTS

2.01 SIGNS, SIGNALS, AND DEVICES

- A. The Contractor shall provide post-mounted and wall-mounted traffic control and informational signs as specified and required by local jurisdictions.
- B. The Contractor shall provide automatic traffic control signals as approved by local jurisdictions.
- C. The Contractor shall provide traffic cones, drums and flashing lights as approved by local jurisdictions.
- D. The Contractor shall provide City of Atlanta police officers and certified flaggers and flagger's equipment as required by GDOT.

PART 3 EXECUTION

3.01 PERMITS

- A. The Contractor shall obtain permits from authorities having jurisdiction over road closures before closing any road. The Contractor shall use forms provided by authorities having jurisdiction (City of Atlanta Division of Traffic and Transportation, GDOT, etc). Refer to Section 01060, Regulatory Requirements.
- B. Permit applications shall indicate the time (in days), length (in feet), the number of lanes, and the purpose of the closure.
- C. All permits are approved for operations during off-peak hours 9:00 a.m. to 4:00 p.m. unless special approval is received.
- D. Operations between the hours of 6:00 p.m. and 10:00 p.m. and Saturdays and Sundays must be approved by the City

- E. Full street closure permits require ninety-six (96) hours advance notice prior to street closure. The following additional information is required prior to approval:
 - 1. The recommended detour route with signage and Traffic Management Plan as per the Manual of Uniform Traffic Control Devices (MUTCD).
 - 2. A copy of the resident and/or business notification letters about the closure. The residents/businesses located between the detour routes must be notified about the closure at least five (5) business days prior to the proposed closure.
- F. The City of Atlanta Division of Traffic and Transportation will return full street closure permit applications to the Contractor with a cover letter to the Fire Chief, Chief of Police, Grady Memorial Hospital, MARTA and the Atlanta Board of Education. The Contractor shall have received the permit application and cover letter at least seventy-two (72) hours before commencing street closure activities.
- G. Lane closure permits require a minimum of forty-eight (48) hour notice prior to lane closure. The Contractor shall continuously maintain the safety of the traveling public during lane closures in accordance with the requirements of the MUTCD and as stipulated by public officers.
- H. The City of Atlanta Division of Traffic and Transportation will return the lane closure applications to the Contractor with a cover letter with copies to the Fire Chief, Chief of Police, Grady Memorial Hospital, MARTA and the Atlanta Board of Education. The Contractor shall have received the permit application and cover letter at least seventy-two (72) hours before commencing lane closure activities.

3.02 PREPARATION OF TRAFFIC CONTROL PLANS

- A. The Maintenance of Traffic drawings included with the Contract Documents shall only be considered as a guide and are not intended to contain all the traffic regulation details that may be required by the specifications, permitting agencies and the MUTCD. The Contractor shall develop detailed staging and traffic control plans for performing specific areas of the Work including but not limited to all requirements for certified flaggers, additional traffic control devices, traffic shifts, detours, paces, lane closures or other activities that disrupt traffic flow. The Contractor shall submit these plans in accordance with the Specifications to receive final approvals from permitting agencies and provide any and all required traffic control devices as required by both the permitting agencies and these specifications at no additional cost to the City.
- B. (Not Used)

3.03 CONSTRUCTION PARKING CONTROL

- A. The Contractor shall control vehicular parking to prevent interference with public traffic and parking, access by emergency vehicles and City's operations.

- B. The Contractor shall monitor parking of construction personnel's vehicles in existing facilities and maintain vehicular access to and through parking areas.
- C. The Contractor shall prevent parking on or adjacent to access roads or in non-designated areas.

3.04 RIGHT OF WAY CONSTRUCTION ACCESS

- A. The City will furnish all rights-of-way for the performance of Work included in this Contract. Areas designated on the Contract Drawings as the Contractor's Work Area will be provided to the Contractor for the duration of construction, without charge. The Contractor will be responsible for observing the limits of the right-of-way and shall prohibit any Work to be done on or any damage to property outside the bounds of the right-of-way. Additional work and storage space, if required, shall be obtained by the Contractor at no additional cost to the City.
- B. (Not Used)

3.04 MAINTENANCE OF TRAFFIC

- A. Whenever and wherever, in the Engineer's opinion, traffic is sufficiently congested or public safety is endangered, the Contractor shall furnish uniformed officers to direct traffic and to keep traffic off the highway area affected by construction operations.
- B. When the Contract requires the maintenance of vehicular traffic on an existing road, street, or highway during the Contractor's performance of Work that is otherwise provided for on the Drawings and these Specifications, the Contractor shall keep such road, street, or highway open to all traffic and shall provide such maintenance as may be required to safely accommodate traffic. The Contractor shall furnish, erect and maintain barricades, warning signs, flaggers, and other traffic control devices in conformity with the requirements of the Georgia Department of Transportation and other local jurisdictions.
- C. The Contractor shall also construct and maintain in a safe condition any temporary connections necessary to ingress into and egress from abutting property or intersecting roads, streets, or highways. The Contractor shall maintain traffic in accordance with any traffic control plans furnished with and made a part of the plan assembly.
- D. The Contractor shall make his own estimate of all labor, materials, equipment, and incidentals necessary for providing the maintenance of traffic as specified in this section.
- E. Unless specified on the Drawings or in these Specifications and subject to the approval of the City, the cost of maintaining traffic specified in this section shall be included under Bid Item, Traffic Regulation.

3.05 UNIFORMED POLICE OFFICER FOR TRAFFIC CONTROL

- A. The Contractor will provide uniformed City of Atlanta police officers to regulate traffic when construction or project operations will impact the following locations:
 - 1. In all signalized intersections
 - 2. In streets designated as “collector” streets
 - 3. In all full street closings
 - 4. In GDOT right of ways
- B. Officers will be currently employed by the City of Atlanta, be in full uniform and have full arrest power while working.
- C. Officers will be employed and paid by the Contractor.
- D. It is the officers’ responsibility to assist in the direction of traffic within the construction site.
- E. City of Atlanta Police Field Operations Division Phone Number: 404-546-7775

3.06 FLAGGERS FOR TRAFFIC CONTROL

- A. The Contractor shall provide Georgia Department of Transportation (GDOT) certified trained and equipped flaggers to regulate traffic when construction operations or traffic encroach on public traffic lanes.
- B. (Not Used)

3.07 FLASHING LIGHTS

- A. The Contractor shall use flashing lights during hours of low visibility to delineate traffic lanes and to guide traffic.
- B. (Not Used)

3.08 HAUL ROUTES

- A. The Contractor shall consult with authorities and establish public thoroughfares to be used for haul routes and site access and obtain a haul route permit as specified in Section 01060, Regulatory Requirements.
- B. The Contractor shall confine construction traffic to designated haul routes.
- C. The Contractor shall provide traffic control at critical areas of haul routes to regulate traffic and minimize interference with public traffic.

3.09 ROAD CLOSURES ON CITY STREETS AND ROADS

- A. No street or road shall be closed without the permission of the Owner of any street or road and the fire department having jurisdiction. Prior to closing a street, road or highway, signs shall be posted for a minimum of seven (7) days prior to actual closing, forewarning of the imminent closing. The City shall determine the information to be placed upon the signs by the Contractor. Where traffic is diverted from the Work, the Contractor shall provide all materials and perform all work for the construction and maintenance of all required temporary roadways, structures, barricades, signs and signalization.
- B. To obtain approval to close a road or street maintained by the City, the Contractor shall proceed as follows:
 - 1. The Contractor shall obtain approval of his traffic plan from the Engineer unless a traffic plan approved by the Engineer is included in the Drawings. The traffic plan must be in accordance with the requirements of the Georgia Department of Transportation and the City of Atlanta.
 - 2. The Contractor shall obtain a utility permit.
 - 3. The Contractor shall apply in writing to the City and obtain a permit to close the road on a specific date. Routine permit approval by the City requires from one (1) to two (2) weeks depending on when the application is received.
 - 4. The Contractor shall obtain a permit from the City before posting closure signs. Signs must be posted for seven (7) days prior to the first day of closure. Signs shall be acceptable to the Engineer.
 - 5. Emergency road closures will be handled by the Engineer.

3.10 PROCEDURES FOR TRAFFIC DETOUR ROUTE PLAN

- A. The Contractor shall provide a sketch map showing his traffic detour route plan to the Engineer. The sketch map need not be drawn to scale but should resemble, as closely as possible, the actual location. The sketch map shall be drawn in a manner so as to provide emergency agencies a better understanding of the detour for quick response. The sketch map shall include directional arrows showing the flow of traffic.
- B. "Road Closed Ahead" signs shall be erected before the start point of the detour indicating the name of the street closed.
- C. Detour signs with appropriate directional arrows shall be erected at every intersection along the detour route until the end of the detour, when the traffic is back to the original street.
- D. The Contractor shall erect an "End Detour" sign at the end of the detour.
- E. Each detour and "End Detour" sign shall be accompanied by an accessory plate indicating the name of the street being detoured.

- F. The Contractor shall apply appropriate traffic control measures in accordance with the requirements of the MUTCD and the City of Atlanta Department of Public Works.

3.11 BARRICADES AND WARNING SIGNS

- A. The Contractor shall furnish, erect, and maintain all barricades and warning signs for hazards necessary to protect the public and the Work. When used during periods of darkness, such barricades, warning signs and hazard markings shall be suitably illuminated or reflectorized.
- B. For vehicular and pedestrian traffic, the Contractor shall furnish, erect, and maintain barricades, warning signs, lights, and other traffic control devices in conformity with the requirements of the Georgia Department of Transportation and the City of Atlanta Department of Public Works.
- C. The Contractor shall furnish and erect all barricades and warning signs for hazards prior to commencing Work which requires such erection and shall maintain the barricades and warning signs for hazards until their dismantling is directed by the Engineer.

3.12 REMOVAL

- A. The Contractor shall remove equipment and devices when no longer required and repair damage caused by installation.
- B. (Not Used)

3.13 RIGHT OF WAY MANUAL

- A. Included at the end of this Section are copies of the title page and pages 42 through and including page 52 from the City's Right-of Way Manual. These pages include Appendices A, B and C which indicate street designations and Appendix D which covers restrictions for working within the City's right of way. These restrictions shall also apply to GDOT right of ways.
- B. (Not Used)

+++ END OF SECTION 01550 +++

SECTION 01600
GENERAL MATERIAL AND EQUIPMENT REQUIREMENTS

PART 1 - GENERAL

1.01 DESCRIPTION

- A. All installed materials and equipment are to be the latest version of the manufacturer's product line and not be outdated by newer versions at the time of purchasing. Materials and equipment, which show any signs of extended storage such as but not limited to corrosion, scratches and dents, will not be accepted for installation in this project.
- B. All equipment used for performing the Work shall conform to the latest version of all applicable safety standards including but not limited to OSHA requirements. Contractor shall not exceed or ignore any requirements or recommendations of the equipment manufacturer. Equipment not meeting requirements of this Section will be barred from use on the project.
- C. All installed material and equipment shall meet or exceed the latest applicable code requirements including but not limited to, Underwriters Laboratory, Standard Building Code and OSHA, as well as requirements of these Specifications. Where there is conflict with requirements of the Contract Documents and code requirements, comply with the more stringent requirements with no additional compensation to the Contractor.

PART 2 - MATERIALS AND EQUIPMENT

2.01 ANCHOR DOWELS

- A. All anchor dowels to be ANSI type 316 stainless steel unless otherwise specified or indicated, and must conform to requirements of this Section and the material articles in the appropriate Sections they are used.
- B. All anchor dowels are to be supplied by the manufacturer or fabricator of the specific material or equipment to be installed.
- C. Design criteria for anchor dowels
 - 1. When the size, length or load carrying capacity of an anchor bolt, expansion anchor, or concrete insert is not shown on the Drawings, provide the size, length and capacity required to carry the design load times a minimum safety factor of four.
 - 2. Determine design loads as follows:
 - a. For equipment anchors, use the design load recommended by the manufacturer and approved by the Engineer.
 - b. For pipe hangers and supports, use one half the total weight of pipe, fittings, valves, accessories and water contained in pipe, between the hanger or support in question and adjacent hangers and supports on both sides.
 - c. Allowances for vibration are included in the safety factor specified above.
 - d. Anchors shall develop ultimate shear and pull-out loads of not less than the

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following values in concrete:

<u>Dowel Diameter (Inches)</u>	<u>Min. Shear (Pounds)</u>	<u>Min. Pull-Out Load (Pounds)</u>
1/2	4,500	6,300
5/8	6,900	7,700
3/4	10,500	9,900

3. Embedment depth to be 6 inches for epoxy anchors and 4 inches for steel expansion anchors, unless noted otherwise on the drawings.

D. Anchor Type and Manufacturer

1. Where epoxy anchors are noted on the drawings, provide ANSI type 316 stainless steel threaded rod with Speed Bond #1 epoxy injection as manufactured by Prime Resins, Inc. or equal.
2. For all other applications, provide ANSI type 316 steel expansion anchors from one of the following manufacturers or approved equivalent.
 - a. Hilti, Incorporated.
 - b. Ramset, Incorporated
3. Install anchors per manufacturer's recommendations and this Section.
 - a. Drilled anchorage holes are to be blown out with compressed air before installing anchor.
 - b. Not used.

2.02 CONNECTION BOLTS

- A. Materials shall be as specified in other Sections of the Specifications, or as shown on the Drawings. Where materials are not specified or shown on the Drawings, they shall be of ANSI Type 316 stainless steel, with ANSI Type 316 stainless steel nuts and washers.
- B. Unless otherwise specified, stud, tap and machine dowels and nuts shall be ANSI Type 316 stainless steel and shall conform to the requirements of ASTM Standard Specification for Carbon Steel Externally and Internally Threaded Standard Fasteners, Designation A307-80. Hexagonal nuts of the same quality of metal as the dowels shall be used. All threads shall be clean cut and shall conform to AN Standard B1.1-1974 for Unified Inch Screw Threads (UN and UNR Thread Form).

2.03 CONCRETE INSERTS

- A. Concrete inserts for hangers shall be designed to support safely, in the concrete that is used, the maximum load that can be imposed by the hangers used in the inserts. Inserts for

hangers shall be of a type, which will permit adjustment of the hangers both horizontally (in one plane) and vertically and locking of the hanger head or nut. All inserts shall be galvanized, then epoxy phenolic primed and top coated with PVC, using thermal bond process.

- B. (Not Used)

2.04 SLEEVES

- A. Unless otherwise indicated on the Drawings or specified, openings for the passage of pipes through floors and walls shall be formed of sleeves of standard-weight, stainless-steel pipe. The sleeves shall be of ample diameter to pass the pipe and its insulation, if any, and to permit such expansion as may occur. Sleeves shall be of sufficient length to be flush at the walls and the bottom of slabs and to project 4-in. above the finished floor surface. Threaded nipples shall not be used as sleeves.
- B. Sleeves in exterior walls below grade or in walls to have liquids on one or both sides shall be as detailed on the Drawings and specified in other sections.
- C. All sleeves shall be set accurately before the concrete is placed or shall be built in accurately as the masonry is being built.

2.05 ELECTRICAL EQUIPMENT ENCLOSURES

- A. All items of electrical equipment that are furnished with process equipment shall conform to the requirements specified under the appropriate electrical sections of the specifications. Enclosures for electrical equipment such as switches, starters, etc., shall conform to the requirements specified under the appropriate electrical sections of the specifications.
- B. (Not Used)

2.06 EQUIPMENT DRIVE GUARDS

- A. All equipment driven by open shafts, belts, chains, or gears shall be provided with acceptable all-metal guards enclosing the drive mechanism. Guards shall be constructed of epoxy paint coated, galvanized sheet steel or galvanized woven wire or expanded metal set in a frame of galvanized steel members. Guards shall be secured in position by steel braces or straps, which will permit easy removal for servicing the equipment. The guards shall conform in all respects to all applicable safety codes and regulations.
- B. (Not Used)

2.07 NAMEPLATES

- A. With the exception of the items mentioned below, each piece of equipment shall be provided with a substantial nameplate of non-corrodible metal, securely fastened in place and clearly and permanently inscribed with the manufacturer's name, model or type designation, serial number, principal rated capacities, electrical or other power characteristics, and similar information as appropriate.

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- B. This requirement shall not apply to standard, manually operated gate, lobe, check and plug valves.
- C. Each process valve shall be provided with a substantial tag of non-corrodible metal securely fastened in place and inscribed with an identification number in conformance with the tag numbers indicated on the Process and Instrumentation Drawings.

2.08 LUBRICANTS

- A. During testing and prior to acceptance, the Contractor shall furnish all lubricants necessary for the proper lubrication of all equipment furnished under this contract.
- B. (Not Used)

2.09 PROTECTION AGAINST ELECTROLYSIS

- A. Where dissimilar metals are used in conjunction with each other, suitable insulation shall be provided between adjoining surfaces so as to eliminate direct contact and any resultant electrolysis. The insulation shall be bituminous impregnated felt, heavy bituminous coatings, nonmetallic separators or washers, or other acceptable materials.
- B. (Not Used)

2.10 TRANSPORTATION, HANDLING, STORAGE AND PROTECTION

- A. Packing and Shipping:
 - 1. Product and materials shall be shipped and handled in ways which will prevent damage.
 - 2. Equipment shall be protected against damage from moisture, dust, handling, or other cause during transport from manufacturer's premises to the project site. Bearing housing, vents and other types of openings shall be wrapped or otherwise sealed to prevent contamination by grit and dirt.
 - 3. Ship equipment, material, and spare parts in assembled units except where partial disassembly is required by transportation regulations or for protection of components.
 - 4. Pipe and appurtenances shall be handled, stored, and installed as recommended by the manufacturer. Pipes shipped with interior bracing shall have the bracing removed only when recommended by the pipe manufacturer.
 - 5. Stiffeners shall be used where necessary to maintain shapes and to give rigidity.
 - 6. Each item or package shall be marked with the number unique to the specification reference covering the item. Spare parts shall be packed in containers bearing labels clearly designating contents and pieces of equipment for which intended.
- B. Acceptance at Site:
 - 1. Damaged items will not be permitted as part of the work except in cases of minor damage that have been satisfactorily repaired and are acceptable to the Engineer.

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2. Damage shall be corrected to conform to the requirements of the Contract before the assembly is incorporated into the Work.
 3. The Contractor shall bear the costs arising out of dismantling, inspection, repair, and reassembly.
- C. Storage and Protection:
1. Store Material in accordance with manufacturer's recommendations.
 2. 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.

2.11 UNIT RESPONSIBILITY

- A. Equipment systems made up of two or more components shall be provided as a unit by the responsible manufacturer. Unless otherwise specified, the Contractor shall obtain each system from the supplier of the driven equipment, which supplier shall provide all components of the system to enhance compatibility, ease of construction, and efficient maintenance. The Contractor shall be responsible to the City for performance of all systems.
- B. Where the detailed specifications require the Contractor to furnish a certificate of unit responsibility, such certificate executed by the manufacturer. No other submittal material shall be processed until the Certificate of Unit Responsibility has been received and has been found to be satisfactory. A typical Manufacturer's Certificate of Unit Responsibility form is included in this specification.

2.12 SERVICES OF MANUFACTURER'S REPRESENTATIVE

- A. Refer to Specification Section 01640 – Manufacturer Services.
- B. (Not Used)

MANUFACTURER'S CERTIFICATE OF PROPER INSTALLATION

Contractor: _____

Equipment Name: _____

Equipment Tag Number(s): _____

Specification Section: _____

Manufacturer/Phone No.: _____

Service Rep./Phone No.: _____

Date: _____ Hours on Site: _____

Purpose: To verify installation recommendations and warranty is valid.

At a minimum, the following items (if applicable) must be checked:

	Yes	No	NA
Equipment serviced with proper lubricants.			
All safety equipment properly installed.			
Proper electrical connections.			
Proper mechanical connections.			
Equipment meets all warranty requirements.			

List additional items checked: (See Detailed Specification Section)

Comments: _____

(List and attach additional pages, if necessary.)

Signatures (Do not initial.)

Contractor: _____

Date: _____

Manufacturer: _____

Date: _____

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Engineer: _____

Date: _____

MANUFACTURER'S CERTIFICATE OF FUNCTIONAL TEST ACCEPTANCE INSTALLATION

Contractor: _____

Equipment Name: _____

Equipment Tag Number(s): _____

Specification Section: _____

Manufacturer/Phone No.: _____

Service Rep./Phone No.: _____

Date: _____ Hours on Site: _____

Purpose: To verify installation, that proper adjustments have been made, that the equipment or system is ready for plant startup and operation and warranty is valid.

At a minimum, the following items (if applicable) must be checked:

	Yes	No	NA
Rotation			
Alignment			
Speed			
Noise level			
Initial adjustments			
Initial calibration			

List additional items checked: (See Detailed Specification Section)

Comments: _____

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(List and attach additional pages, if necessary.)

Signatures (Do not initial.)

Contractor: _____

Date: _____

Manufacturer: _____

Date: _____

Engineer: _____

Date: _____

**MANUFACTURER'S CERTIFICATE
OF
PERFORMANCE TEST ACCEPTANCE**

Contractor: _____

Equipment Name: _____

Equipment Tag Number(s): _____

Specification Section: _____

Manufacturer/Phone No.: _____

Service Rep./Phone No.: _____

Date: _____ Hours on Site: _____

Purpose: To certify that the equipment or system identified above has been successfully tested for performance and is ready to be accepted by the City for full-time operation.

This certifies that the above equipment or system operated under actual performance conditions, and that the equipment or system meets the specified performance criteria.

Comments: _____

(List and attach additional pages, if necessary.)

Signatures (Do not initial.)

Contractor: _____

Date: _____

Manufacturer: _____

Date: _____

Engineer: _____

Date: _____

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**CONTRACTOR'S CERTIFICATE
OF
EQUIPMENT START-UP READINESS**

Contractor: _____

Equipment Name(s): _____

Equipment Tag Number(s): _____

Specification Section: _____

"I, the undersigned, do hereby certify that all of the necessary hydraulic structures, piping systems, and valves have been successfully tested; that all necessary equipment systems and subsystems have been checked for proper installation, started, and successfully tested to indicate that they are all operational; that the systems and subsystems are capable of performing their intended functions; and that the facilities noted above are ready for startup and intended operation."

Signature Title

Date

**MANUFACTURER'S CERTIFICATE
OF
UNIT RESPONSIBILITY**

Manufacturer: _____

Equipment Name: _____

Specification Section(s): _____

Manufacturer/Phone No.: _____

Service Rep./Phone No.: _____

Purpose: To certify that the equipment or system manufacturer identified above accepts unit responsibility for equipment or systems furnished.

This certifies that the above equipment or system manufacturer accepts unit responsibility for equipment or systems furnished under the indicated specification section(s) and that the components furnished are compatible and comprise a functional unit suitable for the specified performance and design requirements.

Signatures (Do not initial.)

Contractor: _____

Date: _____

Manufacturer: _____

Date: _____

+++ END OF SECTION 01600 +++

**SECTION 01610
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. In addition, 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.
- B. All equipment, materials and products damaged during transportation or handling shall be repaired or replaced by the Contractor at no additional cost to the City prior to being incorporated into the Work.

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. 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. The Contractor shall regularly inspect lifting belts, spreader bars, shackles, etc. to ensure the integrity of those items.
- B. Lifting and handling drawings and instructions furnished by the manufacturer or supplier shall be strictly followed. Eyebolts or lifting lugs furnished on the equipment shall be used in handling the equipment. Shafts and operating mechanisms shall not be used as lifting points. 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.

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PART 2 PRODUCTS

(NOT USED)

PART 3 EXECUTION

(NOT USED)

+++ END OF SECTION 01610 +++

SECTION 01612
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, tool, 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.
- B. The Contractor shall store materials, supplies, and equipment at the site in such orderly fashion and in such locations as approved by the Engineer that will not unduly interfere with the progress of the Work or the work of any other contractors, or activities of City personnel.

1.02 STORAGE AND PROTECTION

A. Storage

- 1. Maintain ample way for foot traffic at all times, except as otherwise approved by the Engineer.
- 2. All property damage by reason of storing of material shall be properly replaced at no additional cost to the City.
- 3. Packaged materials shall be delivered in original unopened containers and so stored until ready for use.
- 4. All materials shall meet the requirements of these Specifications at the time that they are used in the Work.
- 5. Store products in accordance with manufacturer's instructions.

B. Protection

- 1. 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.
- 2. All materials shall be delivered, stored, and handled to prevent the inclusion of materials and damage by water, breakage, vandalism or other cause.
- 3. Substantially constructed weather tight 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.
- 4. In the event of damage, immediately make all repairs and replacements necessary for the approval of the Engineer and at no additional cost to the City.
- 5. Store material in accordance with manufacturer's recommendations.

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6. Unless otherwise permitted in writing by the Engineer, building products and materials including but not limited to: cement, grout, plaster, gypsum board, particleboard resilient flooring, acoustical tile, paneling, finished lumber, insulation, and wiring shall be stored indoors in a dry location. Building products such as rough lumber, plywood, concrete block and structural tile may be stored outdoors under a properly secured waterproof covering.
7. 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.

1.03. EXTENDED STORAGE

- A. In the event that certain items of major equipment such as air compressors, pumps, and mechanical aerators have to be stored for an extended period of time, the Contractor shall provide satisfactory long-term storage facilities which are acceptable to the Engineer. 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.
- B. (Not used)

PART 2 – PRODUCTS – NOT USED

PART 3 – EXECUTION – NOT USED

+++ END OF SECTION 01611 +++

**SECTION 01640
MANUFACTURER SERVICES**

PART 1 – GENERAL

1.01 SCOPE

- A. The work under this Section defines the minimum scope of services to be provided by the Contractor using factory representatives of the manufacturers of the equipment to be installed during installation, start-up, and operator training.
- B. Equipment manufacturers assigned unit responsibility for systems comprised of several components shall provide the services of factory representatives from each component manufacturer to perform the duties required under these Specifications. The equipment manufacturer assigned unit responsibility shall be responsible for coordinating the activities of the system component manufacturers.

1.02 DEFINITIONS

- A. Man-Day: One person for 8 hours within regular Contractor working hours.
- B. (Not Used)

1.03 SUBMITTALS

- A. In addition to all submittal requirements, the following specific information shall be provided:
 - 1. Preliminary Training Plan: Submit within 120 days after Notice to Proceed.
 - 2. Training Schedule: Submit not less than 30 days prior to start of equipment installation and revise as necessary for acceptance.
 - 3. Final Training Plan: Submit after training coordination meeting.
 - 4. Training Materials:
 - a. Submit written outlines of proposed training sessions not less than 30 days prior to scheduled training.
 - b. Furnish complete training materials, to include operation and maintenance data as required in this section. Provide 12 extra copies of all training materials to Owner.
 - c. Quality Control Submittals: When specified in the individual Specifications, submit:
 - d. Qualifications and resume of Manufacturer's Representative performing specified services.
 - e. Manufacturer's Certificate of Proper Installation: On form appended to this section.
- B. (NOT USED)

1.04 QUALIFICATION OF MANUFACTURER'S REPRESENTATIVE

- A. Qualification of the representatives for installation, start-up, and operator training purposes shall be appropriate for the equipment being installed and shall be subject to the approval of the Engineer. For instances where equipment has significant process complexity, furnish the services of engineering personnel knowledgeable in the process involved and the function of the equipment. Authorized representatives of the manufacturer shall be factory trained and experienced in the technical applications, installation, operation, and maintenance of respective equipment, subsystem, or system. Additional qualifications may be specified elsewhere.
- B. References in various equipment sections using the terms “factory representative” or “field representative” shall mean an employee of the equipment manufacturer who is completely knowledgeable of the construction, installation, operation and maintenance of the equipment. A Sales representative does not qualify. Any field or factory representative, not an active employee of the manufacturer, must provide documentation/certification from the manufacturer stating that the individual, by name, has been formally trained in the installation, operation, and maintenance of the equipment and is authorized to make the required certification to perform the required services.
- C. No substitute representatives will be allowed unless prior written approval by Engineer has been given.

1.05 COORDINATION

- A. The Contractor shall coordinate the visits of factory representatives during installation, start-up, and operator training in accordance with the requirements of Section 01650 of these Specifications.
- B. The Contractor shall notify the Engineer 72 hours prior to any impending visit by factory representatives to allow the Engineer to be present.
- C. The Contractor shall coordinate the visits of all factory representatives for operator training with the City. The Contractor shall provide the Engineer and City with a training schedule no later than thirty (30) days prior to the start of the training period.
- D. Only if approved by the Engineer, the period of service on more than one item furnished by the same manufacturer may run concurrently.

1.06 FULFILLMENT OF SPECIFIED MINIMUM SERVICES

- A. Where manufacturers' services are specified, furnish manufacturer's qualified representative. Where time is necessary in excess of that stated in the Specifications for manufacturers' services, additional time required to perform the specified services shall be considered incidental work.
- B. The Manufacturer's Qualified Representative shall be responsible to perform the following but not limited to:

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1. Schedule manufacturer's services to avoid conflicting with other onsite testing or other manufacturer's onsite services.
2. Determine that all conditions necessary to allow successful testing have been met before scheduling services.
3. Ensure only those days of service approved by Engineer will be credited to fulfill the specified minimum services.
4. If specified, manufacturer's onsite services shall be 8 hours minimum and include as a minimum:
5. Provide assistance during product (system, subsystem, or component) installation to include observation, guidance, and instruction of Contractor's assembly, erection, installation, or application procedures.
6. Be responsible for inspection, checking, and adjustment as required for product(s) (system, subsystem, or component) to function as warranted by manufacturer and necessary to furnish written approval of installation.
7. Revisit the site as required to correct problems and until installation and operation are acceptable to Engineer.
8. Provide resolution of assembly or installation problems attributable to, or associated with, respective manufacturer's products and systems.
9. Provide assistance during functional and performance testing and startup demonstration, and until product acceptance by the Owner.
10. Training of Owner's personnel in the operation and maintenance of respective product as required.
11. Completion of Manufacturer's Certificate of Proper Installation (form enclosed at end of this section) with applicable certificates for proper installation and initial, interim, and final test or service.

1.07 TRAINING PLAN

- A. Preliminary Training Plan: If specified, and within 120 days after Notice of Award, submit for each proposed course:
 1. Title and objectives.
 2. Training schedule.
 3. Prerequisite training and experience of attendees.
 4. Recommended types of attendees (e.g., managers, engineers, operators, maintenance).
 5. Course description and outline of course content.
 6. Duration.

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7. Location (e.g., training center or site).
 8. Format (e.g., lecture, self-study, demonstration, hands-on).
 9. Instruction materials and equipment requirements.
- B. Final Training Plan: Submit the following after training coordination meeting, if specified.
1. Updated versions of course descriptions from preliminary training plan.
 2. List of Attendees for each course.
 3. Schedule of training courses including dates, durations, and locations of each class.
 4. Detailed course schedule for each day showing time allocated to each topic.
 5. Resumes of instructors providing the training.

1.08 TRAINING SCHEDULE

- A. List specified equipment and systems with respective manufacturers that require training services of manufacturers' representatives and show:
1. Estimated dates for installation completion.
 2. Estimated training dates to allow for multiple sessions when several shifts are involved.
- B. Adjust training schedule to ensure training of appropriate personnel as deemed necessary by Owner, and to allow full participation by manufacturers' representatives. Adjust schedule for interruptions in operability of equipment.
- D. Coordinate with Progress Schedules as specified in Section 01650, FACILITY STARTUP.

1.09 TRAINING CITY'S PERSONNEL

- A. Furnish trained, articulate personnel to coordinate and expedite training, to be present during training coordination meetings with Owner, and familiar with operation and maintenance manual information.
- B. Furnish manufacturers' representatives for detailed classroom and hands-on training to Owner's personnel on operation and maintenance of specified product (system, subsystem, component) and as may be required in applicable Specifications.
- C. Manufacturer's Representative: Familiar with plant operation and maintenance requirements as well as with specified equipment.
- D. Pre-startup Training:
1. Coordinate training sessions with Owner's operating personnel and manufacturers' representatives.
 2. Complete at least 7 days, but no more than 14 days, prior to actual startup.

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- E. Post-Startup Training: Furnish and coordinate training of Owner's operating personnel by respective manufacturer's representatives. Manufacturer's representative shall be required for a follow-up visit of one day.
- F. Taping of Training Sessions: The Owner will provide audio/video taping of all training sessions. Manufacturer's trainer is to provide appropriate props, such as, charts, photographs and samples in large enough sizes to be video-taped. All trainers are to provide their full cooperation to the Owner's video technician.

1.10. INSTALLATION INSPECTION SERVICES

- A. The Contractor shall furnish the services of a competent factory representative to inspect the installation of each piece of equipment prior to start-up and functional testing in accordance with the requirements of these Specification. The time required shall be shown in the equipment sections of these Specifications, but shall be no less than one 8 hour day.
- B. The factory representative shall certify that the equipment has been installed in accordance with the manufacturers' recommendations and is ready for start-up.

1.11. START-UP SERVICES

- A. The Contractor shall furnish the services of a competent factory representative to supervise the start-up, functional testing, and field performance testing for each item or system installed in accordance with Section 01650 and the equipment sections shown in Divisions 2 through 16 of these Specifications. The time required shall be shown in the equipment sections, but shall be no less than one 8 hour day.
- B. (Not Used)

1.12. OPERATOR TRAINING SERVICES

- A. The Contractor shall furnish the services of a factory representative to train the City's personnel in the operation and maintenance of each item installed under these Specifications. The time required shall be shown in the equipment sections, but shall be no less than one 8 hour day.
- B. (Not Used)

1.13. SUPPLEMENTS

- A. The supplements listed below, following "END OF SECTION," are part of this Specification.
 - 1. Manufacturer's Certificate of Proper Installation.
 - 2. Manufacturer's Instruction Certification Form.
- B. (Not Used)

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PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

**CITY OF ATLANTA WATER SUPPL PROGRAM PHASE 1
MANUFACTURER'S CERTIFICATE OF PROPER INSTALLATION**

OWNER _____

EQPT SERIAL NO: _____

EQPT TAG NO: _____

EQPT/SYSTEM: _____

PROJECT NO: _____

SPEC. SECTION: _____

SITE LOCATION:

I hereby certify that the above-referenced equipment/system has been:

(Check Applicable)

<input type="checkbox"/>	Installed in accordance with Manufacturer's recommendations.
<input type="checkbox"/>	Inspected, checked, and adjusted.
<input type="checkbox"/>	Serviced with proper initial lubricants.
<input type="checkbox"/>	Electrical and mechanical connections meet quality and safety standards.
<input type="checkbox"/>	All applicable safety equipment has been properly installed.
<input type="checkbox"/>	System has been performance tested, and meets or exceeds specified performance requirements. (When complete system of one manufacturer)
<input type="checkbox"/>	System has been started up and meets or exceeds performance requirements.

I, the undersigned Manufacturer's Representative, hereby certify that I am (i) a duly authorized representative of the manufacturer, (ii) empowered by the manufacturer to inspect, approve, and operate his equipment and (iii) authorized to make recommendations required to assure that the equipment furnished by the manufacturer is complete and operational, except as may be otherwise indicated herein. I further certify that all information contained herein is true and accurate.

Date: _____, 20____

Manufacturer:

By Manufacturer's Authorized Representative:

(Authorized Signature)

CITY OF ATLANTA (Spec Writer - Insert Project Name)
MANUFACTURER'S INSTRUCTION CERTIFICATION FORM

Contract No.: _____ Specification Section:

Equipment Name: _____

Contractor: _____

Manufacturer of Equipment Item: _____

The undersigned manufacturer certifies that a service engineer has instructed the City operating personnel in the proper maintenance and operation of the equipment designated herein.

Operations Check List (check appropriate spaces)

Startup procedure reviewed _____

Shutdown procedure reviewed _____

Normal operation procedure reviewed _____

Others: _____

Maintenance Check List (check appropriate spaces)

Described normal oil changes (frequency) _____

Described special tools required _____

Described normal items to be reviewed for wear _____

Described preventive maintenance instructions _____

Described greasing frequency _____

Others: _____

Date

Manufacturer

Signature of Authorized Representative

Date

Signature of City's Representative

Date

Signature of Contractor's Representative

+++ END OF SECTION 01640 +++

**SECTION 01650
FACILITY STARTUP**

PART 1 - GENERAL

1.01 DEFINITIONS

- A. Pre-Operational Checkout (Step 1): Are those documented physical checks (tests) that must occur to insure that an item of equipment or equipment system is 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. Also, Phase/motor rotation checks.
 3. Instrument calibration and loop tests. 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.
 5. Air-tightness integrity of building sections that are to be fire-rated.
- B. Functional Test: (Step 2): A test or tests, in the presence of the Engineer and Owner, 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 will be performed under simulated conditions to determine contract compliance. This test will utilize plant effluent, potable water, or another acceptable substitute test media. The equipment will 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 will 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), will 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 Engineer and Owner, of all components within a system collectively to insure that the system and all of its integral components function as intended. Water and/or other temporary media supplied by the Contractor will be circulated through the completed facility/system for 5 days with systems being operated under various loading conditions as proposed by the Contractor and approved by the City's Engineer.

The instrumentation and control system automatic function for the overall system will be verified and documented during the operational testing stage as described above.

- D. Punchlist: All items that could affect, or be affected by, the full time operation of the system

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(as deemed critical by the City Engineer) must be complete prior to the Operational Test phase.

- E. Acceptance Test (Step 4): The start-up and operation of the systems installed, under actual operating conditions, as part of the actual plant process. The acceptance test period is 30 days. The Owner's O&M staff will be responsible for running the system with the Contractor's support team being available for assistance 24/7. Upon completion of this commissioning period the Contractor may apply for a Substantial Completion certificate.
- F. Performance Test: Any special tests, performed in the presence of the Engineer and Owner, called for by the specific equipment or system specification which 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 City Engineer when all or a part of the work as identified in the Engineer's certification, has been properly installed per the contract documents and manufacturer recommendations, deemed operational through the completion of the Pre-operational checkout, Functional Test, Operational Test, has all test documents with Operation and Maintenance manuals delivered, is sufficiently completed in accordance with the requirements of the Contract Documents and has been demonstrated through the 30 day Acceptance Test thus proving that the identified portion of the work can reliably be utilized for the purposes for which it is intended.

1.02 SUBMITTALS

Submittals shall be made in as required and in addition, the following specific information shall be provided

- 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 21 days prior to commencement.
- B. Quality Control Submittals:
 - 1. Manufacturer's Certificate of Proper Installation as required.
 - 2. Test Reports: Functional and performance testing, in format acceptable to Engineer and certification of functional and performance test for each piece of equipment or system specified.
 - 3. Certifications of Calibration: Testing equipment.

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4. Resumes of manufacturer's representatives that will be present onsite during startup testing activities.

1.03 CONTRACTOR FACILITY STARTUP RESPONSIBILITIES

A. General:

1. The Contractor shall provide, at no expense to the City, all power, fuel, compressed air supplies, water, and chemicals; as well as all 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 all 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 also provide all necessary qualified operations personnel and manufacturers field service personnel of the major equipment suppliers on an eight hour per day basis at the facilities and on a 24 hour per day basis locally during the operational and acceptance test period.
3. At no time during startup shall the Contractor allow the facility to be operated in a manner which 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 The Existing Systems

1. Anytime the Contractor ties into or modifies an existing system, a detailed work plan shall be required. Submittal of this work plan must 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 any gates or valves which must 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. A coordination meeting with the City's plant operating staff, the Contractor, the Engineer and the Designer must be held at least 7 days prior to the commencement of the modification or tie-in. The day before the commencement of the modification or tie-in, a final coordination meeting shall be held giving final detailed work assignments to all parties involved.
2. The City and Engineer have the right to require, at no additional cost to the City, stand-by equipment on any 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 is responsible for meeting all OSHA standards including entrance and exit safety, confined space entry, fall protection, scaffolding, rigging, etc.

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C. Contractor's Startup Quality Assurance Manager

1. The Contractor shall appoint an operations engineer or equally qualified operations specialist as Startup Manager to manage, coordinate, and supervise all aspects of the Contractor's startup and testing program including, but not limited to those components of the program as listed with this appendix. The Startup Manager shall have at least five (5) years of total experience, or experience on at least five separate projects, in managing the startup commissioning of mechanical, electrical, instrumentation, HVAC, and piping systems. Operations engineers shall be graduates from a minimum 4-year course in mechanical, civil or a related program of study. Operations specialists shall have equivalent documented experience in plant operation and maintenance. Contractor shall submit the Startup Manager's resume for review and approval a minimum of six months prior to any testing, or prior to 50% completion of the first constructed system.
2. (Not Used)

D. Contractor's Testing Team

1. Contractor's Testing Team shall include at a minimum the Quality Assurance Manager, qualified Mechanical/Equipment Foreman, qualified Electrical Journeyman, qualified Instrument Technician, and qualified/Certified Plant Operations personnel.
2. Contractor is responsible to have the appropriate personnel, procedures, and test forms at the test site when performing a scheduled checkout/testing activity that is to be witnessed by the City Engineer.

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 two (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 will fall between 60 and 85 percent of full scale. Pressure gages 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.
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 start-up 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

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acceptance of each performance test. All analysis instruments, sensors, gages, 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.

1.04 OWNER/ENGINEER FACILITY STARTUP RESPONSIBILITIES

A. General:

1. Review Contractor's test plan 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 and special tools and operation and maintenance information for Owner-furnished equipment.

PART 2 - PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.01 START-UP PROGRAM IMPLEMENTATION

A. Start-Up Meetings

1. The Contractor shall schedule and conduct regular periodic start-up meetings (separate from regular progress meetings). The start-up meetings will be held at least every 10 days (once start-up planning commences) and may be scheduled at a more frequent interval by the City Engineer if necessary. Start-up meetings shall be held at a location designated by the Contractor and approved by the City Engineer.
2. Start-up meetings shall be attended by the City Engineer, Contractor, Sub-contractors as appropriate to the agenda, suppliers as appropriate to the agenda, and others as required.
3. The meeting agenda shall generally include review and approval of minutes of previous meeting, review of start-up progress since the previous meeting, field observations, problems, and conflicts, problems which impede Start-Up Schedule, delivery schedules, corrective measures and procedures to regain the start-up schedule, revisions to Start-Up Schedule, progress and schedule of the preceding work period, coordination of schedules, review of start-up submittal schedules and status of start-up related requests for information, and any other business deemed appropriate.

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B. Start-up 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 the overall Start-up Acceptance Test Plan. The City Engineer will not witness any testing work until the Contractor has submitted a schedule to which the City Engineer 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, and also re-forecast the upcoming testing and reflect any schedule adjustments accompanied by written reason for the change. The Contractors baseline start-up and testing schedule is to be submitted with the overall test plan.

C. Documentation

1. The Contractor shall develop a records-keeping system to document all 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 City Engineer, the Contractor's Start-Up/Quality Assurance Manager, and the Equipment Manufacturer. A separate file shall be established for each system, organized by start-up phase (i.e., pre-operational, functional, operational, acceptance test phase), and will include sections for each item of equipment. These files shall include the following information and documentation as a minimum. Test plan and documentation organization shall be as follows:

a. Test Plan Organization

- i. Index.
- ii. Schedule
- iii. Step 1 & 2: Each type of equipment will 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.

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- iv. Step 3: A separate section will 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.
 - v. Step 4: Another section is to be designated for the Acceptance Testing and include the following:
 - a. Detailed work plans, communications plan, safety plan, and contingencies, as well as all other requirements.
 - b. 30 day test overview and proposed spreadsheet forms to be utilized by the Contractors staff to record appropriate operational and performance data on a regular interval for the 30 days.
 - c. System acceptance test completion/sign-off form.
6. The forms attached to this Appendix 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 nor 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 equipment and system installed under this contract. Acceptable example documentation forms for all systems and items of equipment shall be produced and submitted for review and approval by the City Engineer **[as a condition precedent to the Contractor's receipt of progress payments in excess of 60 percent of the contract amount]**. Once the City Engineer has reviewed and taken no exception to the 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 will be submitted for approval.
7. The complete test plan and all its sections are to be submitted (60 days prior to any testing) and approved, Code 1 or Code 1C, prior to the start of any testing.

3.02 TEST PLAN IMPLEMENTATION

- A. This program will be implemented in 4 distinct steps (phases). These steps are the Pre-Operational Checkout, the Functional Testing, the Operational Testing, and the Acceptance Testing.
- B. (Not used)

3.03 STEP 1 - PRE-OPERATIONAL CHECKOUT AND TESTING

- A. The first step involves the **Pre-operational checkout**. This would include 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:

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1. Wire insulation megohm reports for all 120V and greater wire.
2. 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. 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 manufacturers 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 manufacturers 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 insure the pipe testing was performed and signed as completed for all the associated piping.
4. Insure that the equipment is clean and free of any construction debris that could potentially cause a malfunction.
5. Insure that all safety guards, signage, and other safety measures such as hearing protection, etc., are in place.
6. Have the manufacturer's representative perform all pre-operational tests per the manufacturers' recommendations and review the equipment installation and sign the Manufacturer's Installation portion of the certification form. If the manufacturer's representative brings his own checklist, obtain a copy of the completed form and attach it to the Contractors completed forms. Note that the manufacturer must also fill out the contract approved checkout form (their own form will not serve as a substitute).
7. All gates and valves associated with the equipment system must be checked for proper installation, adjustment, and lubrication per the manufacturer's recommendations.

C. Concrete Tanks – Pre-Operational Checkout

1. All water-retaining concrete structures shall be tested for watertightness in accordance with ACI 350.1R. The maximum allowable leakage rate shall be 0.075% over a 24-hour period.

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D. 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. All 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 all 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 1000 volts DC.
2. Complete Test Form for each installed motor. Measure the insulation resistance of all motors before connection. Measure the insulation resistance for all motors at the time of delivery as well as when connected. Insulation resistance values less than 10 megohms are not acceptable.
3. Adjust and make operative all protective devices. Perform a functional check of the control circuit prior to energization of the equipment.
4. Review all associated electrical terminations, switches, and breakers for satisfactory installation.

E. 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, gages, and meters to be installed in that particular system have been calibrated and the calibration work has been witnessed by the City's Engineer.
3. Testing of instrument process piping/tubing, wiring and individual components shall be completed and documented on the approved test forms provided to the City Engineer 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. Any component which fails to meet the required tolerances shall be repaired by the manufacturer or replaced, and the above tests repeated until the component is within tolerance.
5. System instrumentation equipment supplied and installed must also be reviewed for proper installation and termination as part of the pre-operational checkout.

F. Pre-Operational Checkout Summary

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1. The pre-operational checkout and testing for each item shall be carried out in accordance with the Contractors submitted and approved procedures and documented on the Contractors 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 all components for the particular equipment.
2. The functional testing for each item of equipment shall be carried out in accordance with the Contractors submitted and approved procedures and documented on the Contractors approved functional test forms.
3. Once 1) all affected equipment has been subjected to the required pre-operational testing procedures; and 2) the City Engineer has witnessed and has not found deficiencies in that portion of the work, individual items of equipment and systems may 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 all 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 either be 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 which 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 City. Disposal methods for test media shall be subject to review by the City Engineer. During the functional test period, the Contractor shall obtain baseline operating data on all equipment with motors greater than 1 horsepower to include amperage, bearing temperatures, and vibration. The baseline data shall be collected for use in the CMMS.
4. Test results shall be within the tolerances set forth in the detailed specification sections of the Contract Documents and as indicated in the Contractors functional test plan and the manufacturers 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 City Engineer and the Contractor regarding the test results or the methods or equipment used in the performance of such test, then the City Engineer

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may order the test to be repeated at the Contractors 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 his expense.

B. The **Functional Test** reports (test documentation) 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 check 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.
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 Contractors 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 Contractors approved functional test form as well as their own signed report to record the results of his/her 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 ensure proper maintenance.

D. Electrical - (Functional Testing)

1. The Contractors' electrician shall be present during all 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 his proposed functional electrical test procedures as part of the testing plan. Lockout/tagout energized areas as needed during testing.
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 will be damaged by reverse operation.

E. Instrumentation and Control – (Functional Testing)

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1. The Contractors' instrumentation representative shall be on site full time during the functional test phase to perform loop checks and to support the Contractors start-up team as needed. Any packaged equipment or manufacturer supplied control panels must be field tested to verify all control interlocks and control functions during this phase of testing by the equipment supplier. Note that the Contractors 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 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 all instruments operate properly.

F. Functional Testing Summary

1. The functional testing for each item of equipment, electrical, and instrumentation shall be carried out in accordance with the Contractors submitted and approved procedures and documented on the Contractors approved functional test forms.
2. (Not Used)

3.05 STEP 3 – OPERATIONAL TESTING

- A. The third step in the program is the Operational Testing. This step begins after all Pre-operational checks and Functional tests have been satisfactorily completed. The Contractor shall plan his activities to allow for City witnessing of all tests and shall provide twenty-four (24) hours advance notice of all testing activities.
- B. The Contractors operational test plan shall be a detailed procedure to confirm all System Automatic Mode functions, verify all system interlocks, and reconfirm all equipment functions and controls. All design and performance criteria will be demonstrated and documented during this 5 day period. The Contractors manufacturer, electrical, and instrumentation representatives will be on site on an 8 hour a day basis and locally on a 24 hours 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, all necessary alterations, adjustments, repairs and replacements shall be made. When the system is again ready for operation, it shall be brought on line 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 Owner and Engineer, 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 all 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

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maintenance equipment, lubricants, approved operation and maintenance data and the specified operation and maintenance instruction prior to the startup with plant process media. All 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. Also a 30 day test overview and proposed spreadsheet forms to be utilized by the Contractors operations staff to record appropriate operational and performance data on a regular interval for the 30 days.

D. **Prerequisites**

1. Prior to the City's issuance of a Certificate of Substantial Completion for all work, the Contractor shall perform Acceptance Testing. Acceptance Testing and the Acceptance Test Plan shall comprehensively cover all 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 re-starting the acceptance testing period. The testing period shall be a minimum of 30 days of continuous operation, during which the facility must meet the following criteria:
2. Continuous satisfactory operation at the rated capacity;
3. Operation without violating the Contract Standards;
4. Operation without creating a materially unsafe condition, nuisance condition or unacceptable risk to personnel, facilities or the public;
5. Operation without producing Biosolids products, air or water emissions, traffic, noise, odors, or other environmental impacts that the City, in its sole discretion, determines to be unacceptable to public safety, health or welfare.
6. All portions of the acceptance test phase will 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 Contractors acceptance test plan.

E. Instrumentation Acceptance Test

1. The instrument loop acceptance test shall fully demonstrate stable operation of the loop under normal operating conditions. This test shall be witnessed by a City Engineer and performed and documented by the Instrumentation System Supplier.
2. 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

1. Liquid flow meters, including all open channel flow meters and all meters installed in pipelines with diameters greater than 2 inches shall be calibrated insitu 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 insitu using the pitot tube

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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 a City Engineer. Confirmed data points shall be validated by not less than three test runs with results which agree within plus or minus 2 percent.

- G. In the event of failure to demonstrate satisfactory performance of the system on the first or any subsequent attempt, all necessary alterations, adjustments, repairs and replacements shall be made. When the system is again ready for operation, it shall be brought on line 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 Owner and Engineer, for the specified duration.
- H. All completed operational test forms will be placed into the master record test plan binder and provided to the City of Atlanta prior to acceptance.

+++ END OF SECTION 01650 +++

**SECTION 01664
TRAINING**

PART 1 – GENERAL

1.01 DESCRIPTION

- A. Reference sections 01640, MANUFACTURER’S SERVICES, 01650, FACILITY STARTUP and 13000 INSTRUMENTATION, CONTROL AND MONITORING SYSTEM GENERAL REQUIREMENTS
- B. This section contains requirements for training the City's personnel, by persons retained by the CONTRACTOR specifically for the purpose, in the proper operation and maintenance of the equipment and systems installed under this Contract.

1.02 QUALITY ASSURANCE

- A. Where required by the detailed specifications, the CONTRACTOR shall provide on-the-job training of the City's personnel. The training sessions shall be conducted by qualified, experienced, factory-trained representatives of the various equipment manufacturers. Training shall include instruction in both operation and maintenance of the subject equipment.

1.03 SUBMITTALS

- A. The following information shall be submitted to the City’s Engineer in accordance with paragraph GC-31 of the GENERAL CONDITIONS. The material shall be reviewed and accepted by the City’s Engineer as a condition precedent to receiving progress payments in excess of 75 percent of the Contract amount and not less than 3 weeks prior to the commencement of training.
 - 1. Lesson plans for each training session to be conducted by the manufacturer's representatives. In addition, training manuals, handouts, visual aids, and other reference materials shall be included.
 - 2. Subject of each training session, identity and qualifications of individuals to be conducting the training, and tentative date and time of each training session.

PART 2 - PRODUCTS

2.01 GENERAL

- A. Where specified, the CONTRACTOR shall conduct training sessions for the City's personnel to instruct the staff on the proper operation, care, and maintenance of the equipment and systems installed under this contract. Training shall take place at the site of the work after the equipment has been installed and tested and under the conditions

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specified in the following paragraphs. Approved operation and maintenance manuals shall be available at least 30 days prior to the date scheduled for the individual training session.

2.02 LOCATION

- A. Training sessions shall take place at the site of the work.

2.03 LESSON PLANS

- A. Formal written lesson plans shall be prepared for each training session. Lesson plans shall contain an outline of the material to be presented along with a description of visual aids to be utilized during the session. Each plan shall contain a time allocation for each subject.
- B. One complete set of originals of the lesson plans, training manuals, handouts, visual aids, and reference material shall be the property of the City and shall be suitably bound for proper organization and easy reproduction. The CONTRACTOR shall furnish ten copies of necessary training manuals, handouts, visual aids and reference materials at least 1 week prior to each training session.

2.04 FORMAT AND CONTENT

- A. Each training session shall be comprised of time spent both in the classroom and at the specific location of the subject equipment or system. As a minimum, training session shall cover the following subjects for each item of equipment or system:
 - 1. Familiarization:
 - a. Review catalog, parts lists, drawings, etc., which have been previously provided for the plant files and operation and maintenance manuals.
 - b. Check out the installation of the specific equipment items.
 - c. Demonstrate the installed unit and indicate how all parts of the specifications are met.
 - d. Answer questions.
 - 2. Safety:
 - a. Using material previously provided and installed equipment, review safety references.
 - b. Discuss proper precautions around equipment.

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3. Operation:
 - a. Using material previously provided and installed equipment, review reference literature.
 - b. Explain all modes of operation (including emergency).
 - c. Check out City's personnel on proper use of the equipment.
4. Preventive Maintenance:
 - a. Using material previously provided and installed equipment, review preventive maintenance (PM) lists including:
 1. Reference material.
 2. Daily, weekly, monthly, quarterly, semi-annual, and annual jobs.
 - b. Show how to perform PM jobs.
 - c. Show City's personnel what to look for as indicators of equipment problems.
5. Corrective Maintenance:
 - a. List possible problems.
 - b. Discuss repairs; point out special problems.
 - c. Open up installed equipment and demonstrate procedures, where practical.
6. Parts:
 - a. Show how to use previously provided parts list and order parts.
 - b. Check over spare parts on hand. Make recommendations regarding additional parts that should be available.
7. Local Representatives:
 - a. Where to Order Parts: Name, address, and telephone.
 - b. Service Problems:
 1. Who to call.
 2. How to get emergency help.
8. Operation and Maintenance Manuals:

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- a. Review any other material submitted.
- b. Update material, as required.

2.05 VIDEO RECORDING

- A. The CONTRACTOR will retain the services of a commercial video taping service to record each training session. After taping, the material may be edited and supplemented by the City with professionally produced graphics to provide a permanent record. The CONTRACTOR shall advise all manufacturers providing training sessions that the material will be videotaped.

PART 3 – EXECUTION

3.01 GENERAL

- A. Training shall be conducted in conjunction with the operational testing and commissioning periods. Classes shall be scheduled such that classroom sessions are interspersed with field instruction in logical sequence. The CONTRACTOR shall arrange to have the training conducted on consecutive days, with no more than 6 hours of classes scheduled for any one day. Concurrent classes shall not be allowed. Contractor/Manufacturer is to plan for up to three classes in any 24 hour period to ensure all shifts are properly trained
- B. Acceptable operation and maintenance manuals for the specific equipment shall be provided to the City prior to the start of any training. Video taping shall take place concurrently with all training sessions.
- C. The following services shall be provided for each item of equipment or system as required in individual specification sections. Additional services shall be provided, where specifically required in individual specification sections.
 1. As a minimum classroom equipment training for operations personnel will include:
 - a. Using slides and drawings, discuss the equipment's specific location in the plant and an operational overview.
 - b. Purpose and plant function of the equipment.
 - c. A working knowledge of the operating theory of the equipment.
 - d. Startup, shutdown, normal operation, and emergency operating procedures, including a discussion on system integration and electrical interlocks, if any.
 - e. Identify and discuss safety items and procedures.

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- f. Routine preventative maintenance, including specific details on lubrication and maintenance of corrosion protection of the equipment and ancillary components.
 - g. Operator detection, without test instruments, of specific equipment trouble symptoms.
 - h. Required equipment exercise procedures and intervals.
 - i. Routine disassembly and assembly of equipment if applicable (as judged by the City on a case-by-case basis) for purposes such as operator inspection of equipment.
2. As a minimum, hands-on equipment training for operations personnel will include:
- a. Identify location of equipment and review the purpose.
 - b. Identifying piping and flow options.
 - c. Identifying valves and their purpose.
 - d. Identifying instrumentation:
 - a. Location of primary element.
 - b. Location of instrument readout.
 - c. Discuss purpose, basic operation, and information interpretation.
 - e. Discuss, demonstrate, and perform standard operating procedures and routine checks.
 - f. Discuss and perform the preventative maintenance activities.
 - g. Discuss and perform startup and shutdown procedures.
 - h. Perform the required equipment exercise procedures.
 - i. Perform routine disassembly and assembly of equipment if applicable.
 - j. Identify and review safety items and perform safety procedures, if feasible.
3. Classroom equipment training for the maintenance and repair personnel will include:
- a. Theory of operation.
 - b. Description and function of equipment.

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- c. Startup and shutdown procedures.
 - d. Normal and major repair procedures.
 - e. Equipment inspection and troubleshooting procedures including the use of applicable test instruments and the "pass" and "no pass" test instrument readings.
 - f. Routine and long-term calibration procedures.
 - g. Safety procedures.
 - h. Preventative maintenance such as routine lubrication; normal maintenance such as belt, seal, and bearing replacement; and up to major repairs such as replacement of major equipment part(s) with the use of special tools, bridge cranes, welding jigs, etc.
4. Hands-on equipment training for maintenance and repair personnel shall include:
- a. Locate and identify equipment components.
 - b. Review the equipment function and theory of operation.
 - c. Review normal repair procedures.
 - d. Perform startup and shutdown procedures.
 - e. Review and perform the safety procedures.
 - f. Perform City approved practice maintenance and repair job(s), including mechanical and electrical adjustments and calibration and troubleshooting equipment problems.

+ + + END OF SECTION 01664 + + +

SECTION 01720 - RECORD DOCUMENTS

PART 1 - GENERAL

1.1 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 include, but are not limited to:
 - 1. Record Drawings
 - 2. Specifications
 - 3. Change orders and other modifications to the Contract
 - 4. Field orders or written instructions, including Requests for Information (RFI) and Design Clarification Memorandums
 - 5. Requests for Information and Design Clarification Memoranda
 - 6. Approved Shop Drawings and samples
 - 7. Field Test Records
 - 8. Coordinates for centerline of Water Main at 100-foot stationing
 - 9. Original copies of all Warranties
 - 10. Final Operation and Maintenance Manuals
- C. The Contractor shall maintain a current set of Record Drawings and GIS data at the project locations or at a location as agreed to by the City's Authorized Representative throughout the Contract Time. These drawings must be the latest revision and match that of the City's Authorized Representative.

1.2 MAINTENANCE OF DOCUMENTS AND SAMPLES

- A. Storage:
 - 1. Store documents and samples in the Contractor's office, apart from documents used for construction
 - 2. Provide files and racks for storage of documents
 - 3. Provide locked cabinet or secure storage space for storage of samples
- B. File documents and samples in accordance with format of these Specifications
- C. Maintenance:
 - 1. Maintain documents in a clean, dry, legible condition and in good order.
 - 2. Do not use Record documents for construction purposes.
- D. Make documents and samples available at all times for inspection by City's Authorized Representative.
- E. Failure to maintain the Record Documents in a satisfactory manner may be cause for withholding payment.

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1.3 QUALITY CONTROL

- A. Unless noted otherwise, Record Drawings and corresponding GIS data shall provide dimensions, distances, coordinates to the nearest 0.1 foot in North American Datum of 1983 (1986 adjustment) Georgia State Plane West 1002 System format. All coordinate values shall be provided as grid coordinates in US Survey Feet.
- B. Unless noted otherwise, Record Drawings and corresponding GIS data shall provide elevations to the nearest 0.01 foot referenced to the North American Vertical Datum of 1988 (NAVD88) format. All coordinate values shall be provided as grid coordinates in US Survey Feet.
- C. Any transformation or adjustment necessary to project surveyed coordinates to the Reference Coordinate System will be the responsibility of the Contractor.
- D. The Contractor shall employ a Professional Land Surveyor (PLS) licensed in the State of Georgia to certify the Record Drawings from the collected GIS data or a post construction, field survey of all water line and appurtenances newly constructed, replaced or otherwise adjusted in position or elevation. Additionally, the contractor shall submit the corresponding GIS data to indicate the as-built condition and GIS data attributes of these structures and pipelines. A post construction survey is not required for rehabilitation projects where lines or appurtenances are not adjusted; however, the GIS data attributes shall be updated to indicate the physical as-built condition.

1.4 DATA ACCURACY

- A. High Resolution: For all water line appurtenances including but not limited to valves, hydrants, and meters, the equipment and means used by Contractor must generate the position of points with a minimum accuracy of three (3) centimeters horizontal and three (3) centimeters vertical. To determine the accuracy obtained, Contractor's GPS system will be calibrated daily against a known point (monuments) prior to beginning work and when the work is completed. The Contractor shall submit a report to the City's Authorized Representative certifying calibration was accomplished and indicating the reference system. Data delivered to the City's Authorized Representative arising from the GPS survey shall be certified by a Professional Land Surveyor. When the GPS equipment cannot be set directly on the point, conventional surveying methods will be used to establish the position to the stated level of accuracy.
- B. Calibration shall be carried out at least on a daily basis in accordance with the GPS equipment manufacturer's instructions. Additional calibrations may be required during the course of the working day for large fluctuations of temperature and/or humidity, also in accordance with the manufacturer's instructions and tolerances. The Contractor shall submit a report to the City's Authorized Representative certifying calibration was accomplished and indicating the reference system.

1.5 INTERFERENCE

- A. A GPS position is required for all newly constructed, replaced or adjusted water line structures regardless of the overhead conditions or other nearby obstructions which may interfere with satellite signals, at no additional cost. In the event coverage conditions do not allow all positions to be obtained by setting directly over the point, rangefinders or other conventional surveying methods may be used to obtain the position of the point(s).

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1.6 RECORDING

- A. Label each document "PROJECT RECORD" in neat, large printed letters.
- B. Recording:
 - 1. Record information concurrently with construction progress.
 - 2. Do not conceal any work until required information is recorded.

1.7 RECORD DRAWINGS

- A. The Contractor must maintain an up-to-date field record set of Record drawings by marking changes and other information directly on a clean set of full-size contract drawings. The Contractor shall submit up-to-date Record drawings with monthly pay applications and have them available for review at monthly progress meetings. Approval of monthly pay applications will not occur until the updated Record drawings are approved. The City's Authorized Representative will review the working drawings to confirm that the recorded information is current.
- B. Record Drawings are a final deliverable and shall be reproducible, shall have a title block indicating that the drawings are Record Drawings, the name of the company preparing the Record Drawings, and the date the Record Drawings were prepared. The Contractor shall provide record drawings in both PDF form as well as the native format (for platcard and GIS update).
- C. Legibly mark Record drawings to record actual construction, including:
 - 1. All Construction:
 - a. Changes of dimension, diameter, or material and detail.
 - b. Location (address, intersections, other) and type of work performed on each manhole or water line (indicate asset ID numbers)
 - c. Changes made by Requests for Information (RFI), field order, clarification memorandums or by change order
 - d. Details not on original Drawings
 - e. The distance (length) between valves on pipe segments where work was performed.
 - 2. Structures:
 - a. Position coordinates, as well as elevations of all water line appurtenances where they have been newly constructed, replaced or adjusted.
 - 3. Mains:
 - a. Class, Date of Installation, Failure type (corrosion, bell split, circumferential cracking, longitudinal cracking, etc.), GPS coordinates (repair location), Lining type, Manufacturer, Material, Size.
 - 4. Hydrants:
 - a. Barrel Size, Date of installation, GPS coordinates, Height, Manufacturer, Number/size of nozzle.
 - 5. Valves:
 - a. Date of installation, Depth to operating nut, Direction to open, GPS coordinates, Manufacturer, Number of turns, Pressure rating, Size, Stem length (when applicable), Type, Vertical or horizontal.
 - 6. Meters:
 - a. Date of Installation, GPS Coordinates, Location Notes, Serial Number, Size, Manufacturer, Type, Model, As-built Register Information for high and low registers. See Section 02668 for additional as-built information.
 - 7. Registers:

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- a. Date of Installation, Serial Number, Size, Type, Register Readings at time of vault delivery/customer connection /meter removal, AMR Readings obtained from drive-by AMR reading location. See Section 02668 Water Installations for additional as-built information.
8. Detector Checks:
 - a. Date of Installation, GPS Coordinates, Serial Number, Size, Manufacturer, Type, Detector Check Bypass Assembly Size, Detector Check Bypass Assembly Meter Information (see above). See Section 02668 Water Installations for additional as-built information.
9. Meter Boxes, Meter Vaults and Detector Check Vaults:
 - a. Date of Installation, GPS Coordinates, Schematic of piping and equipment within vaults, Internal dimensions of vault and hatch (L x W x D), Design loading. See Section 02668 Water Installations for additional as-built information.
10. Water Service Lines
 - a. Date of Installation, GPS Coordinates for tapping and abandonment locations.
 - b. See Section 02668 Water Installations for additional as-built information.
11. Other:
 - a. GPS coordinates for fittings (tees, elbows, sleeves, taps), Type of fittings.

1.8 SPECIFICATIONS

- A. Legibly mark each Record drawing to record:
 1. Manufacturer, trade name, catalog number, and supplier of each product and item of equipment actually installed.
 2. Changes made by Requests for Information (RFI), field order, clarification memorandums, or by change order.

1.9 GIS DATA

- A. Contractor shall provide a GIS data file containing both electronic and hard copy format at the completion of each newly installed or relocated water line (includes fire hydrants, valves, vaults, deadmen, dead ends etc.). The hard copy data must be submitted for approval by the City's Authorized Representative. Electronic data will not be accepted without hard copy data. Data shall be submitted in an ESRI shapefile format. Shapefile shall include data pertaining to all associated appurtenances, elevations, pipe diameters, material composition, install date. Each submittal must be numbered according to the numbering system outlined in Specification Section 01350.
- B. The hard copy data shall include a cover letter and printed spreadsheet that corresponds to the electronic data submitted. If the survey work is performed by a subcontractor, the cover letter shall provide certification of data accuracy by a Professional Land Surveyor (PLS) licensed in the State of Georgia. If the survey work is performed by the prime Contractor, the cover letter shall provide certification of data accuracy by a Professional Land Surveyor (PLS) licensed in any State in the United States of America. The hard copy data must be bound, with the PLS seal placed on the cover letter; OR, the hard copy data may be submitted unbound, with the PLS seal placed on each and every sheet of unbound data submitted.
- C. The attached GPS Certification Form shall be signed and sealed by a Registered Land Surveyor in Georgia and submitted for each identifiable water distribution feature.

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- D. Numerical value measurement data precision shall be 1/1000 or three decimal places. Each data worksheet shall include individual data records arranged in template formats and header values conforming to examples provided below;

1.10 SUBMITTAL

- A. At work assignment or contract closeout (whichever comes first), the Contractor shall submit two copies of Record Documents to the City's Authorized Representative.
- B. The submittal shall include a transmittal letter, in duplicate, containing;
 - 1. date
 - 2. project title and number
 - 3. contractor's name and address
 - 4. title and number of each record document and
 - 5. Signature of Contractor or Contractor's authorized representative.
- C. Additionally, the Contractor shall edit the digital PDF(s) files furnished for each Project to include all changes based upon actual field conditions. The Contractor shall submit marked up map(s) showing the position of unmapped and incorrectly positioned structure(s) and/or pipelines discovered during the work. All map(s) shall be marked up with red text and delivered to the City's Authorized Representative upon the completion of each watershed. Supplemental sketches shall also be provided in red text, as necessary to clearly depict the actual site conditions including, but not limited to congested areas and established access roads. A legend shall be added to the title block indicating the symbology, color coding and descriptions. The date, the words "As-Built" and company name shall also be included in the title block.

END OF SECTION 01720

ATTACHMENT A



GPS CERTIFICATION FORM

The purpose of this form is to provide the City of Atlanta with additional GPS/Survey information necessary to maintain the GIS system. This form should be completed for each sewershed and submitted with the Certified GPS.

Name of Sewershed:	Contractor Name: Contact Number:	Surveyor Name: Contact Number:
Brief description of survey equipment used: (Manufacturer, Model No., Age)		
<p>Reference Coordinate System used</p> <p>a. Horizontal</p> <ul style="list-style-type: none"> • Datum _____ • Adjustment _____ • Coordinate System _____ • Unit of Measure _____ <p>b. Vertical</p> <ul style="list-style-type: none"> • Datum _____ • Geoid Model _____ • Unit of Measure _____ <p>c. Geodetic monuments used or name of network RTK service _____</p> <p>d. Scale factors for Conventional Survey _____</p> <p>e. If calibration or transformation was applied, list parameters _____</p> <p>f. Are coordinates Grid or Ground? _____</p>		

Signature and Seal of Surveyor

Date

SECTION 01730 OPERATING AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 SCOPE

- A. The Contractor shall provide three hard copies and two digital copies of a complete and comprehensive reference manual (Operating and Maintenance Manual) containing operating and maintenance data to enable operators and plant Owners to correctly operate, service and maintain all equipment and accessories covered by the Specifications and Drawings. The data contained in the manual shall explain and illustrate clearly and simply all principles and theory of operation, operating instructions, maintenance procedures, calibration procedures and safety precautions and procedures for the equipment involved.
- B. No separate payment will be made for the Operating and Maintenance Manuals and the cost of said manual shall be included in the Contract Price.

1.2 SUBMITTAL SCHEDULE

- A. The Contractor shall submit, for the Owner's approval, two preliminary drafts of proposed formats and outlines of contents of manuals within 60 calendar days after the Notice to Proceed. The Owner will notify the Contractor, in writing, of any deficiencies and will return one copy of the submittal for completion and/or correction.
- B. Submit three preliminary copies and one digital copy of the manuals before the work covered by the Contract Documents is 50 percent complete. The Owner will notify the Contractor, in writing, of any deficiencies in the manuals and will return one copy of the manual for completion and/or correction.
- C. Before the work covered by the Contract Documents is 75 percent complete, the Contractor must submit three hard copies and two digital copies of the revised and completed manual, complete in detail as specified below.

1.3 SUBMITTAL FORMAT

- A. Format for Printed and Bound Document:
 - 1. Each hard copy of the manual shall be assembled in one or more loose leaf binders, each with title page, typed table of contents, typed list of tables, typed list of figures, and heavy section dividers with reinforced holes and numbered plastic index tabs.
 - 2. Binders shall be uniform for all manuals and shall be 3-ring, hardback type, with transparent vinyl pocket front cover suitable for inserting identifying cover and with a transparent vinyl pocket on the spine for label.
 - a. Composition and printing shall be arranged so that punching does not obliterate any data.
 - b. The cover and binding edge of each manual shall have the Project title, Specification section number and title, and manual title printed thereon, all as approved by the Owner.

Water Supply Tunnel System Connection to Chattahoochee Water Treatment Plant

3. Drawings:
 - a. All copies of Shop Drawings, figures and diagrams shall be reduced to either 8-1/2 by 11-inches or to 11-inches in the vertical dimension and as near as practical to 17-inches in the horizontal dimensions.
 - b. Whenever possible, material shall be 8-1/2 inches by 11 inches or 11 inches by 17 inches z-folded to 8-1/2 inches by 11 inches. If necessary, materials larger than 11 inches by 17 inches may be provided; however, they shall be folded to approximately 8-1/2 inches by 11 inches so that the title block is clearly visible without unfolding.
4. Each submittal shall have a cover sheet that includes the following information:
 - a. The date of submittal and the dates of any previous submittals.
 - b. The Project title.
 - c. Submittal numbering shall be in accordance with The City of Atlanta's latest standard specifications.
 - d. The names of the Contractor, Supplier, and Manufacturer.
 - e. Identification of the product, with the Specification section number, permanent equipment tag numbers and applicable Drawing No.

B. Format for Digital Copy:

1. All textual data shall be provided as a single electronic file in searchable Adobe Acrobat Portable Document Format (PDF).
2. The PDF file(s) shall be fully indexed using the Table of Contents, searchable with thumbnails generated.
3. All text in the document must be text selectable with the exception of pages which are in their entirety are Drawings or diagrams.
4. Word searches of the PDF document must function successfully.
5. All Drawing data shall be provided in digital format.
6. Materials not available in original digital format (available only in paper format) shall be scanned as noted above into a PDF format and cleaned to remove smudges, fingerprints, artifacts, and other extraneous marks.
7. All notes, version stamps, etc. shall be preserved.
8. Color maps, color photographs, and black and white and gray scale photograph files shall be saved as GIF or JPG files, compatible with an extractable viewer such as Adobe Photoshop or equivalent.

1.4 CONTENTS OF OPERATING AND MAINTENANCE MANUAL

- A. A check list shall be completed and provided with each submittal indicating the contents of the manual. The check list to be used by the Contractor will be provided at the Preconstruction Conference.
- B. General: All material shall be tailored to the specific function that the equipment serves in the facility.
- C. If material covers more than one product type or includes equipment information not relevant to the project, the applicable information for the equipment supplied shall be clearly indicated by bubbles or arrows.
- D. Highlighting that obliterates the information when photocopied or scanned is not acceptable.

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- E. If catalog cuts are included in the submittal, the catalog name and number, and the company name, address and telephone number shall be provided on the catalog cut or typewritten on a separate sheet of paper.
- F. Neatly typewritten table of contents for each volume, arranged in systematic order.
 - 1. Contractor, name of responsible principal, address and telephone number.
 - 2. A list of each product required to be included, indexed to content of the volume.
 - 3. List, with each product, name, address and telephone number of:
 - 4. Local source of supply for parts and replacement.
 - 5. Manufacturer.
 - 6. Identify each product by product name and other identifying symbols as set forth in Contract Documents.
 - 7. A Table of Contents for each equipment manual that reflects all procedure numbers, page numbers, figure numbers, and tables, as well as the volumes, chapters, and/or sections of each manual.
- G. Product Data:
 - 1. Include only those sheets which are pertinent to the specific product.
 - 2. Annotate each sheet to:
 - a. Clearly identify specific product or part installed.
 - b. Clearly identify data applicable to installation.
 - c. Delete references to inapplicable information.
- H. Drawings:
 - 1. Supplement products data with Drawings as necessary to clearly illustrate:
 - a. Relations and component parts of equipment and systems.
 - b. Control and flow diagrams.
 - 2. Coordinate Drawings with information in Project Record Documents to assure correct illustration of completed installation.
 - 3. Do not use Project Record Documents as maintenance drawings.
- I. Written text, as required to supplement product data for the particular Installation:
 - 1. Organize in consistent format under separate headings for different procedures.
 - 2. Provide logical sequence of instructions of each procedure.
- J. Copy of each warranty, bond and service contract issued.
- K. Provide information sheet for Owner's personnel including:
 - 1. Proper procedures in event of failure.
 - 2. Instances which might affect validity of warranties or bonds.
- L. Provide Equipment Data in Excel spreadsheet format (for use in Owner's Computerized Maintenance Management System).
 - 1. Equipment ID (ISA tag number or as shown on the Drawings).
 - 2. Sub-unit.
 - 3. Description.
 - 4. Area (Name of Water Reclamation Facility, e.g., W.B. Casey WRF).
 - 5. Equipment Type (e.g. Check Valve).
 - 6. Manufacturer.
 - 7. Model Number.
 - 8. Serial Number.

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9. Equipment Location.

- M. Detailed disassembly, overhaul and reassembly, installation, alignment, adjustment and checking instructions.
- N. Detailed operating instructions for start-up, calibration, routine and normal operation, regulation and control, safety, shutdown and emergency conditions. Detailed list of settings for relays, pressure switches, temperature switches, level switches, thermostats, alarms, relief valves, rupture discs, etc.
- O. Detailed preventative maintenance procedures and schedules, including detailed lubrication instructions and schedules, identification of required lubricants and operating fluids (description, specification and trade name of at least two manufacturers), and diagrams illustrating lubrication points.
- P. Detailed guide to equipment and/or process “troubleshooting”.
- Q. Detailed parts lists identified by title, materials of construction, manufacturer's part number, list of recommended spare parts identified as specified above, current cost list for recommended spare parts, predicted life of parts subject to wear, and an exploded or concise cut-away view of each equipment assembly.
- R. Electrical and instrumentation schematics, including motor control centers, control panels, wiring diagrams, instrument panels and analyzer panels.
- S. List of all special tools supplied and description of their use. Special tools include any tool not normally available in an industrial hardware or mill supply house.
- T. List of names and addresses of nearest service centers for parts, overhaul and service.
- U. Procedures for storing, handling and disposing of any chemicals or products used with the equipment or system.
- V. For equipment and systems, also provide the following:
 - 1. Control and wiring diagrams provided by the controls manufacturer.
 - 2. Sequence of operations by the controls manufacturer.
 - 3. Charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
- W. The supplier's operation and maintenance information will address the particular equipment furnished, with specific details on operation and maintenance practices. General data is not acceptable. Information contained in the manual which is not appropriate to the Project shall be marked out and noted as “N/A.”

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 01730

OPERATING AND MAINTENANCE DATA 01730 - 4

Water Supply Tunnel System Connection to Chattahoochee Water Treatment Plant

SECTION 01740 - CLEANING AND DISPOSAL

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. During the progress of the Work Contractor shall keep the Project work area and other immediate impacted areas free from accumulations of waste materials, rubbish, and other debris. Removal and disposal of such waste materials, rubbish, and other debris shall conform to applicable Laws and Regulations. At the completion of the Work, the Contractor shall remove from the Project work area, all waste materials, rubbish, debris, tools, appliances, construction equipment and machinery, and surplus materials and shall restore to original condition all property not designated for alteration by the Contract Documents.

1.2 RELATED WORK

- A. Each Section: Cleaning for specific products or work.

1.3 DISPOSAL AND CLEANING

- A. Conduct cleaning and disposal operations to comply with codes, ordinances, regulations and anti-pollution laws.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Use only those cleaning materials which will not create hazards to health or property and which will not damage surfaces.
- B. Use only those cleaning materials and methods recommended by manufacturer of the surface material to be cleaned.
- C. Use cleaning materials only on surfaces recommended by cleaning material manufacturer.

PART 3 - EXECUTION

3.1 DURING CONSTRUCTION

- A. Execute periodic cleaning to keep the work, the site and adjacent properties free from accumulations of waste materials, rubbish and windblown debris, resulting from construction operations.
- B. Provide on-site containers for the collection of waste materials, debris and rubbish.

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- C. Remove waste materials, debris and rubbish from the site periodically and dispose of at legal disposal areas away from the site.
- D. Refer to Section 01060 for Stormwater discharges

3.2 DUST CONTROL

- A. Clean interior spaces prior to the start of finish painting and continue cleaning on an as-needed basis until painting is finished.
- B. Schedule operations so that dust and other contaminants resulting from cleaning process will not fall on wet or newly-coated surfaces.

3.3 FINAL CLEANING

- A. Employ skilled workmen for final cleaning.
- B. Remove grease, mastic, adhesives, dust, dirt, stains, fingerprints, labels and other foreign materials from sight-exposed interior and exterior surfaces.
- C. Wash and shine glazing and mirrors.
- D. Polish glossy surfaces to a clear shine.
- E. Ventilating Systems:
 - 1. Clean permanent filters and replace disposable filters if units were operated during construction.
 - 2. Clean ducts, blowers and coils if units were operated without filters during construction.
- F. Broom clean exterior paved surfaces; rake clean other surfaces of the grounds.
- G. Prior to final completion, or Owner occupancy, conduct an inspection of sight-exposed interior and exterior surfaces and all work areas, to verify that the entire work is clean.

END OF SECTION 01740

SECTION 01780

ASSET MANAGEMENT RECORDS

PART 1 - GENERAL

1.01 SCOPE:

The work under this Section includes gathering and electronically recording financial and technical information needed to support the Owner's Fixed Asset Registry and Computerized Maintenance Management System (CMMS).

1.02 FIXED ASSETS:

- A. The Contractor shall generate the financial information necessary to support the Owner's Fixed Asset Registry, CMMS and submit the information periodically, as directed by the Engineer.
- B. Financial information (Purchase/Salvage/Disposal Price) shall be provided for the following categories of assets:
 - 1. Equipment - All equipment with a purchase value of \$5,000 or more and all equipment that has been assigned an "equipment" or "tag" number in contract documents. The term "equipment" includes but is not limited to: all process equipment, HVAC equipment, instrumentation, valves and gates (including actuators), tanks, electrical panels (including switchgear, MCCs, VFDs, panel boards, automatic transfer switches, heat trace panels, and the like), factory and field control panels, patch panels, control system panels (including PLC and DCS cabinets, marshalling (I/O) cabinets, etc.), roll-up doors, cranes and hoists, copiers, maintenance equipment, shelving, cabinets, laboratory equipment, furniture and A/V equipment. The asset value of the equipment shall be the Contractor's actual purchase price without installation, taxes, overheads, or mark-ups. The Contractor shall obtain a breakdown of equipment values from its vendors and suppliers, where possible, and use its best efforts to provide or estimate the actual purchase price. In addition, the Contractor shall provide an estimate of the cost of installation of each equipment item (e.g., setting, aligning, grouting, etc.)
 - 2. Structure – The cost of structures (typically those structures that require individual building permits) including all labor associated with the structure and all materials (including piping, raceway, wiring, supports, and appurtenances) incorporated into the structure. The structure cost shall include all improvements to the structure and, as applicable, the cost of demolition or other changes to the structure, as directed by the Engineer.
 - 3. Site Improvements – The cost of site improvements shall include all

- earthwork, manholes / handholes, culverts and drainage structures, piping, ductbank and wiring not incorporated in a structure, roads, curbs, sidewalks, grassing and landscaping, demolition, and any other improvements to the site. The site improvements cost shall include all improvements to the site and, as applicable, the cost of demolition or other changes to the site, as directed by the Engineer.
4. Special Items – Certain portions of the construction may have a different useful life (from an accounting standpoint). An example of this is roofing on a structure. These special items, as directed by the Engineer, shall be listed separately. The Contractor shall also provide an estimate of the installation cost of the special item.
 5. General Costs - The Contractor shall provide, as a separate line item when directed by the Engineer, the contractor's general costs (general conditions, field engineering, management, supervision, overhead, profit, mobilization, demobilization, permits, bonds, insurance, etc.), associated with the Project.
 6. Salvage Items - The Contractor shall provide, as a separate line item when directed by the Engineer, description of items removed from service and returned to the City as Salvage associated with the Project.
 7. Disposed Items - The Contractor shall provide, as a separate line item when directed by the Engineer, description of items removed from service and disposed associated with the Project.
- C. The Contractor shall provide the required financial information in a format acceptable to the Engineer, with the cost information displayed individually, distributed, or rolled up as directed by the Engineer. See Part 1.06 for examples.
- D. Information to be included as part of fixed asset reporting shall include, as applicable:
1. Tag Number (equipment number, structure number, other unique identification number, as applicable, and as directed by the Engineer)
 2. Structure Name (for site improvements use "Site Improvements")
 3. Description (equipment description or description of asset)
 4. Manufacturer
 5. Vendor (or supplier)
 6. Model Number
 7. Serial Number
 8. Purchase Price (cost as defined above, if applicable)
 9. Installed Date (usually the date of Substantial Completion) or Date removed from service
 10. Extended Warranty Information (if applicable)

1.03 COMPUTERIZED MAINTENANCE MANAGEMENT SYSTEM:

- A. In addition to the Fixed Asset information described above, the Contractor shall collect information needed to support data input for the Owner's Computerized Maintenance Management System (CMMS) and submit the information periodically, as directed by the Engineer. Both the Fixed Asset and CMMS data information will be submitted monthly as a requirement of the payment application process.
- B. The Contractor will collect equipment information on all installed equipment that has an associated preventative maintenance in the vendor's O&M manuals.
- C. The Contractor shall take digital photos of all equipment nameplates and electronically file the information by Structure Name and Tag Number. Data (such as serial numbers) must be collected or verified from equipment after it is in its installed location.
- D. A substantial part of the data needed for the CMMS is provided on the equipment nameplates, however, the Contractor may need to refer to submittals, operations and maintenance manuals, and/or other manufacturer information to obtain dimensions, weights, etc., that are not included on nameplates.
- E. Part 1.05 below provides examples of information needed for various types of equipment. Multiple forms may be needed for a single piece of equipment. Actual information required will be as directed by the Engineer.

1.04 INFORMATION SUBMITTALS:

- A. The Contractor shall record in a Microsoft Excel spreadsheet file, the data collected for the Asset Registry and CMMS to the Owner through the Engineer.
- B. The format of a typical Asset – CMMS Spreadsheet is as shown in the first two exhibits under Part 1.06 with each asset on a separate row and the various data fields in columns (only the first nine columns of a 100+ column spreadsheet are shown). Due to the nature of instrumentation, a separate detailed Instrumentation Spreadsheet (which allows multiple model / serial numbers and other unique information to be associated with a single instrument) is also shown in the third exhibit under Part 1.06. The total cost for instrumentation from the Instrumentation Spreadsheet, in the example, is entered as a line item in the Asset – CMMS Spreadsheet.
- C. A separate Asset – CMMS Spreadsheet shall be prepared for each structure or portion of the Project, including site improvements, as directed by the Engineer.
- D. A database with a single table and forms similar to those shown in Part 1.05 is a suggested means for data entry, with such database table exported to an MS Excel spreadsheet to produce the required spreadsheet for each structure or portion of the Project. The creation of the database is not required.

- E. To the extent available, the Contractor should obtain a list(s) of equipment as described in Part 1.02 Paragraph B.1 above from the Engineer for importation into the database or spreadsheet(s).
- F. The Contractor shall submit to the Engineer, a draft of the Asset – CMMS Spreadsheet for each structure or portion of the Project, by the 50% construction complete stage of the structure or portion of the Project, for review as to form and completeness of the asset list. If requested by the Engineer, the Contractor shall submit copies of the spreadsheet periodically (but no more than once a month), as a work in progress for the Engineer’s review. Failure to submit the spreadsheets, as requested by the Engineer, may result in delayed processing of the most current pay request (until the spreadsheet is submitted and accepted).
- G. After an O&M has been accepted with no exceptions taken, the preventative maintenance detailed in the O&M manual shall be entered in an Excel spreadsheet for importation into the City’s CMMS. The Contractor will submit copies of the spreadsheet as part of the CMMS Spreadsheet submittal as a work in progress for the Engineer’s review. Failure to submit the spreadsheets, as requested by the Engineer, may result in delayed processing of the most current pay request (until the spreadsheet is submitted and accepted).
- H. The Contractor shall submit, to the Engineer, a preliminary copy of the Asset - CMMS Spreadsheet for any structure or portion of the Project a minimum of sixty (60) days prior to the anticipated Substantial Completion date for that structure or portion of the Project, with all information complete, except for the date of Substantial Completion. The final Asset - CMMS Spreadsheet for each structure or portion of the Project shall be submitted as part of the requirement for Substantial Completion. Failure to submit the spreadsheet as described above may result in delay in achieving Substantial Completion.
- I. At the end of the Project, all Asset -CMMS Spreadsheets pertaining to the work must be complete, submitted to and accepted by the Engineer in order to achieve Final Completion of the Project. The total of all spreadsheets for the Project must equal the total Contract Price.

1.05 EXAMPLES OF TYPICAL DATA AND SUGGESTED DATABASE TABLES:

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The image shows a software window titled "General : Form" with a "General" header. It contains several input fields for data entry:

- Search:** A dropdown menu.
- TAG_NO:** A text input field.
- StructureTitle:** A text input field.
- Equipment Description:** A text input field.
- Manufacturer:** A text input field.
- InstalledDate:** A date input field.
- Vendor:** A text input field.
- WarrantyExpdate:** A date input field.
- MODEL:** A text input field.
- PurchasePrice:** A text input field with a pre-filled value of "\$0.00".
- SerialNumber:** A text input field.
- ProRateExtendWarranty:** A text input field.

At the bottom, there is a record navigation bar showing "Record: 1 of 952" with navigation icons for first, previous, next, and last records, as well as a search icon.

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Motor Data 1 : Form

Motor Data

Search

TAG_NO:

EquipmentDescription:

MotorManufacturer: MotorEnclosure:

MotorModel: MotorFrame:

MotorSerial: MotorType:

MotorHorsepower: EVOLT:

MotorSpeed: E_PHASE:

MotorServiceFactor: MotorAmps:

MotorInsulation: MotorDesignTemp:

MotorNoiseLevel: MotorDriveType:

MotorWeight:

Record: 1 of 952

Gearbox Data 1 : Form

Gearbox Data

#Name?

Search

TAG_NO:

EquipmentDescription:

GearReducerManuf GearReducerType:

GearModel: GearReducerRatio:

GearSerial: GearHP:

GearWeight: GearTorque:

GearSpeed:

Record: 1 of 952

Water Supply Tunnel System Connection to Chattahoochee Water Treatment Plant

Actuator Data : Form

#Name?

Actuator Data

Search

TAG_NO:

EquipmentDescription:

ActuatorManuf: ActuatorBase:

ActuatorModel: ActuatorCoupling:

ActuatorSize:

ActuatorSerialNo: ActuatorSpeed:

ActuatorTempCode: ActuatorTorque:

NEMAEnclosure: Lubrication:

ActuatorMotorRating: ActuatorElectClass:

E_VOLT: E_AMPs:

E_PHASE:

ActuatorWeight:

Record: 1 of 952

Electrical Equip Data : Form

#Name?

Electrical Equipment Data

Search

TAG_NO:

EquipmentDescription:

EVOLT: Type:

E_PHASE: E_AMPs:

Source: NEMAEnclosure:

Record: 1 of 952

Water Supply Tunnel System Connection to Chattahoochee Water Treatment Plant

Pump Data : Form #Name?

Pump Data

Search

TAG_NO:

Equipment Description:

Type: TDH:

ConstructionMaterial: GPM:

Service: MGD:

Weight: RatedPressure:

Centrifugal Pumps Hose Pumps

ImpellerSize: Hose/InsertType:

SuctionLineSize: Hose/TubeSize:

DischargeLineSize: CapacityPerRevolution:

BodyStyle:

CastAndRotor:

Submersible Pump Electrical Info

E_VOLT: E_HP:

E_PHASE: E_RPM:

Record: of 952

Tank Data : Form #Name?

Storage Tank Data

Search

TAG_NO:

EquipmentDescription:

Diameter: BaseElevation:

E_CAPACITY: ConstructionMatl:

Length: CheckValveSize:

Width: CheckValveType:

Height:

Record: of 952

The screenshot shows a software window titled "Other Equipment Data : Form". The window contains the following elements:

- Window title: Other Equipment Data : Form
- Search bar: A red "Search" label followed by a dropdown menu.
- Input fields: TAG_NO, EquipmentDescription, Type, E_Weight, E_CAPACITY, Width, Height, ValveSize, Actuator?, GearBox?, ConstructionMatl, ScrewDiameter, ScrewLength, FlightSize, Fans / Blowers, E_Speed.
- Section: "Gates and Valves" (under Width, Height, ValveSize, Actuator?, GearBox?)
- Section: "Conveyors" (under ScrewDiameter, ScrewLength, FlightSize)
- Section: "Fans / Blowers" (under E_Speed)
- Section: "Related Equipment Data" (under E1Type, E2Type, E1Manufacturer, E2Manufacturer, E1ModelNo, E2ModelNo, E1SerialNo, E2SerialNo)
- Record navigation: "Record: 1 of 952" with navigation icons.

1.06 ASSET REGISTRY CMMS SPREADSHEET EXAMPLES:

1	TAG_NO	StructureTitle	EquipmentDescription	Manufacturer	Vendor	MODEL	SerialNumber	PurchasePrice	InstalledDate
2	06	06 - FINE SCREENING - LIME	FSL Structure	Pizzagalli	Pizzagalli	N/A	N/A	\$6,300,000	5/25/2010
3	06inst	06 - FINE SCREENING - LIME	Instrumentation (see Invensys details)	Various	Invensys	N/A	N/A	\$62,200	5/25/2010
4	06roof1	06 - FINE SCREENING - LIME	Standing Seam Roof	Berrage	Pierre	N/A	N/A	\$85,000	5/25/2010
5	06roof2	06 - FINE SCREENING - LIME	Built-up Roof	Johns - Mansville	Dakota	N/A	N/A	\$40,000	5/25/2010
6	ACC-0601	06 - FINE SCREENING - LIME	Air Cooled Condenser	Liebert	Shumate	PFH067AH	N/A	\$50,000	5/25/2010
7	AHU-0601	06 - FINE SCREENING - LIME	DX Air Handling Unit	Liebert	Shumate	BU060E	N/A	\$75,000	5/25/2010
8	ATS-0601	06 - FINE SCREENING - LIME	Automatic Transfer Switch	Eaton	Mayer	ATV3KDA30300KJU	LAT04380-002	\$2,405	5/25/2010
9	Door-06-101B	06 - FINE SCREENING - LIME	Fine Screen Roll-up Door	APD	APD	Pro GHX	193718	\$10,000	5/25/2010
10	Door-06-102B	06 - FINE SCREENING - LIME	Lime Roll-up Door	APD	APD	Pro GH4X	193715	\$10,000	5/25/2010
11	EUH-0601	06 - FINE SCREENING - LIME	Electric Unit Heater	TPI Corporation	Shumate	P3P5505T 43WD5T01	N/A	\$2,000	5/25/2010
12	EUH-0602	06 - FINE SCREENING - LIME	Electric Unit Heater	TPI Corporation	Shumate	P3P5505T 43WD5T01	N/A	\$2,000	5/25/2010
13	F-0601	06 - FINE SCREENING - LIME	FRP axial supply fan	Hartzell	Shumate	A35-366-E-FGFM3	0921759	\$10,000	5/25/2010
14	F-0602	06 - FINE SCREENING - LIME	Propeller Wall exhaust Fan	Loren Cook	Shumate	240AW-24AB	050SC58531-00/0000701	\$5,000	5/25/2010
15	F-0603	06 - FINE SCREENING - LIME	Propeller Wall exhaust Fan	Loren Cook	Shumate	AWB-24A6B	050SC58531-00/0002101	\$5,000	5/25/2010
16	F-0604	06 - FINE SCREENING - LIME	Propeller wall exhaust fan	Loren Cook	Shumate	160AW-16A17D	050SL58531-00/0003501	\$5,000	5/25/2010
17	F-0605	06 - FINE SCREENING - LIME	Propeller wall exhaust fan	Loren Cook	Shumate	AWD-20A11DA	050SL58531-00/0004801	\$5,000	5/25/2010
18	FCP-06C11	06 - FINE SCREENING - LIME	Silo No. 1 Truck Fill Panel	RDP Technologies	TDH Company	0803	N/A	\$10,000	5/25/2010
19	FCP-06C12	06 - FINE SCREENING - LIME	Lime System No. 1 FCP	RDP Technologies	TDH Company	N/A	UL# 979572	\$10,000	5/25/2010
20	FCP-06D11	06 - FINE SCREENING - LIME	Silo No. 2 Truck Fill Panel	RDP Technologies	TDH Company	0803	N/A	\$10,000	5/25/2010
21	FCP-06D12	06 - FINE SCREENING - LIME	Lime System No. 2 FCP	RDP Technologies	TDH Company	N/A	UL# 979571	\$10,000	5/25/2010
22	FCP-06E31	06 - FINE SCREENING - LIME	Compressed Air FCP	Quincy	Pizzagalli	N/A	5623	\$5,000	5/25/2010
23	FCP-06E51	06 - FINE SCREENING - LIME	Lime Unloading Blower FCP	Benshaw Controls	Aerzen	N/A	E20814175-3	\$5,000	5/25/2010
24	FV-06C24	06 - FINE SCREENING - LIME	Pebble Lime Flow Valve #1	Bray	RDP	30-119	03663468	\$2,000	5/25/2010
25	FV-06C29	06 - FINE SCREENING - LIME	Slaked Lime Flow Valve #1	Bray	RDP	30-119	03730145	\$2,000	5/25/2010
26	FV-06D24	06 - FINE SCREENING - LIME	Pebble Lime Flow Valve #2	Bray	RDP	30-119	03663469	\$2,000	5/25/2010
27	FV-06D29	06 - FINE SCREENING - LIME	Slaked Lime Flow Valve #2	Bray	RDP	30-119	03730140	\$2,000	5/25/2010
28	G-06A01	06 - FINE SCREENING - LIME	Fine Screen No. 1 Inlet Gate	Fontaine	Fontaine	2537272KCW/FE	2535070966221-1	\$20,000	5/25/2010
29	G-06A02	06 - FINE SCREENING - LIME	Fine Screen No. 2 Inlet Gate	Fontaine	Fontaine	2537272KCW/FE	2535070966221-2	\$20,000	5/25/2010
30	G-06A31	06 - FINE SCREENING - LIME	Fine Screen No. 1 Outlet Gate	Fontaine	Fontaine	2537299KCW/FE	2535070966231-1	\$20,000	5/25/2010
31	G-06A32	06 - FINE SCREENING - LIME	Fine Screen No. 2 Outlet Gate	Fontaine	Fontaine	2537299KCW/FE	2535070966231-2	\$20,000	5/25/2010
32	G-06A43	06 - FINE SCREENING - LIME	Fine Screen Inlet Box Gate	Fontaine	Fontaine	2035454KCW	2035070966211-1	\$20,000	5/25/2010
33	H-0601	06 - FINE SCREENING - LIME	480V Panelboard	Eaton	Mayer	PRL3A	LAT04380-022	\$787	5/25/2010
34	H-0602	06 - FINE SCREENING - LIME	480V Panelboard	Eaton	Mayer	PRL3A	LAT04380-019	\$578	5/25/2010
35	H-0603	06 - FINE SCREENING - LIME	480V Panelboard	Eaton	Mayer	PRL3A	LAT04380-020	\$578	5/25/2010
36	HTMP-0601	06 - FINE SCREENING - LIME	Heat Trace Monitoring Panel	Cleveland Electric Compar	Cleveland Electric Compar	N/A	N/A	\$1,000	5/25/2010
37	L-0601	06 - FINE SCREENING - LIME	208/120V Panelboard	Eaton	Mayer	PRL1A	LAT04380-016	\$253	5/25/2010
38	L-0602	06 - FINE SCREENING - LIME	208/120V Panelboard	Eaton	Mayer	PRL1A	LAT04380-017	\$311	5/25/2010
39	LCP-06	06 - FINE SCREENING - LIME	DCS Cabinet / System	Invensys	Invensys	N/A	N/A	\$120,000	5/25/2010
40	LCT-0601	06 - FINE SCREENING - LIME	Lighting Contactor	Cleveland Electric Compar	Cleveland Electric Compar	N/A	N/A	\$2,500	5/25/2010
41	M-06A11	06 - FINE SCREENING - LIME	Drum Screen No. 1	Eimco-Brackett Green	Eshelman Company	N/A	N/A	\$600,000	5/25/2010
42	M-06A21	06 - FINE SCREENING - LIME	Drum Screen No. 2	Eimco-Brackett Green	Eshelman Company	N/A	N/A	\$600,000	5/25/2010
43	M-06A51	06 - FINE SCREENING - LIME	Sampler	Teledyne ISCD	Pizzagalli	4700	209G01282	\$3,000	5/25/2010
44	M-06C11	06 - FINE SCREENING - LIME	Silo No. 1 Vent Filter	Donaldson Torit	RDP Technologies	TBV200	2761598-1-Unit1	\$10,000	5/25/2010
45	M-06C12	06 - FINE SCREENING - LIME	Lime Feeder No. 1	RDP Technologies	TDH Company	0900	N/A	\$20,000	5/25/2010
46	M-06C13	06 - FINE SCREENING - LIME	Bin Activator No. 1	Metalfab Inc.	RDP Technologies	CD18-2000	908012	\$20,000	5/25/2010
47	M-06C22	06 - FINE SCREENING - LIME	Lime Slaker No. 1 Mixer	RDP Technologies	TDH Company	N/A	N/A	\$30,000	5/25/2010
48	M-06C31	06 - FINE SCREENING - LIME	Grit Separator No. 1	Kason	RDP Technologies	K40-1-SS	M8035	\$20,000	5/25/2010
49	M-06C42	06 - FINE SCREENING - LIME	Lime Slurry Tank No. 1 Mixer	Sharpe Mixers	RDP Technologies	2E5-25	50763-2	\$30,000	5/25/2010
50	M-06D11	06 - FINE SCREENING - LIME	Silo No. 2 Vent Filter	Donaldson Torit	RDP Technologies	TBV200	2761598-1-Unit2	\$10,000	5/25/2010
51	M-06D12	06 - FINE SCREENING - LIME	Lime Feeder No. 2	RDP Technologies	TDH Company	0900	N/A	\$20,000	5/25/2010
52	M-06D13	06 - FINE SCREENING - LIME	Bin Activator No. 2	Metalfab Inc.	RDP Technologies	CD18-2000	908012	\$20,000	5/25/2010
53	M-06D22	06 - FINE SCREENING - LIME	Lime Slaker No 2 Mixer	RDP Technologies	TDH Company	N/A	N/A	\$30,000	5/25/2010

1	A	B	C	D	E	F	G	H	I
	TAG_NO	StructureTitle	EquipmentDescription	Manufacturer	Vendor	MODEL	SerialNumber	PurchasePrice	InstalledDate
54	M-06D31	06 - FINE SCREENING - LIME	Grit Separator No. 2	Kason	RDP Technologies	K40-1-SS	M8036	\$20,000	5/25/2010
55	M-06D42	06 - FINE SCREENING - LIME	Lime Slurry Tank No. 2 Mixer	Sharpe Mixers	RDP Technologies	2E5-25	50763-1	\$30,000	5/25/2010
56	M-06E21	06 - FINE SCREENING - LIME	Air Compressor	Gardner Denver	Pizzagalli	CBSPLA, PL Series-3 - 30HPS	D066770	\$10,000	5/25/2010
57	M-06E31	06 - FINE SCREENING - LIME	Compressed air dryer	Quincy	Pizzagalli	RNC25A1	RGUJ225B01A2NC09023	\$5,000	5/25/2010
58	M-06E51	06 - FINE SCREENING - LIME	Lime Unloading Blower	Aerzen	Pizzagalli	AMUSA GM035S-00	907444	\$10,000	5/25/2010
59	M-06F71	06 - FINE SCREENING - LIME	Fine Screen Monorail / Hoist	Acco	Pizzagalli	C2W-03	532/20/13354	\$30,000	5/25/2010
60	MAU-0601	06 - FINE SCREENING - LIME	Direct-fired makeup air unit	Reznor	Shumate	RDF2-80-3	BID827AN01696MV7	\$50,000	5/25/2010
61	MCC-0601	06 - FINE SCREENING - LIME	Motor Control Center	Eaton	Mayer	Freedom Series 2100	LAT04380 IT.013	\$53,045	5/25/2010
62	P-06B11	06 - FINE SCREENING - LIME	Screenings Transfer Pump No. 1	Haigh Engineering	Eimco-Brackett Green	Macipump 350	35454-H26215	\$10,000	5/25/2010
63	P-06B12	06 - FINE SCREENING - LIME	Screenings Transfer Pump No. 2	Haigh Engineering	Eimco-Brackett Green	Macipump 350	35454-H26214	\$10,000	5/25/2010
64	P-06B21	06 - FINE SCREENING - LIME	Screenings Transfer Pump No. 3	Haigh Engineering	Eimco-Brackett Green	Macipump 350	35454-H26213	\$10,000	5/25/2010
65	P-06B22	06 - FINE SCREENING - LIME	Screenings Transfer Pump No. 4	Haigh Engineering	Eimco-Brackett Green	Macipump 350	35454-H26216	\$10,000	5/25/2010
66	P-06E01	06 - FINE SCREENING - LIME	Lime Slurry Feed Pump No. 1	Watson Marlow	Watson Marlow	SFX 40	26779	\$25,000	5/25/2010
67	P-06E02	06 - FINE SCREENING - LIME	Lime Slurry Feed Pump No. 2	Watson Marlow	Watson Marlow	SFX 40	26780	\$25,000	5/25/2010
68	P-06E03	06 - FINE SCREENING - LIME	Lime Slurry Feed Pump No. 3	Watson Marlow	Watson Marlow	SFX 40	26789	\$25,000	5/25/2010
69	P-06E41	06 - FINE SCREENING - LIME	Lime Slur Additive Meter Pump No. 1	Watson Marlow	Watson Marlow	520UN/R2	110358	\$5,000	5/25/2010
70	P-06E42	06 - FINE SCREENING - LIME	Lime Slur Additive Meter Pump No. 2	Watson Marlow	Watson Marlow	520UN/R2	110359	\$5,000	5/25/2010
71	T-0601	06 - FINE SCREENING - LIME	Dry Type Transformer	Eaton	Mayer	H48M28T 30EE	J08D00184	\$910	5/25/2010
72	T-0602	06 - FINE SCREENING - LIME	Dry Type Transformer	Eaton	Mayer	H48M47T 30EE	J08L00574	\$830	5/25/2010
73	T-0603	06 - FINE SCREENING - LIME	Dry Type Transformer	Eaton	Mayer	H48M28F15EE	J08D00112	\$830	5/25/2010
74	T-06B10	06 - FINE SCREENING - LIME	Screenings Conditioning Tank No. 1	Haigh Engineering	Eimco-Brackett Green	1000 ACE Package	N/A	\$5,000	5/25/2010
75	T-06B20	06 - FINE SCREENING - LIME	Screenings Conditioning Tank No. 2	Haigh Engineering	Eimco-Brackett Green	1000 ACE Package	N/A	\$5,000	5/25/2010
76	T-06C11	06 - FINE SCREENING - LIME	Lime Silo No. 1	Imperial Industries	RDP Technologies	606512-0X34-11	I50392-1	\$200,000	5/25/2010
77	T-06C21	06 - FINE SCREENING - LIME	Lime Slaker No. 1	Tekkem	RDP Technologies	PRS-200B	N/A	\$50,000	5/25/2010
78	T-06C41	06 - FINE SCREENING - LIME	Lime Slurry Tank No. 1	RDP Technologies	TDH Company	N/A	N/A	\$35,000	5/25/2010
79	T-06D11	06 - FINE SCREENING - LIME	Lime Silo No. 2	Imperial Industries	RDP Technologies	606512-0X34-11	I50392-2	\$200,000	5/25/2010
80	T-06D21	06 - FINE SCREENING - LIME	Lime Slaker No. 2	Tekkem	RDP Technologies	PRS-200B	N/A	\$50,000	5/25/2010
81	T-06D41	06 - FINE SCREENING - LIME	Lime Slurry Tank No. 2	RDP Technologies	TDH Company	N/A	N/A	\$35,000	5/25/2010
82	T-06D51	06 - FINE SCREENING - LIME	Sulfamic Acid Feed Tank	Snyder Industries	Pizzagalli	N/A	N/A	\$15,000	5/25/2010
83	V-06A13	06 - FINE SCREENING - LIME	Screen No. 1 Spray Water Valve	Hayward	SIP	True Union	N/A	\$2,000	5/25/2010
84	V-06A23	06 - FINE SCREENING - LIME	Screen No. 2 Spray Water Valve	Hayward	SIP	True Union	N/A	\$2,000	5/25/2010
85	V-06A41	06 - FINE SCREENING - LIME	EQE / Fine Screen 30" Isolation Valve	DeZurik	Ecotech	9492401R001	854451-2	\$30,000	5/25/2010
86	V-06A42	06 - FINE SCREENING - LIME	Primary Sed. / Fine Screen 42" Flow Control	DeZurik	Ecotech	9492400R001	854451-1	\$50,000	5/25/2010
87	V-06A61	06 - FINE SCREENING - LIME	EQE / Fine Screen 18" Flow Control Valve	DeZurik	Ecotech	N/A	Tag# 1380279	\$50,000	5/25/2010
88	V-06A62	06 - FINE SCREENING - LIME	EQE / Fine Screen 12" Flow Control Valve	DeZurik	Ecotech	N/A	Tag# 1380278	\$20,000	5/25/2010
89	V-06B31	06 - FINE SCREENING - LIME	FSCR from Tank No. 1 to Inlet Box	Hayward	SIP	True Union	N/A	\$5,000	5/25/2010
90	V-06B32	06 - FINE SCREENING - LIME	FSCR to Liquid Separators No. 1 and 3	Hayward	SIP	True Union	N/A	\$5,000	5/25/2010
91	V-06B33	06 - FINE SCREENING - LIME	FSCR from Tank No. 2 to Inlet Box	Hayward	SIP	True Union	N/A	\$5,000	5/25/2010
92	V-06B34	06 - FINE SCREENING - LIME	FSCR to Liquid Separators No. 2 and 4	Hayward	SIP	True Union	N/A	\$5,000	5/25/2010
93	VFD-06E01	06 - FINE SCREENING - LIME	Lime Slurry Feed Pump No. 1 VFD	Benshaw Controls	Watson Marlow	N/A	E200814273A-1	\$3,000	5/25/2010
94	VFD-06E02	06 - FINE SCREENING - LIME	Lime Slurry Feed Pump No. 2 VFD	Benshaw Controls	Watson Marlow	N/A	E200814273A-2	\$3,000	5/25/2010
95	VFD-06E03	06 - FINE SCREENING - LIME	Lime Slurry Feed Pump No. 3 VFD	Benshaw Controls	Watson Marlow	N/A	E200814273A-3	\$3,000	5/25/2010
96	WCP-0601	06 - FINE SCREENING - LIME	DCS Workstation	Invensys	Invensys	N/A	N/A	\$5,000	5/25/2010
97	WL-0601	06 - FINE SCREENING - LIME	Fixed Wall Louver	Ruskin	Shumate	ELF6375X	N/A	\$2,250	5/25/2010
98	WL-0602	06 - FINE SCREENING - LIME	Combination wall louver	Ruskin	Shumate	ELC6375DAX	N/A	\$2,250	5/25/2010
99	WL-0603	06 - FINE SCREENING - LIME	Combination wall louver	Ruskin	Shumate	ELC6375DAX	N/A	\$2,250	5/25/2010
100	WL-0604	06 - FINE SCREENING - LIME	Fixed Wall Louver	Ruskin	Shumate	ELF6375X	N/A	\$2,250	5/25/2010
101	WL-0605	06 - FINE SCREENING - LIME	Combination wall louver	Ruskin	Shumate	ELC6375DAX	N/A	\$2,250	5/25/2010
102	WL-0606	06 - FINE SCREENING - LIME	Combination wall louver	Ruskin	Shumate	ELC6375DAX	N/A	\$2,250	5/25/2010
103	WL-0607	06 - FINE SCREENING - LIME	Combination wall louver	Ruskin	Shumate	ELC6375DAX	N/A	\$2,250	5/25/2010
104	WL-0608	06 - FINE SCREENING - LIME	Combination wall louver	Ruskin	Shumate	ELC6375DAX	N/A	\$2,250	5/25/2010
105								\$9,502,227	

	A	B	C	D	E	F	G	H	I	J	K	L	M
	TAG	InstrumentType	Building	Manufacturer	Model	SerialNo	Description	TotalPrice	Accuracy	Range	MinValue	MaxValue	EngUnits
1	AE/AIT-06F10	Gas Detector	06 - Fine Screen / Lime	Draeger	6810098 - Methane	ARZK-0284	Draeger Polytron IR 334 - Methane		< 2% LEL	0-100% LEL	0% LEL	100% LEL	% LEL
2	AE/AIT-06F10	Accessory	06 - Fine Screen / Lime	Draeger	6809750	N/A	Draeger Splash Guard		N/A	N/A	N/A	N/A	N/A
3	AE/AIT-06F10	N/A	06 - Fine Screen / Lime	Draeger	SC04085	N/A	Stainless Steel Tags 1" x 2.5"		N/A	N/A	N/A	N/A	N/A
4	AE/AIT-06F10	Splash Guard	06 - Fine Screen / Lime	Draeger	6809780	N/A	Calibration Adapter for Splash Guard		N/A	N/A	N/A	N/A	N/A
5	AE/AIT-06F10	Digital Display	06 - Fine Screen / Lime	Precision Digital	PD677-N-EX	0902-97861-1-19	4-20mA Digital Display		N/A	0-100%	0%	100%	%
6	AE/AIT-06F10	N/A	06 - Fine Screen / Lime	Precision Digital	PDA-SSTAG	N/A	Stainless Steel TAG		N/A	N/A	N/A	N/A	N/A
7	AE/AIT-06F10	Accessory	06 - Fine Screen / Lime	Draeger	6809450	N/A	Field Verification Cell		N/A	N/A	N/A	N/A	N/A
8	AE/AIT-06F10	N/A	06 - Fine Screen / Lime	Precision Digital	PDN-CALDATA	N/A	Calibration Services	\$ 3,000	N/A	N/A	N/A	N/A	N/A
9	AE/AIT-06F15	Gas Detector	06 - Fine Screen / Lime	Draeger	6810098 - Methane	ARZK-0177	Draeger Polytron IR 334 - Methane		< 2% LEL	0-100% LEL	0% LEL	100% LEL	% LEL
10	AE/AIT-06F15	Accessory	06 - Fine Screen / Lime	Draeger	6809750	N/A	Draeger Splash Guard		N/A	N/A	N/A	N/A	N/A
11	AE/AIT-06F15	N/A	06 - Fine Screen / Lime	Draeger	SC04085	N/A	Stainless Steel Tags 1" x 2.5"		N/A	N/A	N/A	N/A	N/A
12	AE/AIT-06F15	Splash Guard	06 - Fine Screen / Lime	Draeger	6809780	N/A	Calibration Adapter for Splash Guard		N/A	N/A	N/A	N/A	N/A
13	AE/AIT-06F15	Accessory	06 - Fine Screen / Lime	Draeger	6809450	N/A	Field Verification Cell		N/A	N/A	N/A	N/A	N/A
14	AE/AIT-06F15	Digital Display	06 - Fine Screen / Lime	Precision Digital	PD677-N-EX	0902-97861-1-2	4-20mA Digital Display		N/A	0-100%	0%	100%	%
15	AE/AIT-06F15	N/A	06 - Fine Screen / Lime	Precision Digital	PDA-SSTAG	N/A	Stainless Steel TAG		N/A	N/A	N/A	N/A	N/A
16	AE/AIT-06F15	N/A	06 - Fine Screen / Lime	Precision Digital	PDN-CALDATA	N/A	Calibration Services	\$ 3,000	N/A	N/A	N/A	N/A	N/A
17	AE/AIT-06F20	H2S Gas Detector	06 - Fine Screen - Lime	Draeger	4543070	ERAC-0174	Polytron ZKP TOX w/o Sensor and Relays		1.0 PPM	0-50 PPM	1.0 PPM	50.0 PPM	PPM
18	AE/AIT-06F20	H2S Gas Detector	06 - Fine Screen - Lime	Draeger	6809610	ARAA-0217	H2S Electrochemical Sensor		1.0%	0-50 PPM	0%	100%	PPM
19	AE/AIT-06F20	Accessory	06 - Fine Screen - Lime	Draeger	4509315	N/A	Splash Guard		N/A	N/A	N/A	N/A	N/A
20	AE/AIT-06F20	Mounting Kit	06 - Fine Screen - Lime	Draeger	4520315	N/A	Wall Mounting Kit w/ 15ft. Cable		N/A	N/A	N/A	N/A	N/A
21	AE/AIT-06F20	N/A	06 - Fine Screen - Lime	Draeger	SC04085	N/A	Stainless Steel Tags 1" x 2.5"		N/A	N/A	N/A	N/A	N/A
22	AE/AIT-06F20	N/A	06 - Fine Screen - Lime	Draeger	SC04004	N/A	Warranty for Polytron ZKP TOX for 48 months	\$ 3,000	N/A	N/A	N/A	N/A	N/A
23	AE/AIT-06F25	H2S Gas Detector	06 - Fine Screen - Lime	Draeger	4543070	ERAC-0408	Polytron ZKP TOX w/o Sensor and Relays		1.0 PPM	0-50 PPM	1.0 PPM	50.0 PPM	PPM
24	AE/AIT-06F25	H2S Gas Detector	06 - Fine Screen - Lime	Draeger	6809610	ARAA-0162	H2S Electrochemical Sensor		1.0%	0-50 PPM	0%	100%	PPM
25	AE/AIT-06F25	Accessory	06 - Fine Screen - Lime	Draeger	4509315	N/A	Splash Guard		N/A	N/A	N/A	N/A	N/A
26	AE/AIT-06F25	Mounting Kit	06 - Fine Screen - Lime	Draeger	4520315	N/A	Wall Mounting Kit w/ 15ft. Cable		N/A	N/A	N/A	N/A	N/A
27	AE/AIT-06F25	N/A	06 - Fine Screen - Lime	Draeger	SC04085	N/A	Stainless Steel Tags 1" x 2.5"		N/A	N/A	N/A	N/A	N/A
28	AE/AIT-06F25	N/A	06 - Fine Screen - Lime	Draeger	SC04004	N/A	Warranty for Polytron ZKP TOX for 48 months	\$ 3,000	N/A	N/A	N/A	N/A	N/A
29	AE/AIT-06A02	Mass Flow Transducer/Disp	06 - Fine Screen - Lime	KROHNE Inc	VN304HA54300010100010	A0962701	IFC300F - Electromagnetic Flow Transducer		N/A	N/A	N/A	N/A	N/A
30	FE/FIT-06A02	N/A	06 - Fine Screen - Lime	KROHNE Inc	N/A	N/A	Additional warranty		N/A	N/A	N/A	N/A	N/A
31	FE/FIT-06A02	Mass Flow Sensor	06 - Fine Screen - Lime	KROHNE Inc	VN164XW5AD03112011000	A0962701	Optiflux 2000 - 42" Mag Flow Meter	\$ 28,000		0-300 GPM	0 GPM	300 GPM	GPM
32	FE/FIT-06A02	Mass Flow Transducer/Disp	06 - Fine Screen - Lime	KROHNE Inc	VN304HA54300010100010	TBA	IFC300F - Electromagnetic Flow Transducer		N/A	N/A	N/A	N/A	N/A
33	FE/FIT-06A60	N/A	06 - Fine Screen - Lime	KROHNE Inc	N/A	N/A	Additional warranty		N/A	N/A	N/A	N/A	N/A
34	FE/FIT-06A60	Mass Flow Meter	06 - Fine Screen - Lime	KROHNE Inc	VN154NA5AD03112011000	TBA	Optiflux 2000 - 24" Mag Flow Meter	\$ 11,000		0 GPM	0 GPM	0 GPM	GPM
35	FE/FIT-06A60	Thermal Flow Switch	06 - Fine Screen - Lime	Fluid Components Int. Inc	FL193S-1B1A4FwC1B03000	304169	Thermal Flow Switch - 25"		+/- 5%	0-20 GPM	0 GPM	20 GPM	SFPS
36	FSL-06F30	N/A	06 - Fine Screen - Lime	Fluid Components Int. Inc	NIST-CAL	N/A	N.I.S.T. Cert Calibration	\$ 2,600		N/A	N/A	N/A	N/A
37	FSL-06F35	N/A	06 - Fine Screen - Lime	Fluid Components Int. Inc	FL193S-1B1A4FwC1B03000	304170	Thermal Flow Switch - 25"		+/- 5%	0-20 GPM	0 GPM	20 GPM	SFPS
38	FSL-06F35	N/A	06 - Fine Screen - Lime	Fluid Components Int. Inc	NIST-CAL	N/A	N.I.S.T. Cert Calibration	\$ 2,600		N/A	N/A	N/A	N/A
39	LE/LIT-06A12A	Ultrasonic Level Transducer	06 - Fine Screen - Lime	Siemens Corporation	7ML5033-1AA003B Z'Y15	PBD/3230217	MultiRanger 100 (Single Point Unit)		0.25%	0-50 ft	1 ft	50 ft	ft
40	LE/LIT-06A12A	N/A	06 - Fine Screen - Lime	Siemens Corporation	7ML1930-1B1	N/A	Stainless Steel TAG		N/A	N/A	N/A	N/A	N/A
41	LE/LIT-06A12A	Ultrasonic Level Sensor	06 - Fine Screen - Lime	Siemens Corporation	7ML1100-0BA20	911175	ST-H Level Transducer (2" NPT - PTFE Face -10m Cable)			0-20 ft	1 ft	26 ft	ft
42	LE/LIT-06A12A	N/A	06 - Fine Screen - Lime	Siemens Corporation	7ML1830-1B1	N/A	Submergence Shield Kit		N/A	N/A	N/A	N/A	N/A
43	LE/LIT-06A12A	N/A	06 - Fine Screen - Lime	Siemens Corporation	7ML1830-1B1	N/A	Submergence Shield Kit		N/A	N/A	N/A	N/A	N/A
44	LE/LIT-06A12A	Mounting Plate	06 - Fine Screen - Lime	Siemens Corporation	7ML1830-1B1	N/A	FMS-210 Channel Bracket, Wall Mount	\$ 1,500		N/A	N/A	N/A	N/A
45	LE/LIT-06A12B	Ultrasonic Level Transducer	06 - Fine Screen - Lime	Siemens Corporation	7ML5033-1AA003B Z'Y15	PBD/3230209	MultiRanger 100 (Single Point Unit)		0.25%	0-50 ft	1 ft	50 ft	ft
46	LE/LIT-06A12B	N/A	06 - Fine Screen - Lime	Siemens Corporation	7ML1930-1B1	N/A	Stainless Steel TAG		N/A	N/A	N/A	N/A	N/A
47	LE/LIT-06A12B	Ultrasonic Level Sensor	06 - Fine Screen - Lime	Siemens Corporation	7ML1100-0BA20	911174	ST-H Level Transducer (2" NPT - PTFE Face -10m Cable)			0-20 ft	1 ft	26 ft	ft
48	LE/LIT-06A12B	N/A	06 - Fine Screen - Lime	Siemens Corporation	7ML1830-1B1	N/A	Submergence Shield Kit		N/A	N/A	N/A	N/A	N/A
49	LE/LIT-06A12B	Mounting Plate	06 - Fine Screen - Lime	Siemens Corporation	7ML1830-1B1	N/A	FMS-210 Channel Bracket, Wall Mount	\$ 1,500		N/A	N/A	N/A	N/A
50	LE/LIT-06A22A	Ultrasonic Level Transducer	06 - Fine Screen - Lime	Siemens Corporation	7ML5033-1AA003B Z'Y15	PBD/3230 ???	MultiRanger 100 (Single Point Unit)		0.25%	0-50 ft	1 ft	50 ft	ft
51	LE/LIT-06A22A	N/A	06 - Fine Screen - Lime	Siemens Corporation	7ML1930-1B1	N/A	Stainless Steel TAG		N/A	N/A	N/A	N/A	N/A
52	LE/LIT-06A22A	Ultrasonic Level Sensor	06 - Fine Screen - Lime	Siemens Corporation	7ML1100-0BA20	911176	ST-H Level Transducer (2" NPT - PTFE Face -10m Cable)			0-20 ft	1 ft	26 ft	ft
53	LE/LIT-06A22A	N/A	06 - Fine Screen - Lime	Siemens Corporation	7ML1830-1B1	N/A	Submergence Shield Kit		N/A	N/A	N/A	N/A	N/A
54	LE/LIT-06A22A	Mounting Plate	06 - Fine Screen - Lime	Siemens Corporation	7ML1830-1B1	N/A	FMS-210 Channel Bracket, Wall Mount	\$ 1,500		N/A	N/A	N/A	N/A
55	LE/LIT-06A22B	Ultrasonic Level Transducer	06 - Fine Screen - Lime	Siemens Corporation	7ML5033-1AA003B Z'Y15	PBD/3230214	MultiRanger 100 (Single Point Unit)		0.25%	0-50 ft	1 ft	50 ft	ft
56	LE/LIT-06A22B	N/A	06 - Fine Screen - Lime	Siemens Corporation	7ML1930-1B1	N/A	Stainless Steel TAG		N/A	N/A	N/A	N/A	N/A
57	LE/LIT-06A22B	Ultrasonic Level Sensor	06 - Fine Screen - Lime	Siemens Corporation	7ML1100-0BA20	911117	ST-H Level Transducer (2" NPT - PTFE Face -10m Cable)			0-20 ft	1 ft	26 ft	ft
58	LE/LIT-06A22B	N/A	06 - Fine Screen - Lime	Siemens Corporation	7ML1830-1B1	N/A	Submergence Shield Kit		N/A	N/A	N/A	N/A	N/A
59	LE/LIT-06A22B	Mounting Plate	06 - Fine Screen - Lime	Siemens Corporation	7ML1830-1B1	N/A	FMS-210 Channel Bracket, Wall Mount	\$ 1,500		N/A	N/A	N/A	N/A
60								\$ 62,200					

+++END OF SECTION+++

**SECTION 01800
MAINTENANCE**

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Contractor will be required to maintain stored and installed equipment and materials until Final Acceptance of the Work. Work included, but is not limited to:
 - 1. Perform all required maintenance.
 - 2. Repair and maintain protective coatings.
 - 3. Repair and replace scratched and damaged materials and equipment.
 - 4. Maintain and operate new equipment placed into service.
- B. Work per this Section starts on the date the equipment and materials are received and continued until the Date of Final Acceptance.
- C. Contractor will monitor equipment storage and subsequently the operation and material functionality on a continual basis during the specified time period. Any deterioration of materials or malfunction of equipment will be followed by swift repair action to minimize the damage. Such repair may include repair and technical services by an independent Contractor if the Engineer deems the Contractor's efforts are ineffective in correcting the problem.
- D. All costs for maintenance and repair of stored and installed equipment and materials, including costs from an independent Contractor, during the specified time period will be the sole responsibility of the Contractor.

+++ END OF SECTION 01800 +++

**SECTION 02000
SITE WORK**

PART 1 GENERAL

1.01 SCOPE

- A. This section outlines site work requirements that are applicable to all site work operations. Refer to specification sections for specific product and execution requirements.
- B. (Not Used)

1.02 QUALITY ASSURANCE

- A. Comply with all applicable local, state, and federal requirements regarding materials, methods of work, and disposal of excess and waste materials.
- B. Obtain and pay for all required inspections, permits and fees. Provide notices required by governmental authorities.

1.03 PROJECT CONDITIONS

- A. Locate and identify existing underground and overhead services and utilities within contract limit work areas. Provide adequate means of protection of utilities and services designated to remain. Repair utilities damaged during site work operations at Contractor's expense.
- B. Arrange for disconnection or disconnect and seal or cap all utilities and services designated to be removed before start of site work operations. Perform all work in accordance with the requirements of the applicable utility company or agency involved.
- C. When uncharted or incorrectly charted underground piping or other utilities and services are encountered during site work operations, notify the Engineer and the applicable utility company immediately to obtain procedure directions. Cooperate with the applicable utility company in maintaining active services in operation.
- D. Locate, protect, and maintain bench marks, monuments, control points and project engineering reference points. Reestablish disturbed or destroyed items at Contractor's expense.
- E. Perform site work operations and the removal of debris and waste materials to assure minimum interference with streets, walks and other adjacent facilities.

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- F. Obtain governing authorities' written permission when required to close or obstruct street, walks and adjacent facilities. Provide alternate routes around closed or obstructed traffic ways when required by governing authorities.
- G. Control dust caused by work. Dampen surfaces as required. Comply with pollution control regulations of governing authorities.
- H. Protect existing buildings, paving and other services or facilities on site and adjacent to the site from damage caused by site work operations. Cost of repair and restoration of damaged items at Contractor's expense.
- I. Protect and maintain street lights, utility poles and services, traffic signal control boxes, curb boxes, valves and other services, except items designated for removal. Remove or coordinate the removal of traffic signs, parking meters and postal mail boxes with the applicable governmental agency. Provide for temporary relocation when required to maintain facilities and services in operation during construction work.
- J. Preserve from injury or defacement all vegetation and objects designated to remain.

PART 2 PRODUCTS

2.01 MATERIALS AND EQUIPMENT

- A. Materials and equipment: As selected by the Contractor, except as indicated in contract documents.
- B. (Not Used)

PART 3 EXECUTION

3.01 GENERAL

- A. Examine the areas and conditions under which site work is performed. Do not proceed with the work until unsatisfactory conditions are corrected.
- B. Consult the records and drawings of adjacent work and of existing services and utilities which may affect site work operations.
- C. Maintain vehicular access to laboratory building and intake facilities at all times.

+++ END OF SECTION 02000 +++

**SECTION 02050
DEMOLITION**

PART 1 - GENERAL

1.01 SCOPE:

- A. The work covered under this Section includes furnishing all labor, equipment and material required to remove asphalt pavements designated for demolition as shown on the Drawings, directed by the Engineer or required for the completion of the Work, including all necessary saw cutting, excavation and backfilling.
- B. The work specified herein and shown on the Drawings is intended to show the extent of the scope of this work but must not be construed as covering it entirely. The Contractor shall visit the site and judge the amount of work required and the problems anticipated in the performance of the work.
- C. (Not Used)
- D. (Not Used)

1.02 SUBMITTALS

- A. Submittals shall be made in accordance with the requirements of the General Conditions of the Contract Documents. In addition, the following specific information shall be provided:
 - 1. The Contractor shall submit to the Engineer, prior to beginning work, a schedule of demolition and detail the methods to be used.
 - 2. The Contractor shall develop and submit a demolition plan which includes a demolition schedule that covers:
 - a. Stationing from and to with start and finish dates.
 - b. Proposed method of demolition.
 - c. Approved haul routes and permit(s) to and from the site.
 - d. Locations of wood piles.

PART 2 - PRODUCTS

2.01 MATERIALS

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- A. The Contractor shall provide all materials and equipment in suitable and adequate quantity as required to accomplish the work shown, specified herein, and as required to complete the project.

PART 3 - EXECUTION

3.01 GENERAL

- A. Shutdown of Existing Operations and Utilities
 - 1. The existing chemical building & raw water intake facility is required to remain in service during construction.
 - 2. Prior to making any pavement removals, saw cut pavements to full depth.
 - 3. Remove designated trees and stumps to at least 2 feet below grade.
- B. PROTECTION
 - 1. Take care to prevent the spread of dust and flying particles. Sprinkle rubbish and debris with water to keep dust to a minimum. Install, operate, and maintain erosion control measures at all times.

PERSONNEL: Perform work by personnel experienced in this type work and in such a manner as to eliminate hazards to persons and property without interference with new work and with use of adjacent areas, public rights-of-way, utilities and structures.

3.02 CONCRETE DEMOLITION

- A. According to drawings

3.03 MASONRY DEMOLITION (Not Used)

3.04 REMOVAL OF EXISTING EQUIPMENT AND PIPING (Not Used)

3.05 PROTECTION OF WORK AND EXISTING FACILITY

- A. Perform the work in a manner that will not damage parts of the site, or systems not intended to be removed. If in the opinion of the Engineer, the method of demolition or cutting may endanger or damage parts of the structure(s) or affect the operation of the facilities, promptly change the method when so notified by the Engineer. Perform all cutting required regardless whether such cutting is specifically indicated. Examine the existing structures, evaluate conditions to be encountered in accomplishing the work, and accommodate such requirements accordingly in the Bid Proposal.

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- B. The Contractor shall exercise full care and shall use such methods and equipment during removal as will maintain the usefulness of vehicular access to telecommunications and antennas at the site at all times.
- C. Any damage done to structures or equipment during removal and any patching, plugging of holes or repairs necessitated because of removal of equipment and piping shall be repaired to the satisfaction of the Engineer and the cost thereof shall be included in the Contract Price.

3.06 DISPOSAL

- A. Disposal: All rubble and waste material shall be hauled off site as it is removed. Stockpiling is not permitted at any time. The Contractor shall be fully responsible for proper disposal of waste materials in accordance with all federal, state and local laws at no additional cost to the City.
- B. Contractor shall not dispose of any trash, material, equipment, or litter on the site. Contractor shall be responsible for any damage to any facilities, tanks or equipment which is damaged by any such foreign material.

3.07 DISPOSITION OF SALVAGEABLE MATERIALS (Not Used)

3.08 REHABILITATION (Not Used)

+++ END OF SECTION 02050 +++

**SECTION 02110
CLEARING AND GRUBBING**

PART 1 - GENERAL

1.01 SCOPE

- A. Work described in this Section includes furnishing all labor, materials, equipment, tools and incidentals required for all clearing and grubbing including, but not limited to, the removal from the site of 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. The extent of clearing is that minimum degree of clearing necessary to carry out all construction activities including construction of appurtenances. Areas protected by silt fences, tree save and other fencing shall not be disturbed at any time.
- C. Clearing and grubbing operations shall be coordinated with temporary and permanent erosion control requirements.
- D. Clearing operations include, but are not limited to, the following:
 - 1. Protection of existing trees and other vegetation
 - 2. Removal of trees and other vegetation
- E. Related Work Specified Elsewhere:
 - 1. Division 1 General Requirements
 - 2. Section 02125, Temporary and Permanent Erosion and Sediment Control.
 - 3. Section 02050, Demolition.
 - 4. Section 02200, Earthwork.

1.02 JOB CONDITIONS

- A. Protection of Existing Improvements:
 - 1. Provide barricades, coverings, or other types of protection necessary to prevent damage to existing improvements.
 - 2. Protect improvements on adjoining properties as well as those on the project site. Restore improvements damaged by this work to their original condition, as acceptable to the Engineer. Replace property line monuments (such as iron pins) removed or disturbed by clearing operations under the direction of a Land Surveyor licensed in the State of Georgia.

B. Protection of Existing Trees and Vegetation:

1. Protect existing trees and other vegetation to avoid cutting, breaking or skinning of roots, skinning and bruising of bark, smothering of trees by stockpiling construction materials or excavated materials within drip lines, foot or vehicular traffic, and parking of vehicles or equipment within drip line. Provide temporary fences, barricades or guards as required to protect trees and vegetation to be left standing.
2. Provide protection for tree roots over 1-1/2 inches diameter that are cut during any construction operation. Coat the cut faces with emulsified asphalt, or other acceptable coating, especially formulated for horticultural use on cut or damaged plant tissues. Temporarily cover all exposed roots of trees with wet burlap to prevent roots from drying out; provide earth cover as soon as possible.
3. Repair or replace damaged trees and vegetation resulting from any construction operation, in a manner acceptable to the Engineer. A qualified arborist approved by the engineer shall perform tree damage repair at no cost to the City. Replace damaged trees that cannot be repaired and restored to full-growth status, as determined by the Engineer.

PART 2 – PRODUCTS (Not Used)

PART 3 - EXECUTION

3.01 EXISTING TREES AND VEGETATION

- A. Avoid cutting or injuring trees designated to remain. Other trees cut or injured shall be solely at Contractor expense to obtain permits, approvals, and pay all fees to the City before cutting and hauling off site.

3.02 CLEARING AND GRUBBING

- A. Clearing operations shall begin no more than seven days before beginning construction work for any area.
- B. Materials to be cleared, grubbed and removed from the project site include but are not limited to vegetation, trees, stumps, roots, lawns, shrubbery, gardens, paving, miscellaneous structures, debris, and abandoned utilities to the minimum practicable extent to complete the work. Limit clearing to a single lane work route without provision for construction vehicles to pass utility operation.
- C. Grubbing shall consist of completely removing roots, stumps, trash and other debris from all areas to be graded 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.

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- D. All stumps, roots, foundations and planking embedded in the ground shall be removed and disposed of. Stumps and roots larger than 1 inch shall be grubbed and removed to a depth not less than 4 feet below grade. All holes or cavities which extend below the subgrade elevation of the proposed work shall be filled with crushed rock or other suitable material, compacted to the same density as the surrounding material.
- E. 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.
- F. Any work pertaining to utility poles shall comply with the requirements of the appropriate utility.
- G. 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 is damaged shall be replaced with new fence material of equal or better quality and construction.
- H. Stumps and roots shall be grubbed and removed to a depth not less than two feet below grade. All holes or cavities which extend below the subgrade elevation of the proposed work shall be filled with crushed rock or other suitable material, compacted to the same density as the surrounding material
- I. Burying of residual materials and organics will not be allowed.
- J. The Contractor shall utilize special precautions required for the protection and preservation of trees, cultivated shrubs, sod, fences, etc. situated within the construction area but not directly within excavation and/or fill limits. The Contractor shall be responsible for repair or replacement of any items damaged as a result of its operations.

3.03 HOLES AND DEPRESSIONS

- A. Fill holes, depressions and voids created or exposed by clearing operations with non-organic soil material approved by the Engineer.
- B. Backfill pavement removal areas with non-organic topsoil in horizontal layers not exceeding six inches loose-depth and compact to 95 per-cent standard Proctor.

3.04 DISPOSAL OF WASTE MATERIALS

- A. Disposal General Requirements: Dispose cleared matter daily so as to maintain site in a safe and neat condition throughout the contract period. Owners of the property may remove merchantable timber, buildings or other items from the work site before the Contractor begins operations, and no assurance exists that any such material will be on the work site

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when the Contractor begins work.

B. On-Site Disposal:

1. When authorized by the Engineer, cut tree trunks and limbs, over two inches in diameter, into 48-inch lengths and neatly stack within work limits on the same property as that on which the tree originally grew.

C. 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. No debris of any kind shall be deposited in any stream or body of water, or in any street or alley. 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 site, shoved onto abutting private properties, or buried on the project site.

3.05 CONSTRUCTION ACCESS ROUTE ON EASEMENT (Not Used)

3.06 TREE REMOVAL ON EASEMENTS (Not Used)

+++ END OF SECTION 02110 +++

SECTION 02125

TEMPORARY AND PERMANENT EROSION AND SEDIMENTATION CONTROL

PART 1 GENERAL

1.01 SCOPE

- A. Work under this section includes furnishing all labor, materials, equipment and incidentals required to install and maintain temporary and permanent erosion and sedimentation controls as shown on the Drawings and as specified herein.
- B. Temporary and permanent erosion and sedimentation controls include mulching and grassing of disturbed areas and structural barriers at those locations which will ensure that erosion during construction will be maintained within acceptable limits. Acceptable limits are as established by the Georgia Environmental Protection Division (EPD) and applicable codes, ordinances, rules, regulations and laws of local and municipal authorities having jurisdiction.
- C. The temporary and permanent erosion and sedimentation control measures shown on the Drawings are minimum requirements. The Contractor shall notify the Engineer of any changes and/or additions to the erosion and sedimentation control measures necessary to accommodate the Contractor's means and methods of operation. Any additional erosion and sedimentation control measures required by the Contractor's means and methods of operation will be installed by the Contractor at no additional cost to the City.
- D. The Contractor shall be solely responsible for the control of erosion and sediment production within the Project area. The Contractor shall install controls that will ensure that storm water and drainage from the disturbed area of the Project site will be filtered or otherwise managed to minimize impacts on receiving waters and/or existing storm drains. Discharged waters shall be free of soil particles and shall meet all applicable permit turbidity requirements.

1.02 SUBMITTALS

- A. Submittals shall be made in accordance with the requirements of the General Conditions of the Contract Documents.

1.03 QUALITY ASSURANCE

- A. The Contractor shall designate a worksite erosion control supervisor. The supervisor shall have the responsibility and authority to coordinate all equipment, personnel and materials needed to maintain project site erosion and sediment control in accordance with the management practices and standards established in the Manual for Erosion and Sediment Control in Georgia, the Drawings and Specifications.

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- B. Within 15 days after receipt of the Notice to Proceed, the Contractor shall submit the name and contact data for the designated erosion control supervisor. The supervisor shall be an individual with an active minimum Level 2 certification as issued by the Georgia Soil and Water Conservation Commission.
- C. The erosion control supervisor shall execute NPDES sampling after each rain event and collect samples for laboratory testing.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Silt fence: Silt fence shall be as detailed on the Drawings and shall meet the requirements of Section 171 – Silt Fence of the GDOT Department of Transportation Standard Specifications.
 - 1. Silt fence fabric shall conform to GDOT Standard Specification Section 881.2.07.
 - 2. Silt fencing shall conform to GDOT Standard Specification Section 894.
 - 3. Silt fence posts and bracing shall conform to GDOT Standard Specification Section 862.
- B. Hay bales shall be clean, seed-free cereal hay type, rectangular in shape.
- C. Woven wire fence backing shall be ½-inch, galvanized steel, chicken-wire mesh.
- D. Filter stone shall be crushed rock conforming to Georgia Department of Transportation Table 800.01, Size Number 57.
- E. Concrete block shall be hollow, non load bearing type.
- F. Concrete shall be 3000 psi in accordance with Section 03300, Cast-in-Place Concrete.
- G. Plywood shall be ¾-inch thick exterior type.

2.02 RIP RAP

- A. Use only one method throughout the Project.
- B. Stone Rip Rap shall consist of sound, tough, durable stones resistant to the action of air and water. Slabby or shaley pieces will not be acceptable. Specific gravity shall be 2.0 or greater. Rip rap shall have less than 66 percent wear when tested in accordance with AASHTO T-96. Unless shown on the Drawings or specified otherwise, stone rip-rap shall be type 3.

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1. Type 1 Rip Rap: The largest pieces shall have a maximum approximate volume of two cubic feet. At least 35 percent of the mass shall be comprised of pieces which weigh 125 pounds or more. The remainder shall be well graded down to the finest sizes. Rock fines shall comprise a maximum of 10 percent of the total mass. Rock fines are defined as material passing a No. 4 sieve. Rip rap size shall conform to Georgia Department of Transportation Standard Specification Section 805 - Stone Dumped Rip Rap, Type 1.
2. Type 3 Rip Rap: The largest pieces shall have a maximum approximate volume of one cubic foot. At least 35 percent of the mass shall be comprised of pieces which weigh 15 pounds or more. The remainder shall be well graded down to the finest sizes. Rock fines shall comprise a maximum of 10 percent of the total mass. Rock fines are defined as material passing a No. 4 sieve. Rip rap size shall conform to Georgia Department of Transportation Standard Specification Section 805 - Stone Dumped Rip Rap, Type 3.

2.03 FILTER FABRIC

- A. Filter fabric for use under rip-rap shall meet the requirements of GDOT Standard Specification Section 881.2.05 for plastic filter fabric.

2.04 CONSTRUCTION EXIT STONE

- A. Stone shall be sound, tough, durable stone resistant to the action of air and water. Slabby or shaley pieces will not be acceptable. Aggregate size shall be in accordance with the National Stone Association Size R-2 (1.5 to 3.5-inch stone) or Type 3 Riprap as specified in paragraph 2.02 of this Section.

2.05 GRASS

- A. Permanent grass shall be of the same type that existed prior to construction.
- B. 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.

2.06 EROSION CONTROL FABRIC

- A. Erosion control fabric shall be equal to Futerra Erosion Control Blanket manufactured by Profile Products LLC. Fabric shall be a non-woven erosion control/vegetation blanket comprised of wood fiber and crimped, interlocking synthetic fibers laminated by accelerated photodegradable polypropylene netting. Fabric shall be 100% biodegradable and photo-degradable within 10 months of installation.

PART 3 EXECUTION

3.01 GENERAL

A. Basic Principles:

1. Conduct the earthwork and excavation activities in such a manner to fit the topography, soil type and condition.
2. Minimize the disturbed area and the duration of exposure to erosion elements.
3. Stabilize disturbed areas immediately.
4. Safely convey run-off from the site to a stable outlet.
5. Retain sediment on site that is generated on site.
6. Minimize encroachment upon watercourses.

B. Temporary Erosion and Sedimentation Control: Temporary erosion and sedimentation control procedures shall be directed toward:

1. Preventing soil erosion at the source.
2. Preventing silt and sediment from entering any waterway if soil erosion cannot be prevented.
3. Preventing silt and sediment from migrating downstream in the event it cannot be prevented from entering the waterway.

C. Permanent Erosion Control: Permanent erosion control measures shall be implemented to prevent sedimentation of waterways and to prevent erosion of the Project site.

3.02 SEDIMENTATION AND EROSION CONTROL MEASURES

- A. Temporary and permanent erosion and sedimentation control measures shall prevent erosion and prevent sediment from exiting the site. If, in the opinion of the Engineer, 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.
- B. All erosion and sedimentation control devices and structures shall be inspected by the Contractor at least once a week and immediately prior to and after each rainfall occurrence. Any device or structure found to be damaged shall be repaired or

replaced by the end of the day. Sediment ponds shall be cleaned out prior to the silt reaching the height or elevation shown on the Drawings.

- C. All erosion and sedimentation control measures and devices shall be constructed and installed as shown on the Drawings or specified herein and maintained until adequate permanent disturbed area stabilization has been provided or permanent pavement has been installed and accepted by the Engineer. After adequate permanent stabilization has been provided or permanent pavement has been installed and accepted by the Engineer, all temporary erosion and sedimentation control structures and devices shall be removed.

3.03 SEDIMENT CONTROL

A. Construction Exit:

1. Construction exit(s) shall be placed as shown on the Drawings and as directed by the Engineer. 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.
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. 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. The stone shall be placed with its top elevation conforming to the surrounding roadway elevations. The stone shall be dropped no more than three feet 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 right-of-way and paved surfaces as directed by the Engineer.
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 right-of-way or paved surfaces has ceased and as directed by the Engineer.

B. Sediment Barriers:

1. Sediment barriers shall include, but are not necessarily limited to, silt fences, hay bales, rock check dams and inlet sediment traps and any device which prevents sediment from exiting the disturbed area.
2. Silt fences, hay bales and rock check dams shall not be used in any flowing stream, creek or river.

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3. Sediment barriers shall be installed as shown on the Drawings and as directed by the Engineer.
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 Engineer. 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 the Engineer.
5. Sediment Barrier Removal:
 - a. Sediment barrier shall be removed once the disturbed area has been stabilized with a permanent vegetative cover or permanent pavement has been installed and the sediment barrier is no longer required as directed by the Engineer.
 - b. Accumulated sediment shall be removed from the barrier and removed from the site.
 - c. All non-biodegradable parts of the barrier shall be disposed of properly. The hay bales may be spread evenly across disturbed areas as a mulching material.
 - d. The disturbed area created by barrier removal shall be permanently stabilized.

3.04 EROSION CONTROL

A. Grassing

1. Grassing shall be as specified in paragraph 3.05 of this Section
2. Temporary Stabilization: Temporary stabilization shall be provided as shown on the Drawings and conforming to these Specifications to control erosion on the site. Temporary stabilization shall be provided to any area which will not receive permanent stabilization within the next 14 calendar days. Partial payment requests may be withheld for those portions of the Project not complying with this requirement.
3. 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. Partial payment requests may be withheld for those portions of the Project not complying with this requirement.
 - b. Grass or sod removed or damaged in residential areas shall be replanted with the same variety within seven calendar days of the completion of work

in any area.

- c. Where permanent stabilization cannot be immediately established because of an inappropriate season, the Contractor shall provide temporary stabilization. The Contractor shall return to the site at the appropriate season to provide permanent stabilization in areas that received only temporary stabilization.

3.05 GRASSING

A. General:

1. (Not Used).
2. When final grade has been established, all bare soil, unless otherwise required by the Contract Documents, shall be seeded, fertilized and mulched in an effort to restore to a protected condition.
3. Specified permanent grassing shall be performed at the first appropriate season following establishment of final grading in each section of the site.
4. All references to grassing, unless noted otherwise, shall relate to establishing permanent vegetative cover as specified herein for seeding, fertilizing, mulching, etc.
5. Permanent grassing shall be of a perennial species.

- #### **B. Grassing activities shall comply with the Manual for Erosion and Sediment Control in Georgia, specifically for the selection of species, planting dates and application rates for seeding, fertilizer and mulching. Where permanent vegetative cover (grassing) cannot be immediately established (due to season or other circumstances) the Contractor shall provide temporary vegetative or mulch cover.**

3.06 RIP-RAP

- #### **A. Unless shown otherwise on the Drawings, rip-rap shall be placed at all points where banks of streams or drainage ditches are disturbed by excavation, or at all points where their natural vegetation is removed. Carefully compact backfill and place rip rap to prevent subsequent settlement and erosion. This requirement applies equally to construction alongside a stream or drainage ditch as well as crossing a stream or drainage ditch.**

B. Placement of Filter Fabric

1. The surface to receive fabric shall be prepared to a relatively smooth condition free from obstructions, depressions and debris. The fabric shall be placed with the long

dimension running up the slope and shall be placed to provide a minimum number of overlaps. The strips shall be placed to provide a minimum width of one foot of overlap for each joint. The filter 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. The fabric shall be placed so that the upstream strip overlaps the downstream strip. The fabric shall be placed loosely so as to give and therefore avoid stretching and tearing during placement of the stones.

2. The fabric shall be protected at all times during construction from clogging due to clay, silts, chemicals or other contaminants. Any contaminated fabric or any fabric damaged during its installation or during placement of rip-rap shall be removed and replaced with uncontaminated and undamaged fabric at no expense to the City.

C. Placement of Rip-Rap

1. The rip-rap shall be placed on a 6-inch layer of soil, crushed stone or sand overlaying the filter fabric. This 6-inch layer shall be placed to maximize the contact between the soil beneath the filter fabric and the filter fabric. Rip-rap shall be placed with its top elevation conforming to the finished grades or the natural slope of the stream bank and stream bottom.
2. The stones shall be dropped no more than 3 feet during construction.
3. Stone rip-rap shall be dumped into place to form a uniform surface and to the thickness specified on the Drawings. The thickness tolerance for the course shall be -6-inches and +12-inches. If the Drawings do not specify a thickness, the course shall be placed to a thickness of not less than 18-inches.

3.07 CLEAN-UP

- A. Remove and dispose of all excess erosion and sedimentation control devices and materials when no longer needed or at the completion of construction as directed by the Engineer. Clean out sediment control basins to an elevation at least one foot lower than the elevations shown on the Drawings.

+++ END OF SECTION 02125 +++

**SECTION 02140
DEWATERING**

PART 1 - GENERAL

1.01 SCOPE:

- A. Construct all permanent Work in areas free from water. Design, construct and maintain all dikes, levees, cofferdams and diversion and drainage channels as necessary to maintain the areas free from water and to protect the areas to be occupied by permanent work from water damage. Remove temporary works after they have served their purpose.
- B. The Contractor shall be responsible for the stability of all temporary and permanent slopes, grades, foundations, materials and structures during the course of the Contract. Repair and replace all slopes, grades, foundations, materials and structures damaged by water, both surface and sub-surface, to the lines, grades and conditions existing prior to the damage at no additional cost to the Owner.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.01 CARE OF WATER:

- A. Except where the excavated materials are designated as materials for permanent work, material from required excavation may be used for dikes, levees, cofferdams and other temporary backfill.
- B. Furnish, install, maintain and operate necessary pumping and other equipment for dewatering the various parts of the Work and for maintaining the foundation and other parts free from water as required for constructing each part of the Work.
- C. Install all drainage ditches, sumps and pumps to control excessive seepage on excavated slopes, to drain isolated zones with perched water tables, and to drain impervious surfaces at final excavation elevation.
- D. After they have served their purpose, remove all temporary protective work at a satisfactory time and in a satisfactory manner. All diversion channels and other temporary excavations in areas where the compacted fill or other structures will be constructed shall be cleaned out, backfilled and processed under the same Specifications as those governing the compacted fill.
- E. When the temporary works will not adversely affect any item of permanent work or the planned usage of the Project, the Contractor may be permitted to leave such temporary works in place. In such instances, breaching of dikes, levees and cofferdams may be required.

3.02 DEWATERING

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- A. By the use of well points, pumps, tile drains or other approved methods, the Contractor shall prevent the accumulation of water in excavated areas. Should water accumulate, it shall be promptly removed.
- B. Excavations shall be continuously dewatered to maintain a ground water level no higher than 3 feet below the lowest point in the excavation.
- C. Piezometric observation wells shall be required, to monitor the ground water level, to insure proper dewatering prior to excavation below the static water table. The number of wells required will vary depending on the size and depth of structures.
- D. No separate payment will be made for dewatering required to accomplish the work.

+++ END OF SECTION 02140 +++

**SECTION 02150
SHEETING, SHORING AND BRACING**

PART I GENERAL

1.01 SCOPE

- A. This section specifies requirements for sheeting, shoring, and bracing of trenches and excavations greater than 5-feet in depth. Where shoring, sheeting, bracing or other supports are necessary, they shall be furnished, placed, maintained, and except as specified otherwise, removed by the Contractor.

- B. Design Requirements:
 - 1. The design, planning, installation and removal, if required, of all sheeting, shoring, lagging, and bracing shall be accomplished in such a manner as to maintain the required excavation or trench section and to maintain the undisturbed state of the soils below and adjacent to the excavation.
 - 2. The Contractor shall design sheeting, shoring, and bracing in accordance with the OSHA Safety and Health Standards as well as state and local requirements.
 - 3. Horizontal strutting below the barrel of a pipe and the use of pipe as support are not acceptable.
 - 4. When the construction sequence of structures requires the transfer of bracing to the completed portions of any new structure or to any existing structure, the Contractor shall provide the Engineer with a complete design analysis of the expected impact of that bracing on the structure. This action shall in no way absolve the Contractor of responsibility of damage resulting from said bracing.

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.

Reference	Title
OSHA 2207	OSHA Safety and Health Standards, Revised 1987

- B. (Not Used)

1.03 SUBMITTALS

- A. Prior to starting any excavation work requiring sheeting, shoring, and bracing, the Contractor shall submit his plans for trench and excavation support systems to the

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Engineer as working drawings in accordance with the requirements of the General Conditions. No provisions of the above requirements shall be construed as relieving the Contractor of his overall responsibility and liability for the work.

- B. The Contractor shall submit a Certification of Compliance properly identified with the project name and project location. The Certification shall state that the sheeting, shoring and bracing have been designed in accordance with the prevailing codes and standards by a Professional Engineer registered in the State of Georgia with the Engineer's seal and signature appearing on the certification. Calculations shall not be submitted unless specifically requested by the Engineer.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 GENERAL

- A. The construction of sheeting, shoring and bracing shall not disturb the state of soil adjacent to the trench and below the excavation bottom.
- B. Trench sheeting below the top of a pipe shall be left in place.
- C. Excavation shall not be started until the design for support systems has been accepted by the Engineer.

+++ END OF SECTION 02150 +++

**SECTION 02200
EXCAVATION AND BACKFILL**

PART 1 – GENERAL

1.01 SCOPE

- A. The work under this Section includes earthwork and related operations, relating specifically to structural and site work including, but not limited to; excavating all classes of material encountered, including blasting; handling; storage; transportation; and disposal of all excavated and unsuitable material; construction of fills and embankments; backfilling around structures; backfilling all pits; compacting; all sheeting; shoring and bracing; preparation of subgrades; surfacing and grading; and any other similar, incidental, or appurtenant earthwork operation which may be necessary to properly complete the Work.
- B. The Contractor shall provide all services, labor, materials, and equipment required for all earthwork and related operations necessary or convenient to the Contractor for furnishing complete Work as shown on the Drawings or specified in these Contract Documents.
- C. Related Work specified elsewhere:
 - 1. Section 01410 Testing Laboratory Services
 - 2. Section 02125 Erosion and Sedimentation Control
 - 3. Section 02140 Dewatering
 - 4. Section 02700 Removing and Replacing Pavement

1.02 GENERAL

- A. Safety: Comply with local regulations and with provisions of the “Manual of Accident Prevention in Construction” of the Associated General Contractors of America, Inc. Occupational Safety and Health Act (OSHA) and all other applicable safety regulations.
- B. The elevations shown on the Drawings as existing are taken from the best available data and are intended to give reasonable information about the existing elevations. The Contractor shall verify conditions to determine the exact quantities of excavation and fill required.
- C. Earthwork operations shall be performed in a safe and proper manner with appropriate precautions being taken against all hazards.
- D. All excavated and filled areas for structures, fills, topsoil areas, embankments and channels shall be maintained by the Contractor in good condition at all times until final acceptance by the City. 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 at no cost to the City.

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- 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 flow uninterrupted in existing open ditches or channels; other surface drains; or temporary drains.
- 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 Work, regardless of the type, character, composition or condition thereof.
- G. The Contractor shall determine the appropriate means, methods, and techniques to make excavations shown on the drawings, regardless of the type of material encountered. Contractor shall make supplemental geotechnical investigations at no additional cost to the City to determine the character of subsurface materials encountered.
- H. The soil testing will be performed by the Contractor's testing laboratory. As a minimum at least one density test shall be performed for every 5,000 square feet of fill area and every two feet of fill lift.
- I. Should the Owner choose to conduct its own testing, 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 supplied by the Contractor, his agents or subcontractors, to conform to the requirements of these Contract Documents shall be paid by the Contractor. Contractor shall provide at least 24 hours advance notice of earthwork operations to the Testing Laboratory. Testing Laboratory shall provide reports to the Engineer with copies to the Contractor certifying (and sealed by a Registered Georgia Engineer) that earthwork is in conformance with the plans and specifications. The Testing laboratory shall witness the placement of all fill, unless otherwise directed by the Engineer.
- J. 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 Engineer.
- K. Stockpile Areas: Provided there is space available, stockpiling material may be on the Shaft access road site in areas to receive fill in subsequent phases of construction.

1.03 SUBMITTALS

Submittals shall be made in accordance with the requirements of the General Conditions of the Contract Documents. In addition, the following specific information shall be provided:

- A. Copies of permits obtained by the Contractor for the work.
- B. Test results, certification of compliance, source and samples for all imported materials.

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- C. Samples of fill materials to be used. Samples shall be submitted 2 weeks in advance of use and shall consist of 0.5 cubic feet of each type of material.
- D. Test reports for compaction.
- E. Regulations: Subcontractor shall obtain at least two copies of all applicable federal, state and local codes, laws, regulations and ordinances regarding the use of explosives. One copy of these codes, laws, regulations and ordinances shall be submitted to the Engineer at least 14 days prior to blasting. The second copy shall be maintained on-site in the Subcontractor's office, for review by all Subcontractor personnel involved in blasting.
- F. Subcontractor Qualifications and Evidence of Experience: Submit resumes of proposed blasting consultant and blasting supervisors to the Engineer. Resumes shall contain listing of experience, references with phone numbers and copies of all required blasting licenses.
- G. Blast Designs and Safety Measures: Submit to the Engineer the following information for initial test blasts and proposed production blast design for each trench and pit as appropriate:
 - 1. Number, location, diameter, depth and orientation of drill holes on a scaled drawing of the excavation or tunnel heading face;
 - 2. Type of explosive and weight of charge in each hole;
 - 3. Type and nomenclature of detonators;
 - 4. Type and distribution of stemming used to fill hole collars for charge confinement;
 - 5. Total amount of explosives in the blast and maximum charge-per-delay;
 - 6. Delay arrangement showing delay period in each hole;
 - 7. Description of the proposed blasting system; and type of firing source;
 - 8. Specific measures taken to protect structures, buried utilities and other facilities that may be potentially affected by blasting operations;
 - 9. Type and methods of shaft covers, matting and containment of blast area to mitigate fly rock;
 - 10. Description of and locations of signage used to announce blast warning signals to any persons that might enter blast areas;
 - 11. Clearing, guarding and communication procedures to confirm that all persons are evacuated to safe areas and that blast areas are secured prior to blasting;

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12. Prediction calculations for noise (air-overpressure) and peak particle velocity (PPV) at the closest structure and at other adjacent structures, pipelines or facilities that maybe potentially affected by blasting operations;
 13. Any redesign of the blasting program shall be submitted to the Engineer.
- H. Blasting Records: Maintain a record of each blast detonated. Submit to the Engineer the following records and information the same day the blasting is performed:
1. Depth of blast holes and the location of the blast point in relation to Project stationing;
 2. Type, strength and quantities of all explosives, types and quantities of detonators, powder factor (lb./cy), and actual firing times of all charges;
 3. Total explosive loadings per round and maximum charge per delay;
 4. Type of rock blasted;
 5. Reference to approved blast design submittal noting any modification;
 6. Time spent scaling rock and approval of rock scaling by designated individual;
 7. On a diagram of the approved blast pattern indicate any holes not drilled, drilled but not loaded, changes in spacing or in pattern of delay charges or in loading of holes. Include notes explaining why changes were made;
 8. Submit an evaluation of the blast indicating tights, areas of significant overbreak and any recommended adjustments for future blasts;
 9. Comments by the blaster in charge regarding any misfires, unusual results, or unusual effects;
 10. Date and exact firing time of blast; name of person in responsible charge of loading and firing and blaster permit number;
 11. Signature and title of person making recording entries;
 12. Vibration and air overpressure monitoring record: Two copies of all blast vibration monitoring data obtained independent of monitoring performed by the Engineer. Submit hard copies of 4-channel waveforms for each blast;
 13. Any other records required by federal, state and local codes, laws, regulations and ordinances.
- I. Blasting Safety and Security Plans:

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1. A complete description of the clearing and guarding procedures that will be employed to ensure personnel, staff, visitors, and all other persons are at safe locations during blasting. This information shall include details regarding visible warning signs or flags, audible warning signals, method of determining blast area zones, access blocking methods, guard placement and guard release procedures, primary initiation method, and the system by which the blaster-in-charge will communicate with site security guards.
2. Detailed description of how explosives will be safely stored, transported and used at the various work sites. Plans shall explain how storage magazines and explosive transport vehicles will satisfy all applicable regulations. This plan shall also indicate how explosives will be inventoried, secured and guarded to prevent theft or unauthorized use of explosives.
3. If the Georgia State Fire Marshal authorizes overnight storage of the explosives, the Subcontractor must submit a detailed storage plan that includes scaled maps indicating proposed location of detonator and explosives that will be stored overnight, distances to nearest occupied buildings, roadways and other limiting items in the American Table of Distances.
4. Include Material Safety Data Sheets (MSDS) and specific details about hazard communication programs for employees.
5. Equipment that will be used to monitor the approach of lightning storms and in the event of such, evacuation and site safety security plans.
6. Contingency plans for handling of misfires caused by cut-offs or other causes.
7. Fire prevention plan details, including smoking policies, procedures and limitations for work involving any open flames or sparks, description and location of all firefighting equipment, and firefighting and evacuation plans.
8. Initial and ongoing blasting and fire safety training programs.
9. Description of the personal protective equipment that will be used by the Subcontractor's personnel, including but not limited to, safety glasses, hard-toe footwear, hardhats and gloves.
10. Description of blast monitoring equipment and listing of individuals that will operate such equipment. Submittal shall indicate that all equipment meets the standards defined in Article 2.02 of this Section.
11. The Subcontractor's Safety Representative shall ensure that ongoing blasting work complies with all applicable regulations.
12. Submit copies of ATF Employee Possessor questionnaire forms (OMB No. 1140-0072) or ATF letters of clearance for all employees that will possess explosives for this

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work as defined in 27 CFR Part 555. Subcontractor employees, without submitted evidence of satisfactory ATF clearance, must not handle, control or have access to explosive materials.

13. Ground vibration and air-overpressure monitoring records: submit two copies of all 4 channel monitoring records done.
14. Deliver to the Engineer, 14 days prior to the start of blasting at any location, two bound copies of the property condition inspection reports (condition survey) containing all field notes, sketches, diagrams, photos and videos.

J. Notification:

1. For all work sites prior to starting blasting, the Subcontractor shall notify the appropriate local municipal officials, above and below-ground utility owners and the Engineer who will notify the general public expected to be potentially affected, of the Subcontractor's intent to conduct controlled blasting operations. Notice shall be given to all operators of all buried pipes, cables, conduits and overhead utility lines and poles located within a 200-foot radial distance of the blast area.
2. Notification to appropriate local municipal officials and utility owners or operators shall be done in writing, at least 48 hours prior to the start of blasting at a particular site or sooner if so required by any applicable local law or regulation, and shall indicate the expected frequency of blasting, hours that blasting might occur and the expected date that blasting will be completed. Upon completion of blasting at the particular site, utility owners or operators shall be notified that blasting has ceased in the area for the duration of the Project.
3. The Subcontractor shall furnish the Engineer with a list of those parties notified in accordance herewith prior to the start of such blasting. The list shall include names, addresses and telephone numbers.
4. The Subcontractor must submit copies of written notification letters sent to the responsible fire protection agency for any sites where explosives are stored overnight. These letters shall be submitted to the Engineer at least 48 hours before any explosives are stored at the site. These letters must be submitted by the Subcontractor to the responsible fire protection agency, 48 hours before explosives are stored at the site.

1.04 QUALITY ASSURANCE

Reference Standards. Comply with all Federal, State and local laws or ordinances, as well as all applicable codes, standards, regulations and/or regulatory agency requirements including the partial listing below:

- A. ASTM C136-84a, Standard Method for Sieve Analysis of Fine and Coarse Aggregates.

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- B. ASTM D1556-82, Test Method for Density of Soils in Place by the Sand Cone Method.
- C. ASTM D1557-78, Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10-lb (4.5-kg) Rammer and 18-in. (457-mm Drop).
- D. ASTM D3107-88, Test Method for Moisture Content of Soil and Soil Aggregate in Place by Nuclear Methods (Shallow Depth).
- E. U.S. Department of Justice, Alcohol, Tobacco and Firearms and Explosives Division (ATF27 CFR Part 555, Implementation of the Safe Explosives Act, Title XI, Subtitle C of Public Law 107-296; Interim Final Rule).
- F. Institute of Makers of Explosives, Dos and Don'ts - Instructions and Warnings for Consumers in Transporting, Storing, Handling, and Using Explosive Materials
- G. Institute of Makers of Explosives, Destruction of Commercial Explosives
- H. Institute of Makers of Explosives, Suggested Code of Regulations for the Manufacture, Transportation, Storage, Sale, Possession and Use of Explosive Materials
- I. Institute of Makers of Explosives, Safety in the Transportation, Storage, Handling and Use of Explosive Materials
- J. Institute of Makers of Explosives, Safety Guide for the Prevention of Radio Frequency Radiation Hazards in the Use of Electric Blasting Caps.
- K. National Fire Protection Association (NFPA), NFPA 495 - Code for the Manufacture, Transportation, Storage and Use of Explosive Materials, 1985 Edition
- L. National Fire Protection Association (NFPA), NFPA 498 - Standard for Explosives, Motor Vehicle Terminals, 1985 Edition
- M. US. Department of Labor, Occupational Safety and Health Administration (OSHA), Construction Standards and Interpretations 29 CFR Part 1926, Subpart V, Section 1926.900, "Blasting and Use of Explosives", final rule dated December 16, 1972.
- N. Official Code of Georgia (OCGA); Code Section 25 - Georgia Blasting Standards Act of 1978, Code Section 25-9-1, et seq.
- O. Vibration Subcommittee of the International Society of Explosive Engineers (ISEE), blast monitoring equipment operation standards (1999).

1.05 QUALITY CONTROL (BLASTING)

- A. The design and execution of blasting shall be performed under the on-site supervision of a licensed blaster certified in the State of Georgia.

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- B. The Subcontractor shall perform blast monitoring as required to satisfy its legal obligation relative to all permits and all applicable federal, state and local codes, laws, regulations and ordinances, and its contractual responsibilities, including safety.
- C. The Engineer may perform blast monitoring to verify conformance with regard to air-overpressure (noise) and peak particle velocity criteria defined by this Section.
- D. Qualifications and Clearance Status:
 - 1. The blasting supervisors (blasters-in-charge) shall have a minimum of 10 years of experience, directly related to the specific types of blasting they will oversee. All blasting supervisors shall be able to document the completion of at least three projects of similar scope and complexity.
 - 2. All blasters and supervising shift foremen shall be properly qualified and licensed in accordance with applicable federal, state and local government regulations. Necessary permits include an Explosives License issued by the Georgia Safety Fire Commissioner.
 - 3. Subcontractor shall be required to retain the services of an experienced blasting consultant with at least 10 years of experience in monitoring blasting operations (test blasts and production blasts), interpreting ground vibration, air overpressure, and impulse amplitudes for similar construction projects, and to prepare all blasting plans, test-blasting plans, and revisions to any of these plans. All blasting plans, test-blasting plans and revisions shall be reviewed by and covered with a signed review letter by the blasting consultant. The blasting consultant will not be required to sign the individual blast plans provided they are signed by an on-site licensed blaster.
 - 4. All persons that handle explosive materials, have control over them, or access to them, must not be prohibited persons, as defined in Section 555.11 of 27 CFR (ATF Rules).

PART 2 PRODUCTS

2.01 MATERIALS

A. Earthwork Materials

- 1. Controlled Fill:
 - a. Proposed fill soils shall be laboratory tested prior to construction use to determine their suitability. All fill material shall be subject to the approval of the Engineer.

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- b. Notification: For approval of imported fill material, notify the Engineer and Testing Laboratory at least three (3) weeks in advance of intention to import material, designate the proposed borrow area, and permit the Testing Laboratory to sample as necessary from the borrow area for the purpose of making acceptance tests to prove the quality of the material. Test results shall be submitted to the Engineer for approval. All fill shall be free of organic matter or debris, have a low to moderate plasticity, ($PI \leq 15$) uniform composition, and be free of rock fragments greater than three inches in dimension. Soils selected for use as fill material shall also have a standard Proctor (ASTM D 698) maximum dry density of at least 90 pounds per cubic foot.
 - c. All on-site fill material shall be soil exclusive of organic matter, frozen lumps or other deleterious substances.
 - d. It shall contain no rocks or earth clumps over 3-inches maximum in dimension.
2. Structural Fill and Structural Backfill:
- a. Select on site materials may be suitable. Testing and recommendation of suitability shall be made by the Testing Laboratory and submitted by the Contractor to the Engineer for approval.
 - b. Imported material shall be sand, uniformly graded crushed rock or other select material recommended by the Testing Laboratory and submitted by the Contractor to the Engineer for approval. Graded aggregate base material as specified in Section 02700, Removing and Replacing Pavement, is acceptable for structural fill and backfill.
 - c. Crushed Rock: Crushed rock used for bedding and drainage stone shall conform to the Georgia Department of Transportation Standard Specifications for construction of Road and Bridges, Section 800 for No. 57 Stone.
3. Coarse Aggregate: Coarse aggregate shall conform to the Georgia Department of Transportation Standard Specifications of Transportation Systems construction of Road and Bridges, Section 800 for No. 57 Stone, Group II, and shall have the following gradation:

Sieve size	Percent Passing	
	100	-
1-½ inch	100	-
1 inch	95	100
¾ inch	-	-
½ inch	25	60
3/8 inch	-	-
#4	0	10

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#8	0	5
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4. Top Soil: Dark organic weed free loam.
- B. Sheeting, Bracing and Timbering: The Contractor shall furnish, place and maintain all sheeting, bracing and timbering required to properly support trenches and other excavations in open cut and to prevent all movement of the soil, pavement, structures, or utilities outside of the trench or pit.

1. General:

- a. All cofferdams, sheeting, bracing and timbering shall be designed, sealed and signed by a registered Professional Engineer in the State of Georgia at the Contractor's expense. A copy of the drawings and design computations shall be submitted to the Engineer for the project files.
- b. Sheeting, bracing and timbering shall be so placed as to allow the Work to be constructed to the lines and grades shown on the Drawings.
- c. If at any time the method being used by the Contractor for supporting any material or structure in or adjacent to any excavation is not reasonably safe the Engineer may require and the Contractor shall provide additional bracing and support necessary to furnish the added degree of safety. The Contractor shall provide such added bracing and support by such method as Contractor may elect to use, but the taking of such added precautions shall in no way relieve the Contractor of sole and final responsibility for the safety of lives, work and structures.
- d. All sheeting and shoring in contact with the concrete or masonry shall remain in place. The sheeting or shoring above the structure may remain in place or be cut off. No sheeting shall be left in place within three feet below the ground surface.
- e. There shall be no payment for sheeting, bracing, and timbering left in place.

2. Timber:

- a. Timber may be substituted for steel sheet piling when approved by the Engineer. Timber for shoring, sheeting or bracing shall be sound and free of large or loose knots and in good condition. Size and spacing shall be in accordance with OSHA regulations.
- b. Remove bracing and sheeting in units when backfill reaches the point necessary to protect the work and adjacent property. Leave sheeting in place when it cannot be safely removed. Cut off sheeting left in place below the finished ground surface by three feet.

3. Steel Sheet Piling:

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Steel sheet piling shall be the continuous interlock type. 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. 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 or vertical movement at all times. In addition to the drawings and computations, the Contractor shall provide closure and sealing details between sheet piling and existing facilities, as well as method of excavation within sheet piling to the Engineer for review before commencing with construction operations. Contractor shall be responsible for all damage to existing utilities and structures resulting from installation of sheet piling. Damage to existing utilities and/or structures resulting from installation of sheet piling shall be repaired at the Contractor's expense.

C. Blasting Materials

1. Only explosive and initiation devices packaged by federally-licensed explosives manufacturing firms shall be used in blasting.
2. Only packaged or cartridge type, non-flowing explosives shall be used in the works. Black powder and nitroglycerine are prohibited for all blasting.
3. Non-electric detonating devices shall be used.
4. Only explosives designed and manufactured for smoothwall (trim) blasting shall be used in perimeter holes for blasting in the shafts, tunnels, trenches, adits, junctions and diversion structure excavations. The linear charge-weight-per-foot of explosives used in shaft perimeter, and tunnel back and rib holes shall not exceed 0.4 lb. /ft. This limitation does not apply to the primer stick, which must not weigh more than 0.5 pounds. Cartridge configurations and detonating cord shall be included in the linear charge weight-per-foot.
5. Explosives, blasting agents, primers, initiators, and ancillary blasting materials shall be kept in original packaging with clearly marked date codes. All explosives and initiating devices used shall be less than one year old.
6. If the Engineer determines that a blasting product appears to be in a damaged or deteriorated condition, the suspect product shall not be used until its condition can be determined. Products found to be damaged or in a deteriorated condition shall be immediately returned to the supplier for safe disposal.

7. Blast Monitoring Equipment

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- a. Equipment for on-site and off-site particle velocity and air overpressure monitoring shall be 4 channel (one overpressure and three seismic channels) units capable of digitally storing collected data. Equipment must be capable of printing ground motion time histories and summaries of peak motion intensities, frequencies and USBM RI8507 PPV frequency plots. Printed report records must also include date, time of recording, operator name, instrument number and date of last calibration.
- b. Instruments shall have a flat frequency response between 2 and 250 Hz for particle velocity and from 2 to 200 Hz for air-overpressure.
- c. The digitizing sampling rate for peak particle velocity and air overpressure measurements shall be at least 1,024 samples per second.
- d. Seismographs shall be capable of performing a self-test of velocity transducers and printed event records shall indicate whether or not the sensor test was successful.
- e. Seismographs used for compliance monitoring shall be capable of recording overpressure from 100 to 148 dB-L, and particle velocity from 0.05 to 5.0 inches/second.
- f. Systems shall be capable of providing printed event reports that include all peak measurements, frequencies and complete waveform plots.
- g. Seismographs shall have adequate memory to digitally record the entire duration of the blast-induced motion.
- h. All seismograph/software systems shall be capable of saving back-up copies of all event files.
- i. If the frequency of blast-induced ground motion for close-in blasting is expected to exceed 250 Hz, monitoring shall be done with instruments that measure acceleration with intensities up to 10 gs and at frequencies between 200 and 5,000 Hz.
- j. The Subcontractor shall supply the Engineer with four blast monitoring units as described above for the duration of the blasting in addition to any monitoring equipment the Subcontractor uses to meet the requirements herein. The Subcontractor shall provide for annual calibration for each of the blast monitoring units and any repair or maintenance required.
- k. Prior to the commencement of any trench blasting operation, perform preconstruction inspections and noise, vibrations and air overpressure surveys.

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- D. Other Materials: All other materials not specifically described but required for proper completion of the work of this Section, shall be as selected by the Contractor subject to the prior approval of the Engineer.
- E. Stockpile area: The stockpile area shown on the drawings, or as directed by the Engineer, shall be used to stockpile soil material for backfilling around structures and to stockpile needed topsoil.

PART 3 – EXECUTION

3.01 GENERAL

- A. Benching of Slopes: When the embankment is to be placed and compacted on hillsides, or when new embankment is to be compacted against existing embankments, or when the embankment is to be built $\frac{1}{2}$ width at a time, the slopes that are steeper than 4:1 as measured at right angles to the embankment shall be continuously benched over those areas as the work is brought up in layers. Benching shall be of sufficient width to permit the operation of placing and compacting equipment. Each successive cut shall begin at the intersection of the original ground and the vertical side of the previous cut. Material thus cut shall be recompacted along with the new embankment material. Proof roll subgrade prior to placement of fill material.
- B. Topsoil:
 - 1. Remove all topsoil to a depth at which subsoil is encountered, from all areas, which are to be cut to lower grades or filled.
 - 2. Topsoil to be used for finish grading may be stored on the site. It shall be piled properly, sloped to drain and covered.
- C. Bracing and Sheeting:
 - 1. Furnish, install, and maintain all sheeting, bracing, and shoring as may be required to properly support the sides of all excavations and to prevent all movement of earth, which could in any way injure the work, adjacent property, or workmen.
 - 2. Properly support all trenches for duct bank installation so as to conform to all pertinent rules and regulations and these Specifications. All trenches deeper than 5 feet shall be shored unless cut to the angle of repose of the excavated soils.
 - 3. Exercise care in the removal of sheeting, shoring, bracing and timbering to prevent collapse or caving of the excavation faces being supported and damage to the work and adjacent property.
 - 4. Do not leave any sheeting or bracing in the trench or excavation after completion of the work, unless approved or instructed by the Engineer. The cost of removing sheeting or bracing shall be at the Contractor's expense.

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5. All sheeting and shoring in contact with concrete or masonry shall remain in place. The sheeting and shoring above the structure may remain or be cut off. No sheeting or shoring left in place shall be within three feet below the ground surface.

D. Obstructions:

1. Remove and dispose of all trees, stumps, roots, boulders, pavement, pipes and the like, as required for the performance of the work.
2. Exercise care in excavating around catch basins, inlets, manholes, piping, duct banks, underground vaults, etc.
3. Avoid removing or loosening castings or pushing dirt into structures.
4. Damaged or displaced castings shall be repaired and replaced, and dirt entering the structures during the performance of the work shall be removed at no additional cost to the City.

E. Utilities to be Abandoned:

1. When pipes, conduits, sewers or other structures are removed from the trench leaving dead ends in the ground, such ends shall be fully plugged and sealed as indicated on the Drawings.
2. Abandoned structures such as manholes, catch basins or chambers shall be entirely removed unless otherwise specified or indicated on the Drawings.
3. All materials from abandoned utilities which can be readily salvaged shall be removed from the excavation and stored on the site at a location as directed by the Engineer.
4. All salvageable materials will remain the property of the City unless otherwise indicated by the Engineer.

F. Extra Earth Excavation:

In case soft material, which, in the opinion of the Engineer is not suitable, is encountered in the bottom of a trench or underneath a structure, the soft material shall be removed and replaced with structural fill or coarse aggregate.

G. Cutting Paved Surfaces and Similar Improvements:

1. Remove existing pavement as necessary for installing utilities and appurtenances or as otherwise shown on the Drawings.
2. Before removing any pavement, mark the pavement neatly, paralleling pipe lines and existing street lines. Space the marks to match the width of the trench.

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3. Sawcut the asphalt pavement along the marks before breaking away from the part of pavement that should remain.
4. Do not pull pavement with machines until completely broken and separated from pavement to remain.
5. Do not disturb or damage the adjacent pavement. If the adjacent pavement is disturbed or damaged, remove and replace the damaged pavement. Refer to Section 02700 for replacement of damaged or removed pavement.

NOTE: No additional payment will be made for removing and replacing damaged adjacent pavement.

6. Remove and replace sidewalks disturbed by construction for their full width and to the nearest undisturbed joint.
7. The Contractor may tunnel under curbs that are encountered. Remove and replace any curb disturbed by construction to the nearest undisturbed joint.

H. Dewatering:

1. The proposed dewatering plan shall be submitted by the Contractor to the Engineer for approval at least ten (10) working days prior to the beginning of any excavation.
2. Furnish, install, maintain and operate necessary pumping and other equipment for dewatering the various parts of the Work and for maintaining the foundation and other parts free from water as required for constructing each part of the Work.
3. By the use of well points, pumps, tile drains or other approved methods, the Contractor shall prevent the accumulation of water in excavated areas. Should water accumulate, it shall be promptly removed.
4. Excavations shall be continuously dewatered to maintain a ground water level no higher than 3 feet below the lowest point in the excavation.
5. Piezometric observation wells shall be required, to monitor the ground water level, to insure proper dewatering prior to excavation below the static water table. The number of wells required will vary depending on the size and depth of structures and shall be included in the plan.
6. The cost for all dewatering and discharge shall be at the Contractor's expense and shall be considered incidental.

3.02 EXCAVATION

A. Method:

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1. All excavations for appurtenances and structures shall be made in such manner and to such depth and width as will give ample room for building the structures and for bracing, sheeting, and supporting the sides of the excavation, for pumping and draining groundwater and wastewater which may be encountered, and for the removal from the trench of all materials excavated.
2. Water shall not be allowed to accumulate in excavations. Contractor shall provide sufficient temporary pumping to assure that surface and ground waters do not saturate foundation soils.
3. Take special care so that soil below the bottom of the structure to be built is left undisturbed.

B. Grades:

1. Excavate to lines and grades indicated on the Drawings.
2. Where excavation grades are not indicated on the Drawings, excavate as required to accommodate installation.

C. Disposal of Excavated Material:

1. Remove and legally dispose of all excavated material not needed to complete filling, backfilling, and grading.
2. Dispose of excess excavated material at locations secured by the Contractor and in accordance with all requirements of federal, state, county and municipal regulations. No debris of any kind shall be deposited in any stream or body of water, or on any street or alley. No debris shall be deposited on any private property except by written consent of the property owner. In no case shall any material be left on the Project site or be buried in embankments or trenches on the Project site. With recommendation of the Testing Laboratory and approval by the Engineer, demolished, crushed concrete may be acceptable for use in fill areas.
3. Excavated materials shall be placed adjacent to the work to be used for backfilling as required.
4. Excavated materials 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 to not cause any drainage problem. Excavated material shall be placed so as to not damage existing landscape or man-made improvements. Surcharging of any bank is not allowed.

D. Rock Excavation:

1. Rock excavation shall mean rock requiring drilling and blasting that occupies an original volume of at least one (1) cubic yard. Rock shall be considered as material which cannot be removed with a crawler tractor equal to a D-8 Caterpillar, equipped

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with a single-tooth ripper or by an excavator trackhoe equal to a Caterpillar 225 rated with a $\frac{3}{4}$ cubic yard capacity with a bucket curling pullout capacity of 25,000 pounds.

2. Where rock is encountered, it shall be excavated to the lines and grades indicated on the Drawings or as otherwise directed by the Engineer. The Contractor shall be responsible for obtaining any blasting permits required.
3. If excess excavation is made or the material becomes disturbed so as to require removal below final subgrade elevations or beyond the prescribed limits, the resulting space shall be refilled with Class B concrete in accordance with Section 03300, Cast-in-Place Concrete.

3.03 EXCAVATING FOR STRUCTURES

A. Excavation:

1. All excavation is unclassified and included in the Contractor's Base Bid. No additional payment will be made for rock excavation.
2. Excavation shall include all substances to be excavated. Excavation for structures shall be to limits not less than 2 feet outside wall lines, to allow for formwork and inspection.
3. Where rock excavation is carried below grade the Contractor shall backfill to grade using concrete or structural fill.
4. Where unsuitable material is encountered excavate material to a depth acceptable to the Engineer and fill with compacted structural fill as required.

B. Excavation for Foundations: Footings and slabs on grades shall rest on undisturbed earth, rock or compacted materials to insure proper bearing.

1. Unsuitable Foundation Material
 - a. Any material in the opinion of the Engineer which is unsuitable for foundation shall be removed and replaced with coarse aggregate or structural fill material as directed by the Engineer.
 - b. No determination of unsuitability will be made until all requirements for dewatering are satisfactorily met.
2. Foundation in Rock: Foundations for a structure shall be on similar materials. Should excavation for a foundation be partially in rock, the Contractor shall undercut that portion of the rock 12-inches and bring the excavation to grade with compacted crushed stone.

C. Construction Observations:

All excavations should be examined by the Engineer prior to reinforcing steel placement to verify that the design bearing pressure is available. All excavations should be clean, level and free of ponded water, mud and loose, frozen or water-softened soils. If it is necessary for an excavation to remain open overnight, or if rain is imminent, a 3-to 4-inch thick "mud mat" of Class B concrete may be placed in the bottom of the excavation to protect the bearing soils until reinforcing steel and concrete can be placed.

D. Unsuitable Bearing:

If unsuitable bearing for foundations is encountered at the elevations indicated on the Drawings, the Engineer shall be notified immediately.

3.04 EXCAVATION BELOW GRADE AND REFILL

If the bottom of any excavation is taken out below the limits shown on the Drawings or specified, it shall be refilled to the bottom grade, at the Contractor's expense, except where rock or unsuitable soil is encountered. The refill shall be 6-inch layers of structural fill or other material satisfactory to the Engineer. The type of material to be used shall be the Engineer's option.

3.05 BACKFILL AND FILL PLACEMENT

- A. Compaction of fill shall be accomplished by placing the fill material in horizontal lifts of eight-inches (8") maximum loose thickness and mechanically compacting each lift to at least the specified dry density.
- B. All fill placement shall be witnessed by an experienced soils technician of the Testing Laboratory and fill density and moisture tests for each lift shall be performed to verify that the specified degree of compaction is being achieved.
- C. Prior to placement of any material in embankments, the area within embankment limits shall be stripped of topsoil and all unsuitable materials removed as described under Excavation. Area to receive fill shall then be scarified to a depth of at least 6-inches.
- D. The fill shall be brought to the proposed elevation by placing and compacting only approved fill materials upon a subgrade approved by the Engineer.
- E. Fill materials shall be placed in continuous approximately horizontal layers extending the full width of the embankment cross-section and the full dimension of the excavation where practicable.
- F. The fill shall be placed at a moisture content that corresponds to a +/- 3% of the optimum moisture content, as determined by the standard Proctor moisture-density relationship test.
- G. Compaction:

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1. The fill shall be uniformly compacted to a dry density that corresponds to at least 95% of the standard Proctor maximum dry density (ASTM D 698) of the fill soil.
 2. The upper twelve-inches (12") of fill beneath the structures and pavement areas shall be compacted to 98% of the standard Proctor maximum dry density.
 3. Scarification and recompacting of the upper fill soils immediately prior to the slab-on-grade and/or pavement construction shall be required.
 4. Compaction of embankments shall be by sheepsfoot rollers with staggered uniformly spaced knobs and suitable cleaning devices. The projected area of each knob and the number and spacing of the knobs shall be such that the total weight of the roller and ballast when distributed over the area of one (1) row of knobs shall be 250 psi. Placement and compaction of materials shall extend beyond the final contours sufficiently to insure compaction of the material at the resulting final surface. Final contours shall then be achieved by a tracked bulldozer or grader shaping the face of the embankment.
 5. The backfill placement in trenches and behind structures shall be uniformly compacted to a dry density that corresponds to at least 95% of the standard Proctor maximum dry density (ASTM D 698) of the fill soil. In confined areas requiring portable compaction equipment the fill material shall be placed in horizontal lifts of four-inches (4") maximum loose thickness.
 6. If tests indicate that density of backfill is less than that specified, the area shall be either be recompacted or undercut, filled, and compacted until specified density is achieved.
- H. Final Grading: Upon completion of construction operations, the area shall be graded to finished contour elevations and grades shown on the Drawings. Graded areas shall be made to blend with remaining ground surfaces. All surfaces shall be left smooth and free to drain.
- I. Moisture:
1. If fill material is too wet, provide and operate approved means to assist the drying of the fill until suitable for compaction.
 2. If fill material is too dry, provide and operate approved means to add moisture to the fill layers.
- J. Proofrolling:
1. All areas where pavement or structures are to be built on compacted fill and other areas where indicated on the Drawing, shall be proofrolled to detect soft spots prior to the placement of fill material or construction of foundations.

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2. Proofrolling shall consist of the moving a 20-30 ton loaded dump truck or pneumatic tire roller over the subgrade after the subgrade is shaped. Proofrolling shall be witnessed by the Engineer.
 3. Pneumatic-tired rollers shall have not fewer than four pneumatic tired wheels which shall be of such size and ply that tire pressures can be maintained between 80 and 100 pounds per square inch for 25,000-pound wheel load during rolling operations. Unless otherwise required, rolling shall be done with tires inflated to 90 psi. The roller wheels shall be located abreast in a rigid steel frame. Each wheel shall be loaded with an individual weight box so that each wheel will bear an equal load when traversing uneven ground. The weight boxes shall be suitable for ballast loading such that the load per wheel shall be 25,000 pounds. The spacing of the wheels shall insure that the distance between the nearest edges of adjacent tires shall be not greater than one-half of the tire width of a single tire at the operating pressure for a 25,000-pound wheel load. The roller shall be operated not faster than 5 feet/second.
 4. Subgrade shall be proofrolled with 6 passes. Depressions that develop during the proofrolling operation shall be filled with suitable material and those filled areas shall be proofrolled with 6 passes. If, after having been filled and proofrolled, the subgrade still contains depressions, the soil shall be undercut to the full depth of the soft material or 5 feet whichever is less, backfilled, and rolled to achieve a compacted subgrade.
 5. After the proofrolled subgrade has been accepted by the Engineer, the surface of the subgrade shall be finish rolled with a smooth steel wheel roller weighing not less than 10 tons. Finished surface of the subgrade shall be within a tolerance of 0.04 feet at every point.
 6. Conduits, pipes, culverts and underdrains shall be neither disturbed nor damaged by proofrolling operations. Rollers shall neither pass over, nor approach closer than 5 feet to conduits, pipes, culverts and underdrains unless the tops of those facilities are deeper than 3 feet.
- K. During wet or rainy periods, aeration (drying) shall be required to reduce the fill materials to the required moisture condition. During dry periods, water shall be added to achieve the proper moisture content for compaction. Silty soils, which are wet, shall require aeration prior to compaction even during dry periods.

3.06 BACKFILLING AROUND STRUCTURES

A. General:

1. Remove debris from excavations before backfilling.
2. Do not backfill against precast structures until so instructed by the Engineer

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3. Wherever possible, backfilling shall be simultaneous on both sides of walls to equalize lateral pressures.
4. Do not backfill on only one (1) side of vertically spanning walls unless walls are adequately shored or permanent construction is in place to furnish lateral support on both top and bottom of wall.

3.07 GRADING

A. General:

1. Perform all rough and finished grading required to attain the elevations indicated on the Drawings.
2. Perform rough grading to an accuracy of plus or minus 0.10 feet.

B. Grading Around Buildings: Control the grading around buildings so the ground is pitched to prevent water from running into the excavated areas of a building or damaging other site features.

C. Treatment After Completion of Grading:

1. After grading is completed, permit no further excavation, filling or grading, except with the approval of the Engineer.
2. Use all means necessary to prevent the erosion of freshly graded areas during construction and until such time as permanent drainage and erosion control measures have been installed.

3.08 EXCESS WATER CONTROL

A. Unfavorable Weather:

1. Do not place, spread or roll any fill material during unfavorable weather conditions.
2. Do not resume operations until moisture content and fill density are satisfactory to the Engineer.
3. Any inundated area that freezes shall be removed and refilled at the Contractor's expense.

B. Provide berms or channels to prevent flooding of subgrade. Promptly remove all water collected in depressions.

C. Pumping, Drainage and Dewatering:

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1. Provide, maintain and use at all times during construction adequate means and devices to promptly remove and dispose of all water from every source entering the excavations or other parts of the Work.
2. Dewater by means, which will insure dry excavations, preserve final lines and grades, and do not disturb or displace adjacent soil.
3. All pumping and drainage shall be done with no damage to property or structures and without interference with the rights of the public, owners of private property, pedestrians, vehicular traffic or the work of other contractors, and in accordance with all pertinent laws, ordinances, and regulations.
4. Do not overload or obstruct existing drainage facilities.

3.09 SETTLEMENT

- A. 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 City.
- B. The Contractor shall make, or cause to be made, all repairs or replacements made necessary by settlement within thirty (30) days after receipt of written notice from the Engineer.

3.10 CLEANING

Upon completion of the work of this Section, remove all rubbish, trash and debris resulting from construction operations. Remove surplus equipment and tools. Leave the site in a neat and orderly condition acceptable to the Engineer, and in conformance with the General Conditions of the Contract Documents.

3.11 BLASTING

- A. Blasting of and in trenches shall be limited to the hours of 7:00 a.m. to 7:00 p.m., Monday through Friday, and 9:00 a.m. to 5:00 p.m. on Saturdays, or as outlined in any variances obtained by the Owner. Blasting in tunnels at a distance further than 250 feet away from the shaft centerline shall be limited to the hours of 7:00 a.m. to 10:00 p.m., Monday through Friday, and 9:00 a.m. to 5:00 p.m. on Saturdays. Blasting is not allowed on Sundays or Holidays.
- B. Blasting vibration and air-over pressure (noise) limitations are defined in Articles 3.05 and 3.06 below.
- C. The Subcontractor shall erect signboards of adequate size stating that blasting operations are taking place in the area, and such signs shall be clearly visible at all points of access to the area. These signs shall also clearly display the audible warning signals (horn signals) that will be used to warn all people in the area of the impending blast.
- D. An audible blast warning system shall be established, publicized, and operated only during blasting hours.

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- E. The Subcontractor shall operate a system to ensure that no personnel remain underground during blasting operations and blasting operations shall not be undertaken until it can be demonstrated that all personnel are accounted for and in a safe location.
- F. The Engineer shall be notified 24 hours before blasts occur at any specific location. The Subcontractor shall provide the Engineer with a schedule for all blasts and shall notify the Engineer if any blast is delayed for more than one hour. However, the Subcontractor will be allowed to re-shoot missed holes and tights, as they are uncovered without advance notice to the Engineer.
- G. Acceptable Controlled Blasting methods will be those utilizing smooth wall blasting, cushion blasting, and line drilling techniques. Use of "pre-splitting" surface excavations is specifically prohibited. Maximum drill round lengths, including subdrilling shall not exceed 0.75 times the minimum dimension of the opening.
- H. Holes shall not be charged with explosives at the same time that drilling or other mechanized equipment not needed to charge the round is being operated within 50 feet of the blast area.
- I. The first blasting operation shall be conducted by the Subcontractor as a test case. The first test blasts shall be no larger than 25 percent of the planned production design blast sized as measured by charge-weight-per-delay. The second and third test blasts shall be no larger than 60 and 100 percent respectively of the planned production design blast. Alternate test blasting plans may be proposed by Subcontractor with approval of Engineer. After each test blast and review of test blasting data, the Subcontractor and Engineer shall meet to review the program. Modifications to the blasting program may be required as a result of this review. Drilling and delay patterns, amount and type of explosive to be used in subsequent production blasts shall be revised according to the results of the test case.
- J. In addition to the monitoring requirements of the Subcontractor as specified herein, monitoring and recording of air-overpressure and vibration will be performed by the Engineer for every blast round. The results will be provided to the Subcontractor within 24 hours of the blast, for review. Changes in drilling and delay patterns and amount of explosives shall be made when tests indicate vibrations and/or overpressures in excess of that specified herein. Any major changes in the production blast design shall be submitted to the Engineer.
- K. All blasts in open cut excavations shall be covered with a sufficient number of steel cable mats or other substantial covering device in order to prevent injury to persons and property, including the structure and equipment used in connection with shaft, open cut or tunnel operation, from flying rock or other material.
- L. After a blast is fired, all loose and shattered rock or other loose material, which may endanger the structure or the workers shall be removed and the excavation made safe before proceeding with work. The Subcontractor shall install the required initial support prior to commencing drilling for the subsequent blasting round. Before drilling of blast holes for a new round, the face shall be thoroughly cleaned and examined for missed holes and unexploded charges. Blasting techniques shall be developed and improved as work progresses. The fact that the removal of loose or shattered rock or other loose material may enlarge the excavation beyond the required limits shall not relieve the Subcontractor of responsibility for such removal and subsequent additional backfill or concrete, and the Subcontractor shall not be entitled to additional payment for over- excavation or overbreak.
- M. No blasting is allowed within 40 feet of freshly placed concrete or grouted rock until 12 hours has elapsed since placement. Shotcrete is exempt from these requirements.

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- N. All transportation of explosives on the surface and any handling, blast charging or tie-in operations shall be stopped immediately upon the approach of an electrical storm, and all persons shall immediately be evacuated from the blasting area to a place of safety. Persons underground shall be notified of the approach and cessation (all clear) of an electrical storm, each by means of different signals. In shafts, tunnels or other excavation handling explosives, loading of holes, connecting up or firing of charges shall not be performed during an electrical storm and all persons shall withdraw to a safe distance from a partially or totally loaded face. During such storms, explosives on the surface shall be left in OSHA-approved transport containers, delivery vehicles, day-storage boxes or in approved storage magazines. At all times, explosives shall be watch guarded and secured by the Subcontractor's personnel that are in safe locations.
- O. All light and power circuits shall be disconnected and/or removed to a point not less than 100 feet from the face while explosives are being transported into the area and while the loading operations are taking place. During the loading operations only OSHA approved lighting may be used.
- P. Air- overpressure shall not exceed 130 decibels when monitored with an instrument with a 2 hertz high pass at any occupied structure. Air overpressure monitoring shall take place at the nearest residential or business structures susceptible to damage or claims of annoyance.
- Q. All measurements of blast-induced air-overpressure shall be done in accordance with the standards developed by the Vibration Section of the International Society of Explosives Engineers-1999.
- R. The maximum intensity of motion in the vertical, longitudinal and transverse directions, measured in the ground near any building or other surface structure shall not exceed 2.0 inches per second at any frequency of motion.
- S. The maximum intensity of motion in the vertical, longitudinal and transverse directions, measured on the ground above any buried utility lines or pipes shall not exceed 4 inches per second at any frequency of motion.
- T. The Subcontractor shall monitor each blast with four (4) seismographs located, as approved, between the blast area and the closest structures and/or utilities. The seismographs used shall be capable of recording Particle Velocity and frequency for three (3) mutually perpendicular components of vibration in the range generally found with Controlled Blasting.
- U. All measurements of blast-induced ground motion shall be performed in accordance with the standards developed by the Vibration Section of the International Society of Explosives, Engineers - 1999.
- V. Blasting operations shall not resume until the Engineer has approved the Subcontractor's revised blasting plan with modifications correcting the conditions causing the suspension.
- W. When blasting operations damage off-site properties or a portion of the work or material surrounding or supporting the work, promptly repair or replace damaged items to the condition that existed prior to the damage, to the satisfaction of the Engineer and property owner at no additional cost to the Owner.
- X. Blasting operations may be suspended by the Engineer for any of the following reasons:
 - 1. The Subcontractor's safety precautions are inadequate.

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2. Air overpressure or ground motion levels exceed specified limits.
3. Existing structural conditions on and off site are aggravated and are damaged by blasting.
4. Blasting causes instability of slopes or causes damage to rock outside the prescribed limits of excavation.
5. The results of the blasting, in the opinion of the Engineer, are not satisfactory.
6. Failure of the Contactor to adhere to the submitted and accepted blast plan.

+++END OF SECTION 02200+++

**SECTION 02225
TRENCH EXCAVATION AND BACKFILL**

PART I GENERAL

1.01 SCOPE

- A. The Contractor shall furnish all labor, materials, equipment, and incidentals required to perform all excavation and backfill required to complete the work as shown on the Drawings and as specified herein. The work shall include, but not be necessarily limited to, excavation and backfill for pipe and appurtenances, manholes and vaults, backfill and compaction, disposal of surplus and unsuitable material and all related work such as sheeting and bracing and dewatering.
- B. Work shall also include the removal of trees, stumps, brush, debris or other obstacles which remain after clearing and grubbing operations, which may obstruct the work, and the removal of all other materials, including rock, to the extent necessary to install the pipe and appurtenances in conformance with the lines and grades shown on the Drawings and as specified herein.
- C. Backfill shall include the refilling and compaction of the fill in the trenches and excavations up to the surrounding ground surface.
- D. 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.
 - 4. Initial Backfill: The area above the haunching material and below a plane 12-inches above the top of the barrel of the pipe.
 - 5. Final Backfill: The area above a plane 12-inches above the top of the barrel of the pipe.
- E. The choice of method, means, techniques, and equipment rests with the Contractor. 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 and available easement or right of way.

1.02 QUALITY ASSURANCE

- A. Reference Standards: The Contractor shall comply with the applicable provisions and recommendations of the latest editions of the following standards, except as otherwise shown on the Drawings or specified herein.
1. ASTM C33 – Standard Specification for Concrete Aggregates
 2. ASTM C136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
 3. ASTM D698 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³)
 4. ASTM D4253 – Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using A Vibratory Table
 5. ASTM D6938 – Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
 6. ASTM D1556 – Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method
 7. ASTM D1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil using Modified Effort (56,000 ft-lbf/ft³)
 8. ASTM D2937 – Standard Method for Density of Soil in Place by the Drive-Cylinder Method
- B. Density: All references to "maximum dry density" shall mean the maximum dry density defined by ASTM D698, except that for cohesionless, free draining soils "maximum dry density" shall mean the maximum index density as determined by ASTM D4253. Determination of the density of foundation, bedding, haunching, or backfill materials in place shall meet with the requirements of ASTM D1556, ASTM D6938 or ASTM D2937.
- C. Sources and Evaluation Testing: Testing of materials to certify conformance with the Specifications shall be performed by an independent testing laboratory.

1.03 SUBMITTALS

- A. The Contractor shall submit record documents in accordance with the requirements of the General Conditions. The Contractor shall record locations of all pipelines installed referenced to survey benchmarks. The Contractor shall also include the locations of all underground utilities encountered and/or rerouted. The Contractor shall provide dimensions, materials, elevations, inverts and direction of flow. The Contractor shall use GPS technology or conventional survey methods to locate utilities.
- B. (Not Used)

1.04 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. The Contractor shall pay particular

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attention to the Safety and Health Regulations Part 1926, Subpart P "Excavations" as described in OSHA publication 2226.

B. (Not Used)

1.05 TESTING

A. Testing shall be performed by an approved independent laboratory.

B. Compaction testing shall be performed in accordance with the requirements of ASTM D1556 or ASTM D6938.

PART 2 PRODUCTS

2.01 TRENCH FOUNDATION MATERIALS

A. Crushed Stone: Crushed stone shall be utilized for trench foundation (trench stabilization) and shall meet the requirements of the Georgia Department of Transportation Specification 800.01, Group I (limestone, marble, or dolomite) or Group II (quartzite, granite, or gneiss). Stone size shall be between No. 57 and No. 4, inclusive.

B. (Not Used)

2.02 BEDDING AND HAUNCHING MATERIALS

A. Water Mains

1. Unless specified otherwise, bedding and haunching materials shall be suitable materials that have been excavated from the trench and have been approved by the Engineer for use as pipe bedding and haunching. 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. Crushed stone, if utilized for bedding and haunching, shall meet the requirements of the Georgia Department of Transportation Specification 800.01, Group I (limestone, marble, or dolomite) or Group II (quartzite, granite, or gneiss). Stone size shall be between No. 57 and No. 4, inclusive.

B. Sewers and Storm Drains: Crushed stone utilized for bedding and haunching shall meet the requirements of the Georgia Department of Transportation Specification 800.01, Group I (limestone, marble, or dolomite) or Group II (quartzite, granite, or gneiss). Stone size shall be between No. 57 and No. 4, inclusive.

C. Filter Fabric - Non-Woven Type

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1. Filter fabric associated with bedding shall be a UV stabilized, spunbonded, continuous filament, needle-punched, polypropylene, non-woven geotextile.
2. The fabric shall have an equivalent open size (EOS or AOS) of 120 - 70. The fabric shall also conform to the minimum property values listed in the following table:

Fabric Property	Unit	Test Procedure	Average Value	
			Typical	Minimum
Weight	oz/yd ²	ASTM D 3776	8.3	
Thickness	mils	ASTM D 1777	105	
Grab Strength	lbs.	ASTM D 4632	240	210
Grab Elongation	%	ASTM D 4632	>50	50
Tear Strength	lbs.	ASTM D 4533	100	85
Mullen Burst	psi	ASTM D 3786	350	320
Puncture Resistance	lbs.	ASTM D 4833	115	100
Permittivity	sec ⁻¹	ASTM D 4491	1.7	
Water Permeability	cm/sec	ASTM D 4491	0.4	
Water Flow Rate	gpm/ft ²	ASTM D 4491	120	
UV Resistance (500 hrs)	%	ASTM D 4355	>85	
pH			2 - 13	

3. If ordered by the Engineer, the filter fabric 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 10 days during initial pipe installation.
4. Filter fabric shall be equal to Polyfelt TS 700, Trevira 1125 or SuPac 7-MP.

D. Electrical Ductbanks: Refer to Section 16119

2.03 INITIAL BACKFILL

- A. Initial backfill material shall be crushed stone or earth materials as specified for bedding and haunching materials.
- B. Earth materials utilized for initial backfill shall be suitable materials selected from materials excavated from the trench. 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. 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.

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When necessary, initial backfill materials shall be moistened to facilitate compaction by tamping.

- C. 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.

2.04 FINAL BACKFILL

- A. Final backfill material shall be general excavated earth materials, shall not contain rock larger than 2-inches at its greatest diameter, 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.

2.05 SELECT BACKFILL

- A. Select backfill shall be materials that meet the requirements as specified for bedding, haunching, initial backfill or final backfill materials, including compaction requirements.
- B. (Not Used)

2.06 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. Ready-mixed concrete shall be mixed and transported in accordance with ASTM C94. Reinforcing steel shall conform to the requirements of ASTM A615, Grade 60.
- B. (Not Used)

2.07 FLOWABLE FILL

- A. Controlled strength flowable fill shall be used as trench backfill only when authorized, in writing, by the Engineer.
- B. Controlled low strength flowable fill shall conform to Section 600 of the Georgia Department of Transportation Standard Specifications for Construction of Roads and Bridges – latest edition.
- C. Flowable fill design mix shall be for “excavatable” fill. Design mix shall be submitted to the Engineer for approval in accordance with Section 600.3.03 of the GDOT Standard Specifications.

2.08 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. Granular material shall meet gradation requirements for Size No. 57 or finer.
- B. (Not Used)

2.09 GRADED AGGREGATE BASE

- A. Graded aggregate base shall be Class “A” meeting the requirements of the Georgia Department of Transportation Specification Section 815.01.
- B. (Not Used)

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 finished graded areas.
- B. 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.
- C. Trench Width:
 - 1. The sides of all trenches shall be vertical to a minimum of one foot above the top of the pipe. 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. The minimum trench width shall be that which allows the proper consolidation of the haunching and initial backfill material.
 - 2. 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.
 - 3. Where rock is encountered in trenches, excavate to remove boulders and stones to provide a minimum of 12-inches clearance between the rock and any part of the pipe, manhole, vault or other structure.
- D. Trench Depth:

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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 and elevations shown on the Drawings.
2. Where rock is encountered in trenches for pipelines, excavate to the minimum depth which will provide a clearance below the pipe barrel of 8-inches for pipe 21-inches in diameter and smaller and 12-inches clearance for larger pipe, manholes and other structures. Remove boulders and stones to provide above minimum clearances between the rock and any part of the pipe, manhole, vault or other structure.

E. Excavated Materials:

1. Excavated materials shall be placed adjacent to the work to be used for backfilling as required. Top soil shall be carefully separated and lastly placed in its original location.
2. 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.
3. Excavated material shall be placed so as not to damage existing landscape features or man-made improvements and also allow access to valves and hydrants.

3.02 SHEETING, SHORING AND BRACING

- A. Sheeting, shoring and bracing is specified in Section 02150.
- B. Protection of the excavation against caving or settling of the banks shall be the sole responsibility of the Contractor. The Contractor shall protect the sides of his excavation by sheeting and bracing as may be necessary. No actions or instructions by the Engineer shall be regarded as the responsibility for security of the trench or the surrounding areas. The full responsibility remains with the Contractor.
- C. The Contractor shall furnish, put in place and maintain sheeting and bracing required to support the side of the excavation and prevent loss of ground which could damage or delay the work or endanger adjacent structures or vehicular traffic. If the Engineer is of the opinion that at any point sufficient or proper supports have not been provided, he may order additional supports placed at the expense of the Contractor. Compliance with such order shall not relieve the Contractor from his responsibility for the sufficiency of such supports. Care shall be taken to prevent voids outside of the sheeting, but if voids are formed, they shall be immediately filled and rammed.
- D. The Contractor shall leave in place to be imbedded in the backfill of the trench, all wood sheeting, bracing and other related items as shown on the Drawings, or which the Engineer may direct him in writing to leave in place at any time during the progress of the work for the purpose of preventing injury to structures, utilities, or property, whether public or private. The Engineer may direct that timber used for sheeting and bracing in

the trench be cut off at any specified elevation, after backfilling and tamping has reached this level.

- E. All sheeting and bracing not left in place shall be carefully removed in such manner as not to endanger the construction of other structures, utilities or property, whether public or private.
- F. The right of the Engineer to order sheeting and bracing left in place shall not be construed as creating any obligation on his part to issue such orders, and his failure to exercise his right to do so shall not relieve the Contractor from liability for damages to persons or property occurring from or upon the work occasioned by negligence or otherwise, growing out of a failure on the part of the Contractor to leave in place in the trench sufficient sheeting and bracing to prevent any caving or moving of the ground adjacent to the sides of the trench.
- G. The Contractor shall receive no payment, other than that included in the price to be paid for pipe, for any extra timber used for sheeting, bracing and other related items. The Contractor shall receive no payment for such timber which was used for the convenience of the Contractor.

3.03 TEST PITS

- A. Test pits for the purpose of locating underground utilities or structures as an aid in establishing the precise location of new work may be excavated by the Contractor. Test pits shall be backfilled as soon as the desired information has been obtained. The backfilled surface shall be maintained in a satisfactory condition for travel until resurfaced as hereinafter specified.
- B. Excavation and backfill of test pits shall be considered work incidental to the project and the cost shall be included in the appropriate bid item.
- C. If, for any reason, a test pit is left open for any period of time, it shall be properly barricaded and lighted by the Contractor.

3.04 ROCK EXCAVATION

- A. Definition of Rock: Refer to 02200.3.02.D.1.
- B. Blasting:
 - 1. Exhaust other practical means of excavating prior to utilizing blasting as a means of excavation. Provide licensed, experienced workmen to perform blasting. Conduct blasting operations in accordance with all existing ordinances and regulations. Protect all buildings and structures from the effects of the blast. Repair any resulting damage. If the Contractor repeatedly uses excessive blasting charges or blasts in an unsafe or improper manner, the Engineer may direct the Contractor to employ an independent blasting

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consultant to supervise the preparation for each blast and approve the quantity of each charge.

2. (Not Used)

- C. Removal of Rock: Dispose of rock off site that is surplus or not suitable for use as rip rap or backfill.
- D. The Contractor shall notify the Engineer prior to any blasting. Additionally, the Contractor shall notify the City and local fire department before any charge is set.

3.05 DEWATERING EXCAVATIONS

- A. Dewater excavation continuously to maintain a water level two feet below the bottom of the trench.
- B. Control drainage in the vicinity of excavation so the ground surface is properly pitched to prevent water running into the excavation.
- C. There shall be sufficient pumping equipment, in good working order, available at all times, to remove any water that accumulates in excavations. 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. Provision shall be made for the satisfactory disposal of surface water to prevent damage to public or private property.
- D. In all cases, accumulated water in the trench shall be removed before placing bedding or haunching, laying pipe, placing concrete or backfilling.
- E. 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. Sump depth shall be at least two feet below the bottom of the trench. 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. Pumps shall be a type such that intermittent flows can be discharged. A standby pump shall be required in the event the operating pump or pumps clog or otherwise stop operation.
- F. Dewater by use of a well point system when pumping from sumps does not lower the water level two feet below the trench bottom. Where soil conditions dictate, the Contractor shall construct well points cased in sand wicks. The casing shall be jetted into the ground, followed by the installation of the well point, filling casing with sand and withdrawing the casing.

3.06 TRENCH FOUNDATION AND STABILIZATION

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- 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. 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 Engineer may determine that the trench bottom is unsuitable and the Engineer may then order trench stabilization by directing the Contractor to over excavate trench bottom and fill with crushed stone.
- C. 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. 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. The ends of the filter fabric shall be overlapped above the pipe.
- D. Where trench stabilization is provided, the trench stabilization material shall be compacted to at least 95 percent of the maximum dry density, unless shown or specified otherwise.

3.07 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.
- 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. The initial layer of bedding placed to receive the pipe shall be brought to the grade and dimensions indicated on the Drawings. All bedding shall extend the full width of the trench bottom. 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. Adjustment to grade line shall be made by scraping away or filling with bedding material. Wedging or blocking up of pipe shall not be permitted. 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. 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, excavate bell holes of ample depth and width to permit the joint to be assembled properly and to relieve the pipe bell of any load.
- D. After the pipe section is properly placed, add the haunching material to the specified depth. The haunching material shall be shovel sliced, tamped, 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. Prior to placement of the haunching material, the bedding shall be clean and free of any water, loose rocks, boulders, or dirt clods.
- E. Pipe Bedding:

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1. The Contractor shall furnish and install pipe on the type and thickness of bedding as shown on the Drawings or as specified by the Engineer.
 2. Pipe bedding requirements for large water transmission mains shall be as specified in Section 02667.
- F. Manholes, Vaults and Other Structures: Excavate to a minimum of 12-inches below the planned elevation of the base of the manhole, vault or structure. Place and compact crushed stone bedding material to the required grade before constructing the manhole, vault or structure.
- G. Compaction:
1. Bedding and haunching materials under pipe, manholes, vaults, structures and accessories shall be compacted to a minimum of 95 percent of the maximum dry density, unless shown or specified otherwise.
 2. Bedding and haunching materials within the limits of restrained joint pipe shall be compacted to a minimum of 95 percent of the maximum dry density, unless shown or specified otherwise.

3.08 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. Place initial backfill material carefully around the pipe in uniform layers to a depth of at least 12-inches above the pipe barrel. 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.
- C. Backfill on both sides of the pipe simultaneously to prevent side pressures.
- D. Compact each layer thoroughly with suitable hand tools or tamping equipment.
- E. Initial backfill shall be compacted to a minimum 95 percent of the maximum dry density, unless shown or specified otherwise. Initial backfill within the limits of restrained joint pipe shall be compacted to a minimum 95 percent of the maximum dry density, unless shown or specified otherwise.
- 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 for initial backfill.

3.09 CONCRETE ENCASEMENT FOR PIPELINES

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- A. Where concrete encasement is shown on the Drawings for pipelines, excavate the trench to provide a minimum of 12-inches clearance from the barrel of the pipe. Lay the pipe to line and grade on solid concrete blocks or solid bricks. 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.
- B. (Not Used)

3.10 FINAL BACKFILL

- A. Backfill carefully to restore the ground surface to its original condition.
- B. The top 6-inches of backfill shall be topsoil or graded aggregate base material, depending upon the trench location.
- C. Excavated material which is unsuitable for backfilling, and excess material, shall be disposed of in a manner approved by the Engineer. Surplus soil may be neatly distributed and spread over the site, if approved by the Engineer, except that surplus soil shall not be distributed and spread over the site in areas under Corps of Engineers jurisdiction. If such spreading is allowed, the site shall be left in a clean condition and shall not affect pre-construction drainage patterns. Surplus rock from the trenching operations shall be removed from the site.
- D. 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.
- E. Pipelines: 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
- F. Manholes, Vaults and other Structures:
 - 1. Backfilling shall be carried up evenly on all walls of an individual structure simultaneously. A variation of 2-feet in elevation will be the maximum allowable. Backfill shall not be allowed against walls until they and their supporting slabs, if applicable, have attained sufficient strength. Backfill shall be subject to the approval of the Engineer.
 - 2. In locations where pipes pass through walls, the Contractor shall take the following precautions to consolidate the backfill up to an elevation of at least 2-feet above the bottom of the pipe:

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- a. Place fill in such areas for a distance of not less than 3-feet either side of the centerline of the pipe in level layers not exceeding 6-inches in depth.
 - b. Thoroughly compact each layer with a power tamper to the satisfaction of the Engineer.
3. Temporary bracing shall be provided as required during construction of all structures to protect partially completed structures against construction loads, hydraulic pressure and earth pressure. The bracing shall be capable of resisting all loads applied to the walls as a result of backfilling.
- G. Final backfill shall be compacted to a minimum 95 percent of the maximum dry density, unless specified otherwise. Final backfill underlying pavement and backfill under dirt and gravel roads and within the limits of restrained joint pipe shall be compacted to a minimum 95 percent of the maximum dry density, unless specified otherwise.
- H. Concrete or bituminous asphalt removed during construction shall not be placed in backfill.
- I. The surface of filled areas shall be graded to smooth true lines in conformance with the grades or elevations shown on the Drawings.

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. Utilize excess material excavated from the trench, if the material is suitable. If excess excavated materials are not suitable, or if the quantity available is not sufficient, provide additional suitable fill material.
- B. (Not Used)

3.12 BACKFILL WITHIN RIGHT-OF-WAYS

- A. Compact backfill within the limits of the any right-of-way including the backfill underlying pavement and sidewalks, and backfill under dirt and gravel roads to a minimum 95 percent of the maximum dry density.
- B. (Not Used)

3.14 FLOWABLE FILL

- A. Where flowable fill is utilized, excavate the trench to provide a minimum of 6-inches clearance on either side of the pipe barrel. Lay the pipe to line and grade on solid concrete blocks or bricks. In lieu of bedding, haunching and initial backfill, place flowable fill to the full width and depth of the trench.

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- B. Flowable fill shall be protected from freezing for a period of 36 hours after placement. Minimum temperature of flowable fill at point of delivery shall be 50 degrees F.

3.15 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. Compacted granular material shall be compacted to a minimum 95 percent of the maximum dry density.
- B. (Not Used)

3.16 TESTING AND INSPECTION

- A. The soils testing laboratory is responsible for compaction tests in accordance with paragraph 1.02 of this Section.
- B. Compaction tests:
 - 1. Compaction tests will be required in existing or proposed streets, sidewalks, driveways and other existing or proposed paved areas at varying depths and at intervals as determined by the Engineer.
 - 2. Minimum requirements for compaction testing shall be a minimum of one (1) test for each 400 feet or less of pipeline and one (1) test at each manhole, vault and other structure unless soil conditions or construction practices, in the opinion of the Engineer, warrant the need for additional tests. One (1) complete compaction test shall consist of individual tests in the same vertical plane over the installed pipe, beginning at a depth of 2-feet above the top of the pipe and at successive two feet vertical increments up to the top of the backfill.
 - 3. The Engineer shall direct where additional compaction tests will be performed along the Project route.
- C. The soils testing laboratory shall be responsible for inspecting and testing stripped site, sub grades 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. Providing excavation as necessary for laboratory personnel to conduct tests.
 - 4. Paying costs for additional testing performed beyond the required scope.
 - 5. Paying costs for re-testing where initial tests reveal non-conformance with specified requirements.

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E. Inspection

1. Earthwork operations, acceptability of excavated materials for bedding or backfill, and placing and compaction of bedding and backfill shall be subject to inspection by the Engineer.
2. Foundations and shallow spread footing foundations shall be inspected by a geotechnical engineer, who shall verify suitable bearing conditions.

F. Contractor shall comply with applicable codes, ordinances, rules, regulations and laws of local, municipal, state and federal authorities having jurisdiction.

+++ END OF SECTION 02225 +++

SECTION 02367

MICROPILES

PART 1 – GENERAL

1.01 SCOPE

- A. This specification section applies to the micropiles for the Peachtree utility bridge foundations only.
- B. Design, detail, furnish, install and test micropiles as shown on the Drawings and as specified.
- C. Furnish services, labor, materials, equipment, and incidentals necessary to fabricate, install and test micropiles and complete the Work.
- D. Perform any additional geotechnical investigation work necessary to provide parameters needed to complete design and construction of helical pier foundation system prior to submitting the design package.
- E. Contract Drawings show only functional features, minimum requirements and some of the required external connections. They do not show all components required for a complete installation nor exact dimensions particular to any manufacturer's equipment. Supply parts, devices and equipment necessary to meet the requirements of the Contract Documents and make dimensional adjustments particular to the fabrications being furnished. Costs associated with such changes and adjustments shall be considered as being included in the price bid for the Work shown and specified.

1.02 REFERENCES

- A. Where referenced by the governing code, the adopted edition shall apply. Otherwise, the latest edition of the reference shall apply.
- B. The following is a list of standards which may be referenced in this section:
 - 1. American Concrete Institute (ACI):
 - a. 318-11, Building Code Requirements for Structural Concrete and Commentary.
 - b. (Note Used)
 - 2. American Institute of Steel Construction (AISC):
 - a. 360-10, Specification for Structural Steel Buildings

- b. Steel Construction Manual, 14th edition.
3. American Society for Testing and Materials International (ASTM):
 - a. A36/A36M, Standard Specification for Carbon Structural Steel.
 - b. A572/A572M, Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel
 - c. A615/A615M, Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
 - d. A992/A992M, Standard Specification for Structural Steel Shapes.
 - e. C150/C150M, Standard Specification for Portland Cement.
 - f. C494/C494M, Standard Specification for Chemical Admixtures for Concrete.
 - g. D1143/D1143M Standard Test Methods for Deep Foundations Under Static Axial Compressive Load.
4. American Welding Society (AWS):
 - a. D1.1, Structural Welding Code – Steel.
 - b. (Note Used)
5. Deep Foundation Institute (DFI).
6. Federal Highway Administration (FHWA)
 - a. Design Manual: Micropile Design and Construction.
 - b. (Note Used)
7. International Code Council (ICC): 2012 International Building Code (IBC).
8. Occupational Safety and Health Administration (OSHA): Standard 29 CFR 1910, Occupational Safety and Health Standards.

1.03 DEFINITIONS

- A. Alignment Load (AL): A nominal load applied to a micropile during testing to keep the testing equipment correctly positioned.
- B. Apparent Free Micropile Length: The length of micropile which is not apparently bonded to the surrounding ground, as calculated from the elastic load extension data during testing.

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- C. Bond Length: The length of the micropile that is bonded to the ground and which is conceptually used to transfer the applied axial loads to the surrounding soil or rock.
- D. Casing: Steel pipe introduced during the drilling process to temporarily stabilize the drill hole.
- E. Centralizer: A device to centrally locate the reinforcement element(s) within the borehole.
- F. Core Steel: Steel reinforcement bar or pipes used to strengthen or stiffen the micropile, excluding any left-in drill casing.
- G. Coupler: The means by which the load can be transmitted from one partial length of reinforcement to another.
- H. Creep Movement: The movement that occurs during the creep test of a micropile under a constant load.
- I. Design Load (DL): Anticipated final maximum service load in the micropile.
- J. Duplex Drilling: A drilling system involving the simultaneous advancement of (inner) drill rod and (outer) drill casing. Flush from the inner drill rod is permitted to exit the borehole via the annulus between rod and casing.
- K. Elastic Movement: The recoverable movement measured during a micropile test.
- L. Free (Unbonded) Length: The designed length of the micropile that is not bonded to the surrounding ground or grout during testing.
- M. Micropile: A small diameter, bored, cast-in-place pile, in which most of the applied load is resisted by the steel reinforcement.
- N. Post Grouting: The injection of additional grout into the bond length of a micropile after the Primary grout as set. Also known as regrouting or secondary grouting.
- O. Primary Grout: Portland cement based grout that is injected into the micropile hole prior to or after the installation of the reinforcement to provide the load transfer to the surrounding ground along the micropile and affords a degree of corrosion protection in compression.
- P. PSI: Pounds per square foot.
- Q. Residual Movement: The non-elastic (non-recoverable) movement of a micropile measured during load testing.
- R. Safety Factor: The ratio of the ultimate capacity to the working load used for the design of any component or interface.

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- S. Single Tube Drilling: The advancement of a steel casing through overburden usually aided by water flushing through the casing. Also known as “external flush.” The fluid may or may not return to the surface around the casing, depending largely on the permeability of the overburden.
- T. Test Load (TL): The maximum load to which the micropile is subjected during testing.
- U. Tremie Grouting: The placing of grout in a borehole via a grout pipe introduced to the bottom of the hole. During grouting, the exit of the pipe is kept at least ten (10) feet below the level of the grout in the hole.
- V. Type A-D: FHWA Classification of micropiles based on method and pressure of grouting.
- W. Working Load: Equivalent term for Design Load.

1.04 DESIGN REQUIREMENTS

- A. Design shoring and falsework system capable of supporting portions of the superstructure during erection. Design shall be performed by a professional engineer licensed in the state where Project will be constructed and experienced in design of Work.
- B. Structural Performance of Micropiles: Design, analyze, test, detail, fabricate and install micropiles including components, connections and anchorage in accordance with the design requirements provided on the Drawings and herein. Micropiles including components, connection and anchorage shall be designed and detailed by a qualified professional engineer licensed in the state where Project will be constructed. Design and analysis shall be done in accordance with recognized engineering practices and principles.
- C. General Design Criteria:
 - 1. Governing Codes: Comply with IBC, amendments and referenced codes and standards therein.
 - 2. Design Guides: FHWA. Establish the minimum structural and geotechnical requirements for the pile, including a permanent casing in the upper non-bonded zone as indicated on the Drawings and central steel reinforcement in accordance with the design guides.
 - 3. Design Capacity: Vertical and lateral capacities as indicated on the Drawings.
 - 4. Safety Factor: The minimum ratio of the actual micropile capacity (ultimate design) and the design micropile load (service load) shall be 2.0. The safety factor applies to any component or interface.

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5. Allowable Vertical Displacement: 0" upward and 1/8" downward.
6. Allowable Horizontal Displacement: As indicated on the Drawings.
7. Overall Micropile Length: Determine overall length such that the required geotechnical capacity is developed by skin friction between grout and ground over a suitable length in an appropriate stratum.
8. Micropile Top Attachment: Distribute the design load (DL) to the concrete foundation such that the concrete bearing stress does not exceed capacity in accordance with ACI 318-11 and the stresses in the steel plates and welds do not exceed capacities in accordance with AISC 360-10 and the AISC Steel Construction Manual.
9. Micropiles shall be designed such that no moment is imparted from the pile into the pile cap (free head condition).
10. Corrosion Protection: Provide corrosion protection for permanent conditions with a service life of 50 year for all loading conditions. Corrosion protection shall be in accordance with the Deep Foundation Institute's recommendations.

1.05 DEFERRED DESIGN DOCUMENT REQUIREMENTS

- A. Deferred design is that portion of the design which is delegated to the Contractor's qualified professional engineer to be the engineer-of-record for the specified Work.
- B. The following is a list of deferred design documents for the micropiles that shall be prepared and sealed, signed and dated by a qualified professional engineer licensed in the state where Project will be constructed:
 1. Shop drawings.
 2. Working drawings.
 3. Calculations.
- C. Submit deferred documents, sealed, signed and dated by a qualified professional engineer licensed in the state where Project will be constructed, for review and acceptance by the Engineer prior to fabrication and installation.
- D. Submit deferred documents for approval to the appropriate permitting agency, where applicable, prior to installation.

1.06 SUBMITTALS

- A. Submittals shall be made in accordance with the requirements of the General Conditions of the Contract Documents. In addition, the following specific information shall be provided.
- B. Shop drawings: Provide fabrication and working drawings including:
 - 1. Scaled drawings showing the number, location, batter and orientation of each micropile. Each micropile shall be have a unique identity number.
 - 2. Design load.
 - 3. Type and size of micropile.
 - 4. Type and size of steel reinforcement.
 - 5. Minimum total bond length.
 - 6. Total micropile length.
 - 7. Grouting volumes and maximum pressures.
 - 8. Micropile top attachment.
 - 9. Micropile cut-off elevation.
 - 10. Steel materials.
 - 11. Pile top attachment.
 - 12. Bond length details.
 - 13. Corrosion protection.
- C. Grout Mix Design: Submit the grout mix design(s), including details of all materials to be incorporated, and the procedure for mixing and placing the grout. This submittal shall include certified test results verifying the acceptability of the proposed mix designs.
- D. Steel Reinforcement Mill Certification: Include ultimate strength, yield strength, elongation and composition.
- E. Casing Steel Mill Certification: Include ultimate strength, yield strength, elongation and composition. In lieu of mill certification, submit two representative coupon tests from each load delivered to the Project.

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- F. Construction Procedures: Submit a detailed narrative describing the proposed construction method to be employed, and encompassing all aspects, peripheral or otherwise, of the Contractor's site operation.
- G. Manpower and Equipment Usage Schedule: Submit a detailed manpower and major equipment usage schedule showing buildup requirements for maintaining schedule.
- H. Testing Method: Submit detailed plans for the method proposed for testing the micropiles prior to testing. Include necessary drawings and details to clearly describe the test method and equipment proposed.
- I. Testing Equipment: Submit calibration data for each test jack, pressure gauge and master pressure gauge to be used. The calibration tests shall have been performed by an independent testing laboratory and tests shall have been performed within six months of the date submitted. Testing shall not commence until the Engineer has approved the jack, pressure gauge and master pressure gauge calibration.
- J. Installation Records: Submit installation records to the Engineer within 30 calendar days after completion of the micropile Work. The records shall be completed within 24 hours after each pile installation is completed. The records shall include the following minimum information:
 - 1. Detailed drilling records including:
 - a. Drilling duration and observations.
 - b. Depth of soil augering/drilling recorded to the nearest vertical one (1) foot length
 - c. Depth of rock coring/drilling recorded to the nearest vertical one (1) foot length
 - d. Information on soil and rock encountered, including description of strata, water, etc.
 - 2. Record drawings showing the number, location and length of each micropile including approximate final tip elevation and cut-off elevation.
 - 3. Design loads.
 - 4. Description of unusual installation behavior, conditions.
 - 5. Any deviations from the intended parameters.
 - 6. Grout records including pressures attained, where applicable, quantity pumped per pile, cement type, compressive strength, etc.
 - 7. Grout quantities pumped.

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8. Pile materials and dimensions including steel manufacturer's mill test reports for steel pile components incorporated into the installation.
- K. Test Records: Complete test records within 24 hours after each test is completed. Submit test records to the Engineer within seven (7) calendar days after completion of the load test. The records shall include the following minimum information:
1. Pile installation record for reaction and test piles.
 2. Dial gauge readings and other survey data used for monitoring pile head movement for each load applied as well as for each increment during hold periods or individual loads.
 3. Strain gage readings at all the same increments as the dial gauge readings.
 4. Jack pressure and load cell readings at all the loading increments.
 5. Reduction of the data showing plots of pile head movement versus applied load as well as plots of the load at each strain gauge for each load increment.
 6. Estimate of the ultimate bond stress or ultimate load transfer between the micropile and the ground.
 7. Suggested modifications to the installation procedure for better constructability and to maximize ultimate pile capacity.
- L. Calculations including additional geotechnical investigation data used to determine basis for helical pier foundation system design. Calculations will be reviewed by Engineer for conformance with design criteria and design intent only.
- M. Installer's Qualifications: Submit a detailed summary of qualifications, including a summary of micropile construction projects to demonstrate compliance with article Quality Assurance. Provide:
1. Project name, location and date.
 2. Owner name with current contact information.
 3. Summary information to describe the type of micropiles constructed, the ground conditions, the construction and testing methods performed and the testing results. Identify any construction or testing difficulties and steps taken to resolve them.
- N. Key Personnel: Submit list of key personnel, who will be engaged in the Work, with experience records including superintendent, driller and project engineer.
- O. Professional Engineer's Licensure.

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- P. Professional Engineer's Experience: Submit a detailed summary of qualifications, including a summary of micropile design projects to demonstrate compliance with article Quality Assurance. Provide:
1. Project name, location and date.
 2. Owner name with current contact information.
 3. Summary information to describe the type of micropiles designed, the superstructure and the ground conditions. Identify any design difficulties and steps taken to resolve them.

1.07 QUALITY ASSURANCE

A. Installer and Personnel Qualifications:

1. Experienced in the design and construction of micropiles having successfully completed a minimum of five (5) projects in the Southeastern United States with similar conditions, size and scope within the past five (5) years.
2. Having key personnel including, but not limited to, a superintendent, driller, and project engineer each with a minimum of three (3) years of experience.

B. Professional Engineer Qualifications: Civil, Structural or Geotechnical Engineer, who is:

1. Licensed in the state where Project will be constructed.
2. Experienced in the design of micropiles having designed a minimum of five (5) projects in the Southeastern United States with similar conditions, size and scope within the past five (5) years.

1.08 SITE CONDITIONS

A. Prior to installation, visit and examine the work site and take into consideration conditions that may affect the work including, but not limited to:

1. Existing conditions of adjoining properties, river embankment, underground utilities and/or structures, streets, buildings and plant operations.
2. Conditions of public thoroughfares and roads for availability, clearances, loads, restrictions, and other limitations affecting transportation to and ingress/egress from the project site.

B. Conform to federal, state and local regulations.

C. Available Geotechnical Information: Test boring logs and laboratory data from the site subsurface investigation are presented in the Project geotechnical report. The data is

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not intended as representations or warranties of continuity of such conditions. It is expressly understood that the City, Engineer and Geotechnical Engineer will not be responsible for interpretations or conclusions drawn from the data. This data is made available for the convenience of the Contractor and is not guaranteed to represent all conditions which may be encountered. The Contractor shall make his own interpretations of the subsurface conditions for the work required under this contract.

1.09 DELIVERY, STORAGE AND HANDLING

A. Preparation for Shipment:

1. Package and clearly tag parts and assemblies that are of necessity shipped unassembled in a manner that will protect materials from damage, and facilitate identification and final assembly in field.
2. Insofar as is practical, factory assemble items provided hereunder.

B. Storage and Handling: In accordance with manufacturer's recommendations and in such a manner as to prevent damage of any kind, including overexposure to sunlight.

PART 2 – PRODUCTS

2.01 GROUT MATERIALS

- A. Cement: Cement shall be Portland cement conforming to ASTM C150 Type I, Type II, Type III or Type V and shall be the product of one manufacturer.
- B. Fillers: Inert fillers such as sand may be used in the grout in special situations such as presence of large voids in the ground or when grout take and travel are to be limited. Fillers shall be approved by the micropile designer and Engineer.
- C. Admixtures: Admixtures shall conform to the requirements of ASTM C494. Admixtures that control bleed, improve flowability, reduce water content, and retard set may be used in the grout subject to the review and approval of the Engineer.
 1. Expansive admixtures shall only be added to the grout used for filling sealed encapsulations.
 2. Admixtures shall be compatible with the grout and mixed in accordance with the manufacturer's recommendations.
 3. Calcium Chloride: Calcium chloride or admixtures containing more than 0.1 percent chloride ions are not permitted.
- D. Water: Water used in mixing concrete shall be potable, clean and free from deleterious amounts of acids, alkalis or organic materials and conform to ASTM C1602.

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2.02 GROUT MIX DESIGN

- A. Provide a stable, homogeneous, neat cement grout or a sand cement grout with a minimum 28-day unconfined compressive strength of 4,000 psi.
- B. The grout shall not contain lumps or any other evidence of poor or incomplete mixing.
- C. Admixtures shall be mixed in accordance with manufacturer's recommendations.

2.03 STEEL REINFORCEMENT

- A. Steel reinforcement shall be deformed bars in accordance with ASTM A615 Grade 60 or Grade 75, full length threaded bars in accordance with ASTM A615 Grade 75 except in marking, or full length threaded bars in accordance with ASTM A722 Grade 150.
- B. Bar couplers in cases of tensile loading shall develop the ultimate tensile stress of the bar, without any evidence of failure. Bar couplers in cases of compressive loading shall be compatible with efficient load transfer and overall reinforcement performance requirements.

2.04 STEEL CASING (PIPE)

- A. Steel casing or pipe shall comply with the tensile requirements of ASTM A252 Grade 3, except the minimum yield strength shall be 36,000 psi (or as specified in the design submittal, and the minimum elongation shall be 15 percent.
- B. "Structural Grade" or "Mill Secondary" material, meeting the requirements above without mill certification may be accepted based on a submittal of a minimum of two coupon tests per delivery and based on material being free from defects (dents, cracks, tears).
- C. Steel casing/pipe shall have a minimum length as shown on the Drawings without field welding.
- D. Casing sections shall be joined by manufactured thread joints constructed to develop at least the required compressive, tensile, shear and/or bending structural strength used in the micropile design.

2.05 PLATES AND SHAPES

- A. Structural steel plates and shapes for pile top attachments shall conform to ASTM A36/A36M or ASTM A992/A992M Grade 50.
- B. (Note used).

2.06 CENTRALIZERS

- A. Centralizers shall be fabricated from plastic, steel, or material that is non-detrimental to the steel reinforcement. Wood shall not be used.
- B. (Note used)

PART 3 – EXECUTION

3.01 INSTALLATION

- A. The micropile installation technique shall be such that it is consistent with the geotechnical, logistical, environmental, and load carrying conditions of the Project. The micropile installer shall select the drilling method and the grouting procedure used for the installation of the micropiles, subject to the approval of the Engineer.
- B. The drilling equipment and methods shall be suitable for drilling through the conditions to be encountered, with minimal disturbance to these conditions or any overlying or adjacent structure or service. The borehole must be open to the defined nominal diameter, full length, prior to placing grout and reinforcement.
- C. The drilling equipment shall be configured to collect all cuttings returned to surface into containers for disposal of cuttings offsite in accordance with Section 02200, Excavation and Backfill.
- D. Installation techniques shall be determined and scheduled such that there will be no interconnection or damage to piles in which grout has not achieved final set.
- E. Centralizers shall be provided at 10-foot maximum vertical spacing on central reinforcement. The uppermost centralizers shall be located a maximum of 5 feet from the top of the micropile. Centralizers shall permit the free flow of grout without misalignment of the reinforcement.
- F. The central reinforcement steel with centralizers shall be lowered into the stabilized drill holes to the desired depth without difficulty. Partially inserted reinforcement bars shall not be driven or forced into the hole such that there will be no interconnection or damage to piles in which the grout has not achieved final set.
- G. Check pile top elevations and adjust all installation micropiles to the planned elevations.

3.02 GROUTING

- A. Provide systems and equipment to measure the grout quality, quantity, and pumping pressure during the grouting operations. This information is to be measured and recorded by the special inspector in accordance with Special Inspections requirements

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- on the Drawings. Where a special inspector is not retained, the Contractor shall measure and record this information.
- B. After drilling, flush the hole with water and/or air to remove drill cuttings and/or other loose debris.
 - C. The pump shall be equipped with a pressure gauge to monitor grout pressures. The pressure gauge shall be capable of measuring pressures of at least 150 psi or twice the actual grout pressures used by the Contractor, whichever is greater. The grouting equipment shall be sized to enable the grout to be pumped in one continuous operation. The grout should be kept in constant agitation prior to pumping.
 - D. The grout shall be injected from the lowest point of the drill hole (by tremie methods) until clean, pure grout flows from the top of the micropile. The tremie grout may be pumped through grout tubes, hollow stem augers, or drill rods. Subsequent to tremie grouting, all grouting operations associated with, for example, extraction of drill casing and pressure grouting, must ensure complete continuity of the grout column. The use of compressed air to directly pressurize the fluid grout is not permissible. The grout pressures and grout takes shall be controlled to prevent excessive heave in cohesive soils or fracturing of soil or rock formations. The entire pile shall be grouted to the design cut-off level.
 - E. Upon completion of grouting of Type A and B piles (as defined by the Federal Highway Administration), the grout tube may remain in the hole, but it shall be filled with grout. Grout tubes for Type C and D piles (as defined by the Federal Highway Administration) shall be installed prior to the tremie grouting.
 - F. Grout within the micropiles shall be allowed to attain the minimum design strength prior to being loaded.
 - G. If the Contractor uses a post-grouting system, all relevant details including grouting pressure, volume, location and mix design, shall be submitted as part of the installation records.

3.03 PILE SPLICES

- A. Pile splices shall be constructed to develop the required design strength of the pile section.
- B. Lengths of casing and steel reinforcement to be spliced shall be secured in proper alignments and in such a manner that no eccentricity between the axes of the two lengths spliced or angle between them results.

3.04 PILE LOAD TESTS

- A. General:

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1. Pile load tests shall be performed to verify the adequacy of the design of the pile system, and the proposed construction procedures prior to installation of production piles.
2. Submit for review and acceptance the proposed micropile load testing procedure. The testing program shall be provided a minimum of two (2) weeks prior to starting the load testing. This micropile verification load testing proposal shall be in general conformance with ASTM D-1143 and shall indicate the minimum following information.
 - a. Type and accuracy of apparatus for measuring load.
 - b. Type and accuracy of apparatus for applying load.
 - c. Type and accuracy of apparatus for measuring the pile deformation.
 - d. Type and capacity of reaction load system, including sealed design drawings.
 - e. Hydraulic jack calibration report.

B. Verification (Pre-Production) Pile Load Test:

1. A minimum of two (2) sacrificial test piles with dead weight, reaction piles, or ground anchors shall be constructed immediately prior to the commencement of the installation of the production micropiles. The number of piles, their location and the type(s) of loading direction are as follows:
 - a. One (1) sacrificial test pile at the south abutment.
 - b. One (1) sacrificial test pile at the north abutment.
2. The micropile load test results shall verify the suitability of the Contractor's design and installation methods and will be reviewed and accepted by the Engineer prior to beginning production micropiles.
3. The drilling and grouting methods, casing and other reinforcement details, and depth of embedment for the test pile shall be identical to the production piles, except where approved otherwise by the Engineer.
4. The tested micropile(s) shall be loaded to 200 percent of the compression and/or tension design load (DL) (i.e., 2.00 DL). The load tested piles must be of the same design as the production piles to ensure meaningful results. The jack shall be positioned at the beginning of the test such that the unloading and repositioning of the jack during the test will not be required. Piles shall be tested under compression loads prior to testing under tension loads. An Alignment Load (AL), if required, may be applied to the pile prior to setting the movement recording devices. This

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Alignment Load shall be no more than ten (10) percent of Design Load (i.e., 0.10 DL): dial gauges shall be zeroed after applying the AL.

5. Axial pile load tests shall be made by loading the micropile and recording the pile head movement in the following load increments:

LOAD	HOLD TIME (MINUTES)
AL	-
0.15 DL	2.5
0.30 DL	2.5
0.45 DL	2.5
AL	1
0.15 DL	1
0.45 DL	1
0.60 DL	2.5
0.75 DL	2.5
0.90 DL	2.5
1.00 DL	2.5
AL	1
0.15 DL	1
1.00 DL	1
1.15 DL	2.5
1.30 DL	10*
1.45 DL	2.5
AL	1
0.15 DL	1
1.45 DL	1
1.60 DL	1
1.75 DL	2.5
1.90 DL	2.5
2.00 DL	10
1.50 DL	5
1.00 DL	5
0.50 DL	5
AL	5

* Hold until Creep Rate Criterion is met.

6. Thereafter for special test piles not to be later used in service, further load cycles may be conducted to failure.
7. Measurement of pile movement shall be obtained at each increment. The load hold period shall start as soon as the test load is applied and the pile movement, with respect to a fixed reference, shall be measured and recorded at 1 minute, 2, 3, 4,

and 5, and 10 minutes (load cycle maxima only). If the creep rate is greater than defined, the test load shall be held for an additional 50 minutes. The total movement between 6 and 60 minutes shall be recorded and compared to the Creep Rate Criterion.

8. Provide the Engineer a written report of the test records confirming micropile geometry and construction details within seven (7) working days after the completion of the pre-production tests. This report shall either confirm the design and construction of the micropile or propose modifications based upon the results of the verification tests.
9. If a micropile that is verification-tested fails to meet the acceptance criteria:
 - a. The cause(s) shall be established, and modifications shall be made to the design, the construction procedures, or both.
 - 1) Modifications may include modifying the installation methods, increasing the bond length, or changing the micropile type or size.
 - 2) Any modification which requires changes to the structure shall have prior review and acceptance of the Engineer.
 - 3) The cause for any modifications of design or construction procedures shall be decided in order to appropriately determine any additional cost implications. Any design or construction procedure modifications or cost of additional verification test micropiles and verification and/or proof load testing shall be at the Contractor's expense. Additional time required to remedy failing proof load tests shall not be cause for delay or impact claims.
 - b. The new system shall be retested, as directed by the Engineer.
10. Verification test piles shall be cut off a minimum of 24 inches below the surrounding ground elevation.

C. Proof (Production) Pile Load Test:

1. Proof test at least two (2) production micropiles. The piles to be tested will be selected by the Engineer in the following areas: one (1) at each abutment. At the Contractor's suggestion, but with the Engineer's concurrence, tension tests may be performed based on maximum DL in compression or tension for friction piles with sufficient structural tension capacity.
2. The micropile load test results shall verify the suitability of the Contractor's design and installation methods, and will be reviewed and accepted by the Engineer prior to pilecap construction.

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3. The tested micropile(s) shall be loaded to 160 percent of the compression and/or tension design load (DL) (i.e., 1.60 DL). The jack shall be positioned at the beginning of the test such that the unloading and repositioning of the jack during the test will not be required. Piles shall be tested under compression loads prior to testing under tension loads. An Alignment Load (AL), if required, may be applied to the pile prior to setting the movement recording devices. This Alignment Load shall be no more than ten (10) percent of Design Load (i.e., 0.10 DL): dial gauges shall be zeroed after applying the AL
4. Axial pile load tests shall be made by loading the micropile and recording the pile head movement in the following load increments:

LOAD	HOLD TIME (MINUTES)
AL	-
0.15 DL	2.5
0.30 DL	2.5
0.45 DL	2.5
0.60 DL	2.5
0.75 DL	2.5
0.90 DL	2.5
1.00 DL	2.5
1.15 DL	2.5
1.30 DL	10*
1.45 DL	2.5
1.60 DL	2.5
1.30 DL	4
1.00 DL	4
0.75 DL	4
0.50 DL	4
0.25 DL	4
AL	4

* Hold until Creep Rate Criterion is met.

5. Measurement of pile movement shall be obtained at each increment. The load hold period shall start as soon as the test load is applied and the pile movement, with respect to a fixed reference, shall be measured and recorded at 1 minute, 2, 3, 4, and 5, and 10 minutes (load cycle maxima only). If the creep rate is greater than defined, the test load shall be held for an additional 50 minutes. The total movement between 6 and 60 minutes shall be recorded and compared to the Creep Rate Criterion.

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6. Provide the Engineer a written report of the test records confirming micropile geometry and construction details within seven (7) working days after the completion of the pre-production tests. This report shall either confirm the production of the micropile or propose modifications based upon the results of the verification tests.
7. If a micropile that is proof tested fails to meet the acceptance criteria:
 - a. The Contractor shall be directed to proof test another micropile within that structure at a location chosen by the Engineer.
 - b. For failed piles and further construction of other piles, the Contractor shall modify the design, the construction procedure, or both.
 - 1) Modifications may include installing replacement micropiles, incorporating the failed micropiles at not more than 50 percent of the maximum load attained, post grouting, modifying the installation methods, increasing the bond length or changing the micropile type, or size.
 - 2) Any modification which requires changes to the structure shall have prior review and acceptance of the Engineer.
 - 3) The cause for any modifications of design or construction procedures shall be decided in order to appropriately determine any additional cost implications. Any design or construction procedure modifications or cost of additional verification test micropiles and verification and/or proof load testing shall be at the Contractor's expense. Additional time required to remedy failing proof load tests shall not be cause for delay or impact claims.

D. Acceptance Criteria:

1. Movement: The pile shall sustain the compression and tension design loads (1.00 DL) with no more than 0.5 inch total vertical movement at the top of the pile as measured relative to the pile prior to the start of testing. If an Alignment Load is used, then the allowable movement will be reduced by multiplying by a factor of $(DL-AL)/DL$ to conservatively account for the movement in reaching AL.
2. Creep Rate: Test piles shall have a creep rate at the end of the 1.30 DL increment which is not greater than 0.040 inch per log cycle of time from 1 to 10 minutes or 0.080 inch per log cycle of time from 6 to 60 minutes and has a linear or decreasing creep rate.
3. Failure is defined as load at which attempts to further increase the test load simply result in continued pile movement, which is defined as a slope of the load versus

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deflection (at end of increment) curve exceeding 0.025 inch per kip. Failure does not occur at any load increment up to and including the maximum test load.

3.05 TOLERANCES

- A. Centerline of piling shall not be more than 3 inches from indicated plan location.
- B. Micropile-hole alignment shall be within 2 percent of design alignment.
- C. Top elevation of micropile shall be within +1 inches or -2 inches of the design vertical elevation.
- D. Centerline of core reinforcement shall not be more than 3/4 inch from centerline of piling.

3.06 FIELD QUALITY ASSURANCE AND QUALITY CONTROL

- A. City-Furnished Quality Assurance, in accordance with IBC Chapter 17 requirements, is provided in the Special Inspections requirements on the Drawings.
- B. Contractor responsibilities and requirements are included in Section 01400, Quality Assurance/ Quality Control.

+++END OF SECTION+++

**SECTION 02510
ASPHALT PAVING**

PART 1 - GENERAL

1.01 SCOPE:

- A. The work under this Section includes, but it is not necessarily limited to, the furnishing and installation of all asphalt paving materials and pavement base materials as indicated on the Drawings and as necessary for the proper performance of this work.
- B. Related Work Specified Elsewhere:

Section 02200, Earthwork.

1.02 SUBMITTALS

- A. Submittals shall be made in accordance with the requirements of the General Conditions of the Contract Documents. In addition, the following specific information shall be provided:
 - 1. Batch design.
 - 2. Density and viscosity tests on each run.
 - 3. Weight slips for pavement base and asphalt paving materials.

1.03 QUALITY ASSURANCE:

- A. Unless otherwise indicated on the Drawings or herein specified, all work under this Section shall be performed in accordance with the current Georgia Department of Transportation Standard Specifications.
- B. Furnish weight slips for all material incorporated in the Project to verify that the required tonnage has been applied.

1.04 PRODUCT HANDLING:

- A. Protection: Use all means necessary to protect the materials of this Section before, during and after installation and to protect the installed work and materials of all other trades.
- B. Replacement: In the event of damage, immediately make all repairs and replacements necessary to gain the approval of the Engineer at no additional cost to the City.

PART 2 - PRODUCTS

2.01 MATERIALS:

- A. General: All materials and products for the work under this Section shall conform to the current Georgia Department of Transportation Standard Specifications except as otherwise specified herein.
- B. Graded Aggregate Base: The sub-base shall be a minimum of 6-inches thick and a width equal to the width of the finished paving. Aggregate base shall be Class A meeting the requirements of the Georgia Department of Transportation Specification Section 815.01. Compact to at least 95% Standard Proctor Density. (ASTM D-698)
- C. Base: The base for all paved roadways shall conform to the requirements of the Georgia Department of Transportation Specifications for the Hot Mix asphalt Section 828 Type "B".
- D. Surface Course: The surface course for all pavement, including paint or tack coat when required by the Engineer, shall conform to the requirements of the Georgia Department of Transportation Specifications for Asphaltic Concrete, Section 828, Type "E".
- E. Prime coat shall be in accordance with Section 412 of the DOT Standard Specifications.
- F. Tack coat shall conform to Section 413 of the DOT Standard Specifications.

PART 3 - EXECUTION

3.01 EXCAVATING, FILLING AND GRADING:

Perform excavating and filling in accordance with Section 02200 entitled "Earthwork" of these Specifications.

3.02 INSTALLATION:

- A. Asphaltic construction shall be performed in accordance with Section 400 of the Georgia Department of Transportation "Standard Specifications, Construction of Roads and Bridges".
- B. Place each course in the required quantities so that when compacted, they will conform to the indicated grade, cross section and minimum thickness as specified or as indicated on the Drawings.

3.03 CLEANING:

- A. Prior to acceptance of the work of this Section, clean the pavement and related areas in accordance with the requirements of the General Conditions of the Contract Documents.

+++ END OF SECTION 02510 +++

**SECTION 02521
CONCRETE SIDEWALKS, CURBS AND GUTTERS**

PART 1 - GENERAL

1.01 SCOPE

- A. Work described in this Section includes furnishing all labor, materials, equipment, tools and incidentals required for construction of concrete sidewalks, curb & gutter which shall consist of monolithic curb and gutter respectively, all constructed of Portland cement concrete, at the locations, and to the lines, grades, cross section, form and dimensions indicated on the Drawings at the Quarry site.
- B. (Not Used)
- C. Related Work Specified Elsewhere:
 - 1. Section 02110, Clearing and Grubbing.
 - 2. Section 02200, Earthwork.
 - 3. Section 02510, Asphalt Paving.
 - 4. Section 03300, Cast-In-Place Concrete.

1.02 PRODUCT HANDLING

- A. Protection: Use all means necessary to protect concrete materials before, during and after installation and to protect the installed work and materials of all other trades.
- B. Replacement: In the event of damage, immediately make all repairs and replacements necessary to the approval of the Engineer at no additional cost to the City.

1.03 SUBMITTALS

- A. Submittals shall be made in accordance with the requirements of the General Conditions of the Contract Documents.

PART 2 - PRODUCTS

2.01 CONCRETE REINFORCEMENT (Not Used)

2.02 CONCRETE AND RELATED MATERIALS

- A. General: Concrete and related materials including, but not necessarily limited to, joint materials, membranes and curing compounds shall conform to Section 03300, Cast-In-Place Concrete.

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- B. Class: All concrete shall be Class B 3,000 psi and conform to requirements of Section 03300.
- C. Water used in mixing concrete shall be fresh, clean, potable water free from injurious amounts of oil, acid, alkali, vegetable, wastewater and/or organic matter.
- D. Admixtures shall meet the following requirements:
 - 1. Except as herein specified, no curative or hardening admixtures shall be used.
 - 2. An air entrainment agent capable of providing 3 to 6 percent air shall be used. Air entraining admixtures which are added to concrete mixtures shall conform to ASTM C 260 for Air Entraining Admixtures for Concrete.
- E. Sub-base shall be constructed of durable material such as bank-run gravel. Minimum depth of sub-base shall be 3-inches.
- F. Joint filler shall be a non-extruding joint material conforming to AASHTO M21 3 for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (non-extruding and resilient bituminous types). The filler for each joint shall be furnished in a single piece for the full depth and width required for the joint unless otherwise specified by the Engineer.

PART 3 - EXECUTION

3.01 EARTHWORK

- A. General: All earthwork shall be performed in accordance with Section 02200, Earthwork, and as specified in this Section.
- B. Backfilling
 - 1. After the subgrade for sidewalks is compacted and at the proper grade, spread 3 inches or more of sub-base material. Sprinkle with water and compact by rolling or other approved method. Top of the compacted gravel shall be at the proper level to receive the concrete.
 - 2. After the concrete has set sufficiently, the spaces on both sides of the curb, gutter, and combined curb and gutter shall be backfilled, and the materials compacted and left in a neat and workmanlike condition.
 - 3. Curbs to be used in the construction of asphalt pavements shall be backfilled prior to placement of base material for asphalt pavement.

3.02 SUBGRADE PREPARATION

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- A. The subgrade shall be formed by excavating to the required depth below the finished surface of the respective types, in accordance with the dimensions and designs indicated on the Drawings or as directed by the Engineer, and shall be of such width as to permit the proper installation and bracing of forms. The subgrade shall be compacted by hand tamping and all soft, yielding or unsuitable material shall be removed and backfilled with satisfactory material and again compacted thoroughly to 98% of dry density per ASTM 698 and finished to a smooth and unyielding surface. The finished grade shall be to the dimensions and design indicated on the Drawings or as directed by the Engineer for the bottom of the proposed construction.

3.03 CONCRETE CURB AND GUTTER CONSTRUCTION

- A. Construct curbs to lines and grade shown or established by the Engineer. Curbs shall conform to the details shown on the Drawings.
- B. Forming:
 - 1. Forms shall be metal and of an approved section. They shall be straight, free from distortions, and shall show no vertical variation greater than 1/4-inch in 10 feet, and shall show no lateral variation greater than 1/4-inch in 10 feet from the true plane surface on the vertical face of the form.
 - 2. Forms shall be of the full depth of the structure and be so constructed as to permit the inside forms to be securely fastened to the outside forms.
 - 3. Securely hold forms in place true to the lines and grades indicated on the Drawings.
 - 4. Wood forms may be used on sharp turns and for special sections as approved by the Engineer.
 - 5. Where wooden forms are used, they shall be free from warp and the nominal depth of the structure.
 - 6. All mortar and dirt shall be removed from forms and all forms shall be thoroughly oiled or wetted before any concrete is deposited.
 - 7. The supply of forms shall be sufficient to permit their remaining in place at least 12 hours after the concrete has been placed.
- C. Joints:
 - 1. Joints shall be constructed as indicated on the Drawings and as specified.
 - 2. Construct joints true to line with their faces perpendicular to the surface of the structure and within 1/4-inch of their designated position.
 - 3. Thoroughly spade and compact the concrete at the faces of all joints to fill all voids.

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4. Install expansion joint materials at the point of curve at all street returns.
5. Install expansion joint material behind the curb at abutment to sidewalks and adjacent structures.
6. Place contraction joints every 10 feet along the length of the curbs and gutters.
7. Form contraction joints using steel templates or division plates which conform to the cross section of the structure. 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.
8. Contraction joint templates or plates shall not extend below the top of the steel reinforcement or shall be notched to permit the reinforcement to be continuous through the joint.
9. Contraction joints shall be a minimum of 1-1/2-inches deep.

D. 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.

E. Concrete Curing:

1. After finishing operations have been completed and immediately after the free water has left the surface, the surface of the structure shall be completely coated and sealed with a uniform layer of curing compound specified in Section 03300, Cast-In-Place Concrete.
2. The compound shall be applied in one or two applications as directed by the Engineer. When the compound is applied in two (2) increments, the second application shall follow the first application within 30 minutes.
3. The compound shall be applied continuously by means of an automatic self-propelled, pressure sprayer as approved by the Engineer at the rate directed by the Engineer, but not less than 1 gallon per 200 square feet of surface.

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4. The equipment shall provide adequate stirring of the compound during application.
5. Should the method of applying the compound not produce uniform coverage, its use shall be discontinued, and the curing shall be by another method approved by the Engineer.

F. Protection:

1. Provide and use sufficient coverings for the protection of the concrete in case of rain or breakdown of curing equipment.
2. Provide necessary barricades and lights to protect the work and rebuild or repair to the approval of the Engineer. 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 City.

3.04 SIDEWALK CONSTRUCTION (Not Used)

3.05 REPLACEMENT CONCRETE CURB AND SIDEWALK (Not Used)

3.06 CLEANING

- A. All excess or unsuitable material shall be disposed of as specified in Section 02050, Demolition.
- B. All surfaces of the Work and adjacent surfaces shall be broom clean. Contractor shall use pressure washing and other means approved by the Engineer to remove splashed and spilled concrete from the Work and adjacent surfaces.
- C. Disturbed seeded areas shall be reseeded per requirements of Section 02933, Seeding.

+++ END OF SECTION 02521 +++

**SECTION 02655
PIPING SYSTEM CLEANING AND TELEVISION INSPECTION**

PART 1 GENERAL

1.01 SCOPE

- A. The Contractor shall furnish all labor, materials, equipment and incidentals required to complete all piping system cleaning and television inspection Work as shown on the Drawings and as specified herein.

1.02 SUBMITTALS

- A. Submittals shall be made in accordance with the requirements of the General Conditions of the Contract Documents. In addition, the following specific information shall be provided:
 - 1. The Contractor shall provide to the Engineer the following information in writing prior to the set deadline, or at the indicated frequency, whichever is applicable.

Type of Submittal	Time/Frequency of Submittal
Experience Record of Contractor/Subcontractor	At Preconstruction Conference
Listing of Safety Precautions and Traffic Control Measures	At Commencement
Listing of CCTV and Sonar Equipment	At Commencement
Manufacturers Details of CCTV and Sonar Equipment	At Commencement
Internal Piping Inspection Project Schedule	At Preconstruction Conference
Listing of Cleaning Equipment & Procedures	At Commencement
Listing of Flow Diversion Procedures	At Commencement
Listing of Preconditioning Procedures	At Commencement
Listing of Backup and Standby Equipment	At Commencement
Location where Debris from Cleaning will be Disposed	At Commencement
Updated Schedule of Planned Inspections/Cleaning of Piping Reaches	Post Commencement and Weekly

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Two (2) copies of CCTV and Sonar findings (2 hard copies of fully detailed logs incorporating a summary statistical breakdown of defects and main findings, two (2) electronic discs of fully detailed logs and CD-ROMS of video output)	One (1) week After Completion of Section
Daily Logs and Progress Reports	Daily
Confined Space Entry Logs	Daily

2. Daily reports and weekly reports survey) shall be e-mailed to the Engineer.
3. The Contractor shall complete a daily written record (diary) detailing the work carried out and any small items of Work which were incidental to the Work. The Contractor shall include in his daily record and reference to the following:
 - a. Delays: Dense traffic, lack of information, sickness, labor, or equipment shortage, etc.
 - b. Weather: Conditions, e.g. rain, sunny, windy, etc.
 - c. Equipment: On site, e.g. specialty cleaning, by-pass equipment, etc.
 - d. Submittals: To the Engineer.
 - e. Personnel: On site by name, e.g., all labor, specialty services, etc.
 - f. Accident: Report, e.g. all injuries, vehicles, etc.
 - g. Incident: Report, e.g. damage to property, property owner complaint, etc.
 - h. Major defects encountered, including collapsed pipe, if any: Cave-ins, sink holes, etc.
4. The Engineer shall certify receipt of the daily record noting any items and adding any observations with reference to claims for payment to the Contractor. The Engineer may at his discretion, for which the Contractor must receive direction in writing, provide for an exception to this requirement for weekly submission of progress rather than for daily submission.

1.03 GENERAL

- A. Internal piping condition assessment shall be used to determine the structural and service condition of piping prior to abandonment, preconditioning or rehabilitation. Assessment shall be performed using pan and tilt color camera CCTV. In those circumstances where depth of flow is too great for CCTV, Sonar or a combination of Sonar and CCTV shall be used.
- B. Internal piping condition assessment shall also be used to inspect newly constructed piping and to survey individual lines that have been preconditioned to further assess condition and record findings.

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- C. It is the responsibility of the Contractor to comply with OSHA regulations, the City of Atlanta's Safety Guidelines, and the City of Atlanta's Confined Space entry Guidelines as applicable. The Contractor shall provide written documentation that all workers have received the training required under these regulations and guidelines.
- D. Two forms of internal condition assessment are required as part of this Contract as follows:
 - 1. Piping Survey: Detailed viewing of the piping ("survey") either manually or with the aid of CCTV and/or Sonar equipment, to assess internal structural condition, service condition, and identify and locate miscellaneous construction features as well as assess the structural and service condition of laterals. Data logging shall be required.
 - 2. Piping Inspection: Viewing the piping ("pull-through") pursuant to investigative work possibly incorporating a radio-sonde transmitter for locating purposes and/or following other operational activity including:
 - a. Locating manhole(s) and/or lateral(s) with or without radio-sonde.
 - b. Piping preconditioning and cleaning activities.
 - c. Piping rehabilitation including point repairs.
 - d. Such other similar purposes as may be required by the Engineer.
- E. Piping inspection shall be carried out manually or with the aid of CCTV and/or Sonar equipment, to assess overall condition. Data logging shall not be required.

1.04 REQUIREMENTS AND EXTENT OF SURVEY/INSPECTION

- A. The Contractor shall survey and/or inspect pipelines with color pan and tilt CCTV imagery and sonar and or combined color pan and tilt CCTV/Sonar (TISCIT) as specified so as to record all relevant features and to confirm their structural and service condition. Surveys/inspections of pipelines shall be carried out in accordance with the reporting format determined by the Engineer. A sample report sheet is attached to this section (Attachment A) and includes the recording of both target total length of piping surveyed/inspected between manholes as well as actual length surveyed/inspected.
- B. All CCTV/Sonar operator(s) responsible for direct reporting of piping condition shall have a minimum of three (3) years previous experience in surveying, processing, and interpretation of data associated with CCTV and Sonar surveys/inspections. The Contractor shall provide the Engineer with written documentation that all CCTV and Sonar survey operators meet these experience requirements. Documentation shall include a list of projects undertaken as well as client name and telephone number for reference.
- C. The Contractor shall provide certification indicating that all personnel have undergone training prior to undertaking internal condition assessment work. Defect Coding, as well as Material, Shape, and Lining Coding used throughout this Project shall conform to the attached listing (Attachment B). General inspection logging requirements are also

included with this section (Attachment C). Training will be carried out at the Contractor's expense.

- D. The Contractor shall complete a daily written record detailing the Work carried out as described in this section.

1.05 FIELD SUPERVISION BY CONTRACTOR

- A. The Contractor shall maintain on the site of the Work at all times a competent field supervisor in charge of the Survey/Inspection. The field supervisor shall be approved in writing by the Engineer prior to commencement of the Work. Any change of supervisor must be approved in writing by the Engineer prior to the change. The field supervisor shall be responsible for the safety of all workers and site conditions as well as ensuring that all work is conducted in conformance with the requirements of these specifications and to the level of quality specified.

1.06 APPLICATION OF INSPECTION TYPE

- A. The following guidelines concerning the use of CCTV and Sonar shall be followed, subject to the review and approval of the Engineer.
 1. CCTV alone shall be used for internal condition assessment where the depth of flow of wastewater is less than twenty-five (25) percent of overall piping diameter at the start of the survey. The Contractor shall make an informed decision to continue should the depth of flow increase beyond the twenty-five (25) percent level but no greater than forty (40) percent of pipe diameter at any time throughout the length.
 2. CCTV combined with Sonar shall be used for internal condition assessment where depth of flow of wastewater varies from twenty-five (25) percent to seventy-five (75) percent of overall piping diameter for piping greater than twenty-four (24) inches in diameter. Where the piping is less than twenty-four (24) inches in diameter and depth of flow of wastewater exceeds twenty-five (25) percent but is less than seventy-five (75) percent of pipe diameter the Engineer shall instruct the Contractor to either: (a) continue using CCTV (where depth of flow is only marginally greater than twenty-five (25) percent of pipe diameter) or (b) use Sonar (by damming or plugging the piping so that the depth of flow exceeds seventy-five (75) percent of pipe diameter).
 3. Sonar alone shall be used where depth of flow in the piping exceeds seventy-five (75) percent of pipe diameter and the level of the flow will be artificially increased, without the risk of flooding, to ensure that the pipe is completely surcharged.

1.07 RESPONSIBILITY FOR OVERFLOWS OR SPILLS

- A. It shall be the responsibility of the Contractor to schedule and perform the Work in a manner that does not cause or contribute to incidence of overflows or spills of wastewater from the piping system.

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- B. In the event that the Contractor's activities contribute to overflows or spills, the Contractor shall immediately take appropriate action to contain and stop the overflow, clean up the spillage, disinfect the area affected by the spill, and notify the Engineer in a timely manner.
- C. The Contractor shall indemnify and hold harmless the City for any fines or third-party claims for personal or property damage arising out of a spill or overflow that is fully or partially the responsibility of the Contractor, including the legal, engineering, and administrative expenses of the City in defending such fines and claims.

PART 2 PRODUCTS

2.01 SURVEY/INSPECTION UNITS

- A. The Contractor shall provide sufficient survey/inspection units and all relevant ancillary equipment, including standby units in the event of breakdown, in order to complete all piping and manhole surveys/inspections as specified in this section.

2.02 SURVEY/INSPECTION VEHICLE

- A. The survey/inspection vehicle shall comprise two totally separate areas.
- B. One area shall be designated as the viewing area and shall be insulated against noise and extremes in temperature, shall be air conditioned and shall be provided with means of controlling external and internal sources of light in a manner capable of ensuring that the monitor screen display is in accordance with the requirements of this section. Seating accommodation shall be provided to allow two (2) people, in addition to the operator, to view clearly the on-site monitor, which shall display the survey/inspection as it proceeds.
- C. The second area shall be a working area and shall be reserved for equipment, both operational and stored. No equipment utilized within the piping shall be allowed to be stored in the viewing area.

2.03 CCTV SURVEY/INSPECTION AND OPERATIONAL EQUIPMENT REQUIREMENTS

- A. The surveying/inspecting equipment shall be capable of surveying/inspecting a length of piping up to at least one-thousand five-hundred (1500) feet when entry onto the piping may be obtained at each end and up to one-hundred (100) feet by rodding or up to seven-hundred and fifty (750) feet where a self propelled unit is used, where entry is possible at one (1) end only. The Contractor shall maintain this equipment in full working order and shall satisfy the Engineer at the commencement of each working shift that all items of equipment have been provided and are in full working order.
- B. Each survey/inspection unit shall contain a means of transporting the CCTV camera and/or Sonar equipment in a stable condition through the piping under survey and/or inspection. Such equipment shall ensure the maintained location of the CCTV camera or

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Sonar equipment when used independently on or near to the central axis of a circular shaped piping when required in the prime position.

- C. Where the CCTV camera and/or Sonar head are towed by winch and bond through the piping, all winches shall be stable with either lockable or ratcheted drums. All bonds shall be steel or of an equally non-elastic material to ensure the smooth and steady progress of the CCTV camera and/or Sonar equipment. All winches shall be inherently stable under loaded conditions.
- D. Each unit shall carry sufficient numbers of guides and rollers such that, when surveying or inspecting, all bonds are supported away from pipe and manhole structures and all CCTV/Sonar cables and/or lines used to measure the CCTV camera's/Sonar head location within the piping are maintained in a taut manner and set at right angles where possible, to run through or over the measuring equipment.
- E. Each unit shall carry a range of flow control plugs or diaphragms for use in controlling the flow during the survey/inspection. A minimum of one (1) item of each size of plug or diaphragm ranging from six (6) inches to two (2) feet diameter inclusive shall be carried.
- F. Each survey/inspection unit shall have on call equipment available to carry out the flushing, rodding, and jetting of piping when such procedures are deemed to be necessary.

PART 3 EXECUTION

3.01 CLEANING PRIOR TO INTERNAL CONDITION INSPECTION

- A. Where required by the Engineer and only when instructed in writing, the Contractor shall clean the piping prior to internal condition inspection.

3.02 PIPING CLEANING UNITS AND EQUIPMENT

- A. The Contractor shall provide sufficient piping cleaning units and equipment, including standby units in the event of breakdown, in order to complete cleaning operations as specified.

3.03 CLEANING OF PIPING

- A. Cleaning means the removal and extraction of silt, debris, and obstructions from the piping which actually prevent entry and use of CCTV equipment, or the completion of the piping run and/or manned-entry inspection of piping, or which is specifically requested by the Engineer. In general cleaning shall not be required as part of the internal condition inspection service unless specifically instructed by the Engineer.
- B. No cleaning shall be required prior to:

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1. Sonar surveys or Sonar combined with CCTV surveys, or Sonar inspections or Sonar combined with CCTV inspections unless specifically instructed.
2. Internal inspection completed following construction and testing of new piping.

3.05 EXTENT OF CLEANING

- A. Cleaning is not required as part of the internal condition inspection service unless specifically instructed by the Engineer or designated in the Bid Schedule.
- B. In the event that cleaning is required and an instruction has been specifically given by the Engineer, the Contractor shall:
 1. Provide and/or manage the equipment necessary for proper jetting, rodding, bucketing, brushing, root cutting, flushing, and vacuum uplift or any other approved removal and extraction system necessary to remove and extract silt, debris, and obstructions from the piping which would otherwise preclude use of CCTV equipment and/or manned-entry inspection of the piping.
 2. Demonstrate the performance capabilities of the cleaning equipment and method for use when requested by the Engineer. If results obtained by the demonstration are not satisfactory, the Contractor shall select other methods or equipment that will clean the piping line and repeat the demonstration.
 3. Install a gauge to monitor working pressure on the discharge of high-pressure pumps for jetting equipment.
 4. Provide more than one (1) type of equipment or attachments on a single reach or at a single location as required.
- C. The Contractor shall exert all reasonable care to avoid damage to the piping or manhole during the cleaning operation. Mechanical equipment used for cleaning shall be equipped with an overload clutch to limit the risk of damage to the pipe.

3.06 REMOVAL OF DEBRIS WITH CLEANING

- A. The Contractor shall provide all equipment and personnel necessary to safely remove and extract silt and debris from the piping through existing manhole access, load it onto trucks for disposal, and dispose of the silt and debris at approved sites.

3.07 CCTV/SONAR - GENERAL

- A. CCTV Camera/Sonar Head Prime Position: The CCTV camera/sonar head shall be positioned to reduce the risk of picture distortion. In circular piping the CCTV camera lens and/or Sonar head shall be positioned centrally (i.e. in prime position) within the piping. In non-circular piping, picture orientation shall be taken at mid-height, unless

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otherwise agreed, and centered horizontally. In all instances the camera lens/sonar head shall be positioned looking along the axis of the piping when in prime position. A positioning tolerance of $\pm 10\%$ of the vertical piping dimension shall be allowed when the camera is in prime position.

- B. CCTV Camera/Sonar Head Speed: The speed of the CCTV camera in the piping shall be limited to eight (8) inches per second for surveys to enable all details to be extracted from the ultimate CD-ROM recording. Similar or slightly higher speed as agreed by the Engineer shall be provided for inspections. The speed of scanning Sonar shall be limited to four (4) inches per second.
- C. CCTV Color Camera: The Contractor shall provide a color pan and tilt camera(s) to facilitate the survey and inspection of all laterals, including defects such as hydrogen sulfide corrosion in the soffit of piping and benching or walls of manholes over and above the standard defects that require reporting, where required by the Engineer. These will be carried out as part of the normal CCTV assessment as the survey or inspection proceeds when instructed by the Engineer. A three-hundred sixty (360) degrees rotational scan indicating general condition must be implemented at every fifty (50) feet interval (min.) along piping, and at manholes and any salient, specified, defect features. The tilt arc must not be less than two-hundred twenty-five (225) degrees.
- D. Linear Measurement:
 - 1. The CCTV/Sonar monitor display shall incorporate an automatically updated record in feet and tenths of a foot of the footage of the camera or center point of the transducer, whichever unit is being metered, from the cable calibration point. The relative positions of the two (2) center points shall also be noted.
 - 2. The Contractor shall use a suitable metering device, which enables the cable length to be accurately measured; this shall be accurate to $\pm 1\%$ or three (3) inches whichever is the greater.
 - 3. The Contractor shall demonstrate compliance with the tolerances in this section, using one or both of the following methods in conjunction with a linear measurement audit form which shall be completed each day during the survey:
 - a. Using of a cable calibration device.
 - b. Tape measurement of the surface between manholes.
 - c. A quality control form will be completed and submitted by the Contractor depicting the level of accuracy achieved.
 - 4. If the Contractor fails to meet the required standard of accuracy, the Engineer shall instruct the Contractor to provide a new device to measure the footage. The Engineer retains the right to instruct the Contractor in writing, to re-survey those lengths of the piping first inspected with the original measuring device using the new measuring device.

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E. Data Display, Recording, and Start of Survey/Inspection:

1. At the start of each piping length being surveyed or inspected and each reverse set-up, the length of pipeline from zero (0) footage, the entrance to the pipe, up to the cable calibration point shall be recorded and reported in order to obtain a full record of the piping length. Only one (1) survey shall be indicated in the final report. All reverse set-ups, blind manholes, and buried manholes shall be logged on a separate log. Video digits shall be recorded so that every recorded feature has a correct tape elapsed time stamp. Each log shall make reference to a start (ST) and finish (FH) manhole unless abandonment took place because of blockage. Manhole number shall be indicated in the remark's column of the detail report. Surveys must not extend over two (2) tapes.
2. The footage reading entered on to the data display at the cable calibration point must allow for the distance from the start of the survey/inspection to the cable calibration point such that the footage at the start of the survey is zero (0).
3. In the case of surveying through a manhole where a new header sheet must be completed, the footage shall be set at zero (0) with the camera focused on the outgoing pipe entrance.
4. At the start of each manhole length a data generator shall electronically generate and clearly display on the viewing monitor and subsequently on the CD-ROM recording a record of data in alpha-numeric form containing the following minimum information:
 - a. Automatic update of the camera's footage position in the piping line from adjusted zero (0).
 - b. Piping dimensions.
 - c. Manhole/pipe length reference numbers.
 - d. Date of survey.
 - e. Road name/location.
 - f. Direction of survey.
 - g. Time of start of survey.
 - h. Piping use.
 - i. Material of construction of the pipe.
5. The size and position of the data display shall be such as not to interfere with the main subject of the picture.
6. Once the survey of the pipeline is under way, the following minimum information shall be continually displayed:
 - a. Automatic update of the camera's footage position in the piping line from adjusted zero (0).
 - b. Piping dimensions in inches.

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- c. Manhole or pipe length reference number (PLR). General convention allows upstream manhole number to be designated PLR.
 - d. Direction of survey, i.e., downstream or upstream.
7. Correct adjustment of the recording apparatus and monitor shall be demonstrated by use of the test tape or other device approved by the Engineer. Satisfactory performance of the camera shall be demonstrated by the recording of the appropriate test device at the commencement of each day for a minimum period of thirty (30) seconds.
 8. Footage and corresponding time elapsed video digit shall be given throughout survey/inspection for all relevant defects and construction features encountered unless otherwise agreed.
 9. Where silt encountered is greater than ten (10) percent of the diameter of the pipe, the depth of silt shall be measured and recorded at approximately fifty (50) foot intervals.
 10. CD-ROM capacity shall be adequate to record two (2) hours of video inspection. Recording of a single segment shall not extend over more than one (1) video tape. No unrecorded gaps shall be left in the recording of a segment between surveys/inspections as the original video tape.
 11. Only segments between manholes on the same piping reach or basin shall be included on one (1) CD-ROM. There shall be no “split surveys” or “split-basins” between CD-ROMs.
 12. All continuous defects shall incorporate a start and finish abbreviation in the log report.
- F. Coding: Defect Coding, as well as material, shape, and lining coding, and conventions used will be provided by the Engineer. The Contractor shall ensure that all surveyors conform to the detailed requirements of the reporting procedure concerning feature description and feature definition as well as the Piping.Dat computer file format attached. An example Piping.Dat Data File is presented in Attachment D.

3.08 MAN ENTRY SURVEY - GENERAL

- A. Photographic Camera Position - General Illustration of Piping Interior:
1. The hand-held photographic camera or CCTV camera shall be positioned to reduce the risk of picture distortion. In circular piping the camera lens shall be positioned centrally looking along the axis of the piping. In non-circular piping picture orientation shall be taken at mid-height, unless otherwise agreed, and centered horizontally.

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2. The hand held photographic camera or CCTV camera shall be positioned so that the long side of the photograph or CD-ROM frame is horizontal.

B. Photographic Camera Position - Laterals/Specific Defect:

1. A means of accurately locating the photographic or camera's footage and any recorded lateral or defect, along the piping shall be provided, to an accuracy of $\pm 1\%$ or six (6) inches whichever is greater. When requested by the Engineer in writing at any time during a survey or inspection, the Contractor shall demonstrate compliance with this tolerance.
2. The device used by the Contractor to measure the footage along the piping will be compared with a standard tape measure. The results will be noted. If the Contractor fails to meet the required standard of accuracy, the Engineer shall instruct the Contractor to provide a new device to measure the footage. The Engineer retains the right to instruct the Contractor in writing to re-survey those lengths of piping inspected with the original measuring device at no extra cost.

- C. Photographic Quality: The in-piping photographic camera or hand held CCTV system and suitable illumination shall be capable of providing an accurate, uniform and clear record of the piping's internal condition. In-piping lighting standards shall meet the requirements of the Engineer and applicable codes regarding safety and power.

3.09 CCTV, MAN ENTRY AND SONAR SURVEY DATA SPECIFICATION

A. Survey Reporting:

1. No later than fourteen (14) days following the completion of a pipeline survey/inspection, the Contractor shall submit to the Engineer two (2) hard copies of all details, i.e. typed reports including summary statistical breakdown of all defects encountered, two CDE-ROMs containing the data transfer file and two CD-ROMs shall be submitted to the Engineer. The supplied data and information shall remain the property of the City.
2. The report shall be computer validated using AMPS/EXAMINER software, or equivalent approved by the Engineer, and presented on two (2) floppy diskettes to provide a summary listing of the number and type of features including defects found for each section of pipeline. The report format is shown in the attached specimen report. This specimen report sheet shall be accurately and fully adopted in style, format, and detail.
3. When requested by the Engineer, the Contractor shall provide hard copy output or manually completed coding sheets at the time of the survey and shall forward copies of these sheets to the Engineer, preferably each day, but at least every other day, together with a daily report on progress.

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- B. Site Coding Sheets: Each piping length, i.e. the length of piping between two (2) consecutive manholes, shall be entered on a separate coding sheet or entered separately electronically. Thus where the Contractor elects to "pull through" a manhole during a CCTV and/or Sonar Survey or "walk through" during a "Man Entry" survey, a new coding sheet shall be started at the manhole "pulled or walked through" and the footage re-set to zero (0) on the coding sheet. Where a length of piping between consecutive manholes is surveyed from each end (due to an obstruction) two (2) coding sheets shall be used. Where a length of piping between two (2) consecutive manholes cannot be surveyed or attempted for practical reasons a (complete header) coded sheet shall be made out defining the reason for abandonment. At uncharted manholes a new coding sheet shall be started and the footage re-set to zero (0).
- C. Measurement Units: All dimensions shall be in feet and inches. Measurement of piping shall be to the nearest inch.
- D. CCTV and Man-Entry Photographs:
1. Photographs shall be taken of all defective laterals and pipeline defects where requested in writing. Where a defect is continuous or repeated the photographs shall be taken at the beginning of the defect and at not less than ten (10) foot intervals thereafter. Where photographs are not otherwise required a general condition photograph shall be taken not more than fifty (50) feet after the previous photograph.
 2. CCTV photographs must clearly and accurately show what is displayed on the monitor, which shall be in proper adjustment.
 3. Photographs must be durable and 3-inch x 5-inch size and shall be supplied in a suitable album or storage drawer the standard of which shall be to the satisfaction of the Engineer.
 4. Still photographs shall be durable and clearly identified in relation to the photograph number (cross referenced to the site survey sheet) street location, piping dimensions, manhole start and finish numbers, survey direction, footage and date when the photograph was taken.
 5. The annotation shall be clearly visible and in contrast to its background, shall have a figure size no greater than fourteen (14) point, and be type printed in upper case.
 6. The annotation shall be positioned so as not to interfere with the subject of the photograph.
 7. The Contractor shall provide color photographs using digital camera or such other mutually agreed upon hard copy color image together with electronic copy.
- E. Control Sample Photographs and/or CD-ROMs: The Engineer may issue a written instruction to the Contractor to provide a sample of the photographs and/or CCTV/Sonar

tapes taken during the contract period which the Contractor shall provide within five (5) working days of receiving the written instruction.

3.10 CCTV/SONAR PERFORMANCE

- A. Color CCTV/Sonar: All CCTV and/or Sonar work shall use color CCTV/Sonar reproduction.
- B. CCTV Picture Quality:
 - 1. An approved test device shall be provided and be available on the site of the Work throughout the Contract, enabling the tests specified in this clause to be checked.
 - 2. The test card shall be Marconi Regulation Chart No. 1 or its approved derivatives with a color bar, clearly differentiating between colors, with no tinting, to show the following: White, Yellow, Cyan, Green, Magenta, Red, Blue, and Black.
 - 3. At the start of each and every working shift, the camera shall be positioned centrally and at right angles to the test card at a distance where the full test card just fills the monitor screen. The Contractor shall ensure that the edges of the test card castellations coincide with the edges of the horizontal and vertical scan (raster). The card shall be illuminated evenly and uniformly without any reflection. The illumination shall be to the same color temperature as the color temperature of the lighting that recorded for subsequent use by the Engineer, the recording time shall be at least thirty (30) seconds. The type of camera used shall be identified on the test recording. The recording must show the camera being introduced into the test device and reaching its stop position. Other test devices may be used subject to approval by the Engineer.
- C. Shades of Gray: The gray scale shall show equal changes in brightness ranging from black to white with a minimum of five (5) clearly recognizable stages.
- D. Color: With the monitor adjusted for correct saturation, the six (6) colors plus black and white shall be clearly resolved with the primary and complementary colors in order of decreasing luminance. The gray scale shall appear in contrasting shades of gray with no tint.
- E. Linearity: The background grid shall show squares of equal size, without convergence/divergence over the whole picture. The center circle shall appear round and have the correct height/width relationship ($\pm 5\%$).
- F. Resolution: The live picture shall be clearly visible with no interference and capable of registering a minimum number of TV lines/pictures height lines. The resolution shall be checked with the monitor color turned down. In the case of tube cameras this shall be six-hundred (600) lines.

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G. Color Constancy:

1. To ensure the camera shall provide similar results when used with its own illumination source, the lighting shall be fixed in intensity prior to commencing the survey. In order to ensure color constancy, generally no variation in illumination shall take place during the survey.
2. The Contractor shall note that the Engineer may periodically check both the live and picture color consistency against the color bar. Any differences will require re-survey of the new length or lengths affected, at the Contractor's expense.

H. Playback and CD-ROM Labeling:

1. CD-ROM playback imaging shall be linked to electronic out put of alpha-numeric data so that if necessary direct interrogation of database can take place with simultaneous viewing of CCTV/Sonar images.
2. Each CD-ROM disc shall be labeled by reference to the header record for the survey section completed together with the following information:
 - a. Sequential (unique) CD-ROM number.
 - b. Basin/catchment worked in.
 - c. Survey company name and logo.
 - d. Survey date.

I. CCTV Focus/Iris/Illumination: The adjustment of focus and iris shall allow optimum picture quality to be achieved and shall be remotely operated. The adjustment of focus and iris shall provide a minimum focal range from six (6) inches in front of the camera's lens to infinity. The distance along the piping in focus from the initial point of observation shall be a minimum of twice the vertical height of the piping. The illumination must allow an even distribution of the light around the piping perimeter without the loss of contrast picture, flare out, or shadowing.

J. Sonar Survey Requirements:

1. Unit rates shall allow for:
 - a. Complete structural and service assessment to the equivalent standard as that obtained through conventional CCTV imagery.
 - b. The means of attenuating flow, where necessary, to facilitate appraisal of the full piping cross section.
 - c. Measurement of flow depth and silt depth.
2. Rates shall allow for continuous output on conventional annotated CD-ROM format of all piping surveyed, supported by complete defect code sheets. Additionally, silt levels shall be assessed as a percentage depth of piping at twenty-five (25) foot

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- intervals for each pipeline surveyed. To facilitate this requirement, and in addition, to assist in diametrical measurement particularly where a piping is deformed and/or where a piping has suffered hydrogen sulfide corrosion; screen graphic facilities shall be made available to enable measurements to be taken in any position across the diametrical profile of the piping as the Sonar survey proceeds and where specifically directed by the Engineer.
3. Where combined CCTV and Sonar imagery is required the output shall display combined CCTV and Sonar images of the piping being surveyed. The Sonar image shall be superimposed on the real CCTV image as a combined operation.
 4. Unit rates shall allow for a comprehensive final report on the findings concerning major defects, including fractures, displaced joints, deformation, corrosion, and lateral intrusions, as well as dominant surface features, including encrustation and silt depths.
 5. The monitor display resolution shall be a minimum of 512 x 512 pixels. The color palette shall have a minimum of sixteen (16) colors with text.
 6. The picture update speed shall not compromise compliance with Sub-clause A (1) or result in unsatisfactory picture resolution.
 7. The range of resolution shall be $\pm \frac{1}{10}$ inch.
 8. The maximum beam width of Sonar energy pulse shall be no greater than two (2) degrees from the center of the transducer.
 9. The transducer shall be of the continuous scanning type.

K. Contractor's Data Quality Control Procedure:

1. The Contractor shall operate a quality control system, to be approved by the Engineer, which will effectively gauge the accuracy of all survey reports produced by the operator.
2. The system shall be such that the accuracy of reporting is a function particularly of:
 - a. The number of faults not recorded (omissions).
 - b. The correctness of the coding and classification of each fault recorded.
3. The minimum levels of accuracy to be attained under the various survey headings are as follows:
 - a. Header Accuracy: ninety-five (95) percent.
 - b. Detail Accuracy: eighty-five (85) percent.

- L. The Contractor's data quality control program shall include routine outside auditing of the work completed by a qualified subcontractor. The qualified subcontractor shall meet the minimum specified Contract requirements for the performance of the Work and shall be approved in writing by the Engineer. The accuracy of the Contractor's data shall be based on the percentage of the data confirmed correct by the subcontractor. The minimum acceptable accuracy of the data shall be eighty-five (85) percent. The general sequence of the auditing shall be as follows:
1. The Engineer shall randomly select one (1) day per month, typically in the first week of the month, and the work performed during this day shall be reviewed and/or repeated by the qualified subcontractor.
 2. If the work is greater than or equal to eighty-five (85) percent accurate, no further outside auditing will be required for the month unless requested by the Engineer at his sole discretion. The cost for this audit is included in the allowances specified in the Bid Form.
 3. If the work is less than eighty-five (85) percent accurate, the Contractor shall at its own expense repeat and/or correct the work and have the work re-audited by the qualified subcontractor.
 4. If the work is still less than eighty-five (85) percent accurate, the Contractor shall repeat and/or correct and have the work re-audited, at its own expense, until the work is greater than or equal to eighty-five (85) percent accurate.
 5. When this re-audited work is found to be greater than or equal to eighty-five (85) percent accurate, the Contractor shall have the work of another randomly selected day in the same month reviewed and/or repeated by the qualified subcontractor at the Contractor's own expense.
 6. Steps 2 through 5 shall be repeated at the Contractor's own expense until the selected day is eighty-five (85) percent accurate on the initial audit.
 7. The occurrence of five (5) randomly selected days not achieving eighty-five (85) percent accuracy on initial subcontractor review will constitute cause for dismissal.
 8. If the Contractor successfully meets the eighty-five (85) percent accuracy requirement for the initial randomly selected day for two (2) consecutive months, the Contractor may subsequently audit one (1) day every other month. The Contractor may continue auditing one (1) day every other month until the initial randomly selected day does not meet eighty-five (85) percent accuracy, at which time it must resume auditing one (1) day every month.

3.11 COLLAPSED PIPING/DEFECTIVE MANHOLES

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- A. Any piping found with greater than ten (10) percent deformation (i.e. collapsed or near to collapse) shall be reported to the Engineer immediately for remedial action. In the event of emergency the Contractor shall call (404)-65-WORKS.
- B. Any manhole found broken, cracked, with missing covers or surcharged, shall be reported to the Engineer immediately for remedial action. In the event of emergency the Contractor shall call (404)-65-WORKS.
- C. Any piping found where the existing conditions pose a threat of personal injury to the public, such as a collapsed piping with attendant depression to roadway, shall be protected by the Contractor until the Engineer arrives at the site of the Work. In the event of emergency the Contractor shall call (404)-65-WORKS.
- D. Any manhole found where the existing conditions pose a threat of personal injury to the public, such as broken, cracked, or missing covers or covers found in traveled portions of any sidewalk or roadway shall be protected by the Contractor until the Engineer arrives at the site of the Work. In the event of emergency the Contractor shall call (404)-65-WORKS.

3.12 TRAFFIC CONTROL

- A. The Contractor shall control traffic in accordance with the requirements of Section 01550, Traffic Regulation.

ATTACHMENT A

**INTERNAL PIPING CONDITION ASSESSMENT
SAMPLE REPORTS**

(For use with City of Atlanta Database)

Water Supply Tunnel System Connection to Chattahoochee Water Treatment Plant

< SURVEY REPORT >						Page Number : 167 >	
Date : 02 05 2000			Time : 10:28				
Contractor	Contract No	Job No	Drainage Area	Div Dist	Pipe L. Ref		
ASI/DG	ASG/0001	0	0	0 000	23250201501X		
Location			Place Name				
BERKELE STREET			MCDANIEL BASIN				
Start Manhole No.	: 23250201001	Depth :	08.0	Total Length :	365.0		
Finish Manhole No.	: 23250201501	Depth :	09.0	Suyed Length :	280.7		
Use	Direction	Size	Shape	Material	Lining Yr Laid	Pipe L	
COMBINED	UPSTREAM	8in	CIRC.	U. CLAY	Z	3.00	
CD-ROM No	U. Model	Comments					
00016	-	-					
Purpose	Weather	Location	Further Information				
-	DRY	-					

< DETAIL >				Page Number : 167 >	
Digit Ph.	Dist CD	Code	Other Details		

0136	0.0	ST	Start of Survey			[0065]
0280	0.0	MH	Manhole 23250201001			
0560	0.0	WL	Water Level is now 05%			
0163	30.2	JN	Junction.	6in at 03o/c	FW	
0180	41.6	JDM	Joint Displaced Medium			
0186	43.3	JN	Junction.	6in at 09o/c	SW	
0200	54.6	OJM	Open Joint Medium			
0203	56.3	JN	Junction.	6in at 09o/c	SW	
0226	79.0	JN	Junction.	6in at 03o/c	FW?	
0236	83.2	JN	Junction.	6in at 09o/c	FW	
0260	106.5	JN	Junction.	6in at 02o/c	FW?	
0270	108.5	JN	Junction.	6in at 09o/c	FW	
0286	120.9	CNI	Conn. Intruding by	1in.	6in Dia at 12o/c	FW
0303	135.4	CL	Longitudinal Crack at 12o/c			
0310	136.0	CNI	Conn. Intruding by	1in.	6in Dia at 12o/c	FW?
0326	147.2	JN	Junction.	6in at 03o/c	FW	
0333	149.8	JN	Junction.	6in at 09o/c	SW	
0346	157.5	JN	Junction.	6in at 03o/c	SW	
0366	175.9	JN	Junction.	6in at 10o/c	SW	
0376	181.0	JN	Junction.	6in at 02o/c	FW?	
0386	184.9	JN	Junction.	6in at 10o/c	SW	
0780	184.9	S1 DES	Debris Silt. 05% loss			
0416	209.3	JN	Junction.	6in at 10o/c	FW?	
0840	209.3	F1 DES	Debris Silt. 05% loss			
0433	218.9	JN	Junction.	6in at 02o/c	SW	
0453	234.2	JN	Junction.	6in at 10o/c	SW	
0470	244.8	FCJ	Circumferential Fracture at Joint at 03 to 05o/c			
0483	254.7	JN	Junction.	6in at 02o/c	FW?	
0970	254.7	S2 DES	Debris Silt. 05% loss			
1940	254.7	S3 RF	Fine Roots			
0490	257.5	JN	Junction.	6in at 09o/c	SW	
0513	279.5	C2 DES	Debris Silt. 50% loss			
0520	280.6	JN	Junction.	6in at 02o/c	SW	

DETAIL CONTINUED ON NEXT PAGE	For Page Number : 167
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Water Supply Tunnel System Connection to Chattahoochee Water Treatment Plant

< CONTINUATION PAGE >		< Page Number : 167 >
Location BERKELE STREET	Place Name MCDANIEL BASIN	
Start Manhole No. : 23250201001	Depth : 08.0	Total Length : 365.0
Finish Manhole No. : 23250201501	Depth : 09.0	Suyed Length : 280.7

< DETAIL CONTINUED >		< Page Number : 167 >
Digit Ph.	Dist CD	Code Other Details

0523 280.7 F2 DES Debris Silt. 50% loss
 1050 280.7 F3 RF Fine Roots
 0523 280.7 SA Survey Abandoned DUE TO SURVEY OVERLAP

< SUMMARY >		< Page Number : 167 >
St Mh No. : 23250201001	Fh Mh No. : 23250201501	Suyed Length : 280.7
SOME MAJOR defects in this length : Deformations : NO		
Mult/Long/Circ Heavy/Medium Gusher/Runner Mass Breaks/Holes Fractures Encrustation Infiltration Roots Obstructions NO NO NO NO NO CIRC Faulty Junctions/Connections : YES		
< END OF SUMMARY >		

Water Supply Tunnel System Connection to Chattahoochee Water Treatment Plant

SURVEY REPORT		Page Number : 170				
Date : 02 05 2000		Time : 17:20				
Contractor	Contract No	Job No	Drainage Area	Div Dist	Pipe L. Ref	
ASI/DG	ASG/0001	0	0	0 000	23250200401X	
Location			Place Name			
MCDANIEL STREET			MCDANIEL BASIN			
Start Manhole No. :	23250201901	Depth :	09.6	Total Length :	085.8	
Finish Manhole No. :	23250200401	Depth :	08.0	Suyed Length :	085.8	
Use	Direction	Size	Shape	Material	Lining Yr Laid	Pipe L
COMBINED	UPSTREAM	12in	CIRC.	U. CLAY	2	3.00
CD-ROM No	U. Model	Comments				
00016	-	-				
Purpose	Weather	Location	Further Information			
	. DRY		-			

DETAIL		Page Number : 170	
Digit Ph.	Dist CD Code	Other Details	

0683	0.0	ST	Start of Survey	[0341]
1370	0.0	MH	Manhole 23250201901	
1940	0.0	WL	Water Level is now 05%	
0683	0.0	S1 DEG	Debris Grease at 07o/c to 05o/c. 05% loss	
0693	13.9	JDM	Joint Displaced Medium	
0700	18.3	OB	Obstruction. 05% loss STONE	
0710	26.3	S2 DES	Debris Silt. 05% loss	
0720	35.4	CXI	Conn Defect/Intr. by 3in. 6in Dia. At 10o/c SW	
1440	35.4	JN	Junction. 6in at 02o/c CAPPED OFF	
0736	40.5	JN	Junction. 6in at 02o/c CAPPED OFF	
0750	46.6	C2 DES	Debris Silt. 15% loss	
0766	60.9	JN	Junction. 6in at 10o/c CAPPED OFF	
0783	73.7	JX	Junction. Defective. 6in Dia at 02o/c SW	
1570	73.7	B	Break. From 11o/c to 01o/c	
0796	81.1	JN	Junction. 6in at 10o/c	
0800	85.8	F1 DEG	Debris Grease at 07o/c to 05o/c. 05% loss	
1600	85.8	F2 DES	Debris Silt. 15% loss	
2400	85.8	MH	Manhole 23250200401	
0800	85.8	FH	Finish of Survey.	

SUMMARY		Page Number : 170		
St Mh No. :	23250201901	Fh Mh No. :	23250200401	Suyed Length : 085.8
SOME MAJOR defects in this length :		Deformations : NO		
Breaks/Holes	Fractures	Encrustation	Infiltration	Roots Obstructions
YES	NO	NO	NO	YES
Faulty Junctions/Connections : YES				
END OF SUMMARY				

Water Supply Tunnel System Connection to Chattahoochee Water Treatment Plant

Date : 02 07 2000		Time : 14:52		Page Number : 184		
Contractor	Contract No	Job No	Drainage Area	Diu Dist	Pipe L. Ref	
ASI/DG	ASG/0001	0	0	0 000	23350305601X	
Location			Place Name			
GAULT STREET			BOULEVARD BASIN			
Start Manhole No. :	23350305601	Depth :	22.0	Total Length :	501.2	
Finish Manhole No. :	23350315501	Depth :	00.0	Suyed Length :	501.2	
Use	Direction	Size	Shape	Material	Lining Yr Laid	Pipe L
COMBINED D/STREAM		12in	CIRC.	U. CLAY	2	3.00
CD-ROM No	U. Model	Comments				
00017		-				
Purpose	Weather	Location	Further Information			
	DRY		-			

Digit Ph.		Dist CD Code		Other Details		Page Number : 184	
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0786	0.0	ST	Start of Survey	[0392]
1580	0.0	MH	Manhole 23350305601	
2360	0.0	WL	Water Level is now 05%	
0790	6.0	S1 EMJ	Encrust Med at Jnt. 15% loss at 07o/c to 05o/c CLOCKS VARY	
0800	12.9	EHJ	Encrust Heavy at Jnt. 25% loss at 12o/c to 05o/c	
0810	15.3	IDJ	Infiltration Dripping at Joint at 11o/c to 12o/c	
0816	18.6	EHJ	Encrust Heavy at Jnt. 25% loss at 01o/c to 05o/c	
0823	24.7	CL	Longitudinal Crack at 12o/c	
0830	31.5	FL	Longitudinal Fracture at 12o/c	
0840	43.2	EHJ	Encrust Heavy at Jnt. 30% loss at 07o/c to 05o/c	
0846	46.3	EHJ	Encrust Heavy at Jnt. 25% loss at 07o/c to 05o/c	
1700	46.3	S2 IDJ	Infiltration Dripping at Joint at 12o/c	
2600	46.3	RFJ	Fine Roots at Joint	
0856	50.9	EHJ	Encrust Heavy at Jnt. 50% loss at 09o/c to 03o/c OBSCURING VISION	
0920	87.5	F2 IDJ	Infiltration Dripping at Joint at 12o/c	
0956	147.1	IDJ	Infiltration Dripping at Joint at 12o/c	
0966	161.0	EHJ	Encrust Heavy at Jnt. 25% loss at 09o/c to 03o/c	
1940	161.0	IDJ	Infiltration Dripping at Joint at 11o/c	
3080	161.0	RFJ	Fine Roots at Joint	
0973	166.5	EHJ	Encrust Heavy at Jnt. 25% loss at 08o/c to 12o/c	
0983	171.1	IDJ	Infiltration Dripping at Joint at 11o/c	
0996	194.7	IDJ	Infiltration Dripping at Joint at 11o/c	
1003	202.4	IDJ	Infiltration Dripping at Joint at 01o/c	
1016	213.7	BJ	Break at Joint. From 06o/c to 08o/c	
1026	217.6	IDJ	Infiltration Dripping at Joint at 11o/c to 12o/c	
1033	225.2	IDJ	Infiltration Dripping at Joint at 01o/c	
1050	252.9	F1 EMJ	Encrust Med at Jnt. 15% loss at 07o/c to 05o/c CLOCKS VARY	
1300	252.9	S3 ELJ	Encrust Light at Joint at 07o/c to 05o/c CLOCKS VARY	
1066	286.4	IDJ	Infiltration Dripping at Joint at 12o/c	
1073	296.2	RMJ	Mass Roots at Joint. 30% loss	
1350	296.2	IDJ	Infiltration Dripping at Joint at 02o/c	

DETAIL CONTINUED ON NEXT PAGE		For Page Number : 184	
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Water Supply Tunnel System Connection to Chattahoochee Water Treatment Plant

< CONTINUATION PAGE >			Page Number : 184 >
Location GAULT STREET	Place Name BOULEVARD BASIN		
Start Manhole No. : 23350305601	Depth : 22.0	Total Length : 501.2	
Finish Manhole No. : 23350315501	Depth : 00.0	Suyed Length : 501.2	

< DETAIL CONTINUED >			Page Number : 184 >
Digit Ph.	Dist CD	Code	Other Details

1086	304.2	RMJ	Mass Roots at Joint. 10% loss
1113	349.6	RMJ	Mass Roots at Joint. 65% loss
1130	367.7	RMJ	Mass Roots at Joint. 05% loss
1133	370.7	RMJ	Mass Roots at Joint. 60% loss
1146	375.8	RMJ	Mass Roots at Joint. 05% loss
1150	377.8	S4 RFJ	Fine Roots at Joint
1186	441.6	BJ	Break at Joint. From 09o/c to 12o/c
1193	442.7	B	Break. From 11o/c to 01o/c
1200	444.8	B	Break. From 11o/c to 01o/c REPAIRED
1206	446.3	CCJ	Circumferential Crack at Joint at 07o/c to 09o/c
1213	448.5	B	Break. From 10o/c to 01o/c REPAIRED
1220	451.8	B	Break. From 11o/c to 01o/c REPAIRED
1230	454.7	B	Break. From 10o/c to 12o/c REPAIRED
1240	457.2	B	Break. From 10o/c to 12o/c REPAIRED
1250	460.3	B	Break. From 09o/c to 01o/c REPAIRED
1256	462.1	B	Break. From 10o/c to 01o/c REPAIRED
1266	471.9	B	Break. From 11o/c to 02o/c REPAIRED
1273	478.5	RMJ	Mass Roots at Joint. 25% loss
1750	478.5	RTJ	Tap Roots at Joint
1346	485.1	RMJ	Mass Roots at Joint. 25% loss
1360	492.7	S5 DES	Debris Silt. 10% loss
1370	501.2	F3 ELJ	Encrust Light at Joint at 07o/c to 05o/c CLOCKS VARY
1940	501.2	F4 RFJ	Fine Roots at Joint
3080	501.2	F5 DES	Debris Silt. 10% loss
3760	501.2	MH	Manhole 23350315501
1370	501.2	FH	Finish of Survey.

< SUMMARY >			Page Number : 184 >
St Mh No. : 23350305601	Fh Mh No. : 23350315501	Suyed Length : 501.2	
SOME MAJOR defects in this length : Deformations : NO			
Breaks/Holes	Mult/Long/Circ	Heavy/Medium	Gusher/Runner Mass
YES	LONG	HEAVY MEDIUM	NO MASS NO
Faulty Junctions/Connections : NO			
< END OF SUMMARY >			

ATTACHMENT B

DEFECT, MATERIAL, SHAPE, AND LINING CODES

Water Supply Tunnel System Connection to Chattahoochee Water Treatment Plant

DEFECT CODES SORTED ALPHABETICALLY BY CODE		
Code	Type	Definition
B	Structural	Conduit broken at..(OR from ...to...) o'clock
BSV	Structural	Conduit broken with soil visible at .. (OR from ...to...) o'clock
BVV	Structural	Conduit broken with void visible at .. (OR from ...to...) o'clock
CC	Structural	Circumferential crack from ...to... o'clock
CI	Miscellaneous	Camera inverted, top of center line at ...o'clock
CL	Structural	Longitudinal crack at ...o'clock
CM	Structural	Multiple cracks from ...to ...o'clock
CS	Structural	Spiral crack from ...to...o'clock
CU	Miscellaneous	Camera submerged
DAE	Service	Encrustation, ...%cross-sectional area loss from ...to...o'clock
DAES	Service	Light Encrustation, ...%cross-sectional area loss from ...to...o'clock
DAEM	Service	Medium Encrustation, ...%cross-sectional area loss from ...to...o'clock
DAEL	Service	Heavy Encrustation, ...%cross-sectional area loss from ...to...o'clock
DAGS	Service	Debris (grease) ...% cross-sectional loss from ... to ... o'clock
DAR	Service	Debris (ragging) ...% cross-sectional loss from ... to ... o'clock
DAZ	Service	Debris (not silt/grease/ragging)%cross-sectional loss from... to ... o'clock
DB	Structural	Brick displaced atto....o'clock
DC	Service	Deposits, hard/compacted% cross-sectional loss from ... to ... o'clock
DF	Service	Deposits, fine% cross-sectional loss from ... to ... o'clock
DGV	Service	Deposits, gravel% cross-sectional loss from ... to ... o'clock
DH	Structural	Conduit deformed. ... % change of horizontal dimension
DI	Structural	Dropped brick invert, gap ... mm
DIF	Service	Ingressed deposit, (fine) ...%cross-sectional loss from ... too'clock
DIGV	Service	Ingressed deposit, (gravel) ...%cross-sectional loss from ... too'clock
DIP	Service	Ingressed deposit, (peat) ...%cross-sectional loss from ... too'clock
DIS	Service	Ingressed deposit, (sand) ...%cross-sectional loss from ... too'clock
DIZ	Service	Ingressed deposit, (other) ...%cross-sectional loss from ... too'clock
DS	Service	Deposits settled, ...% cross-sectional loss from ... to ... o'clock
DV	Structural	Conduit deformed, ... % change of vertical dimension
DZ	Service	Deposits settled (other), ... % cross-sectional loss from ... to ... o'clock
FC	Structural	Circumferential fracture from ... to ... o'clock
FH	Miscellaneous	Finish on conduit survey length
FL	Structural	Longitudinal fracture at ... o'clock
FM	Structural	Multiple fractures from ... to ... o'clock
FS	Structural	Spiral fracture from ... to ... o'clock
GO	Miscellaneous	General observation
GP	Miscellaneous	General photograph
H	Structural	Hole in piping at ... (OR from ... to ...) o'clock
HSV	Structural	Hole in piping w/soil visible at ... (OR from ... to ...) o'clock
HVV	Structural	Hole in piping w/void visible at ... (OR from ... to ...) o'clock
ID	Service	Infiltration dripper at ... (OR from ... to ...) o'clock
IG	Service	Infiltration gusher at ... (OR from ... to ...) o'clock
IR	Service	Infiltration runner at ... (OR from ... to ...) o'clock
ISGT	Construction	Intruding grout material at ... (OR from ... to ...) o'clock
ISSR	Construction	Intruding sealing material at ... (OR from ... to ...) o'clock
ISZ	Construction	Intruding sealing material (other) at ... (OR from ... to...)

Water Supply Tunnel System Connection to Chattahoochee Water Treatment Plant

IW	Service	Infiltration weeper at ... (OR from ... to ...) o'clock
JA	Structural	Joint Angular
JAM	Structural	Joint Angular, medium
JAL	Structural	Joint Angular, large
JL	Miscellaneous	Joint length changes at ... (OR from ... to...) o'clock
JO	Structural	Joint offset (displaced)
JOS	Structural	Joint offset (displaced), small/slight(< "t")
JOM	Structural	Joint offset (displaced), medium ("t" to 1.5 "t")
JOL	Structural	Joint offset (displaced), large (>1.5 "t")
JS	Structural	Joint separated (open)
JSS	Structural	Joint separated (open), small (< "t")
JSM	Structural	Joint separated (open), medium ("t" to 1.5 "t")
JSL	Structural	Joint separated (open), large (> 1.5 "t")
LC	Miscellaneous	Conduit lining changes (starts) at this point
LD	Construction	Line of conduit deviates down
LFAC	Structural	Lining, abandoned connection at ... to ... o'clock
LFB	Structural	Lining/coating blistered at ... (OR from... to...) o'clock
LFBK	Structural	Lining/coating buckled at ... (OR from... to...) o'clock
LFCS	Structural	Lining, service cut shifted at ... o'clock
LFD	Structural	Lining/coating detached at ... (OR from ... to) o'clock
LFE	Structural	Lining, defective end at (OR from ... to ...) o'clock
LFOC	Structural	Lining, overcut service at ... (OR from ... to ...) o'clock
LFR	Structural	Lining/coating wrinkled at ... (OR from ... to ...) o'clock
LFUC	Structural	Lining, undercut service at ... (OR from ... to ...) o'clock
LFZ	Structural	Lining/Coating failure, other at ... (OR from ... to ...) o'clock
LL	Construction	Line of conduit deviates left
LLD	Construction	Line of conduit deviates left then down
LLU	Construction	Line of conduit deviates left then up
LR	Construction	Line of conduit deviates right
LRD	Construction	Line of conduit deviates right then down
LRU	Construction	Line of conduit deviates right then up
LU	Construction	Line of conduit deviates up
MB	Structural	Missing bricks at ... (OR from ... to ...) o'clock
MC	Miscellaneous	Conduit material changes at this point
MM	Structural	Mortar missing at ... (OR from ... to ...) o'clock, may include Slight (S), Medium (M), or Large (L)
NBR	Construction	Node, branch at ... o'clock
NCOM	Construction	Node, mainline clean out, at ... o'clock
NCOP	Construction	Node, property clean out, at ... o'clock
NDP	Construction	Node, discharge point, at ... o'clock
NJB	Construction	Node, junction box
NM	Construction	Node, meter
NMH	Construction	Node, manhole
NOC	Construction	Node, other special chamber
NWA	Construction	Node, wastewater access
NWW	Construction	Node, wet well
OBB	Service	Obstruction, brick/masonry at ... o'clock and/or % cross-sectional loss
OBC	Service	Obstruction, through connection, at ... o'clock and/or % cross-sectional loss
OBI	Service	Obstruction, protruding through wall, at ... o'clock and/or % cross-sectional loss

Water Supply Tunnel System Connection to Chattahoochee Water Treatment Plant

OBJ	Service	Obstruction, wedged in joint, at ... o'clock and or % cross-sectional loss
OBM	Service	Obstruction, pipe material in invert, % cross-sectional loss
OBN	Service	Obstruction, construction debris, % cross-sectional loss
OBP	Service	Obstruction, external pipe/cable through piping, % cross-sectional loss
OBR	Service	Obstruction, rocks, % cross-sectional loss
OBS	Service	Obstruction, built into structure, % cross-sectional loss
OBZ	Service	Obstruction, other, % cross-sectional loss
RB	Service	Ball of roots, ... % cross-sectional area loss from ... to ... o'clock
RBB	Service	Ball of roots, barrel, ... % cross-sectional area loss from ... to ... o'clock
RBL	Service	Ball of roots, lateral - inside service, ... % cross-sectional area loss
RBC	Service	Ball of roots, Connection - outside service, ... % cross-sectional area loss
RF	Service	Fine roots
RFB	Service	Fine roots, barrel
RFL	Service	Fine roots, lateral - inside service
RFC	Service	Fine roots, connection - outside service
RM	Service	Medium roots, ... %cross-sectional area loss from ... to ... o'clock
RMB	Service	Medium roots, barrel, ... %cross-sectional area loss from ... to ... o'clock
RML	Service	Medium roots, lateral - inside service, ... %cross-sectional area loss from ... to ... o'clock
RMC	Service	Medium roots, connection - outside service, ... %cross-sectional area loss from ... to ... o'clock
RPL	Structural	Point repair, localized liner, at ... (OR from ... ft to ... ft)
RPP	Structural	Point repair, patch repair, at ... (OR from... to...) o'clock
RPR	Structural	Point repair, pipe replaced, at ... (OR from ... to ...) ft
RPZ	Structural	Point repair, other (including joint seal), at ... (OR from... to...) ft or o'clock
RT	Service	Tap roots, ... % cross-sectional area loss from ... to ... o'clock
RTB	Service	Tap roots, barrel, ... % cross-sectional area loss from ... to ... o'clock
RTL	Service	Tap roots, lateral - inside service, ... % cross-sectional area loss from ... to ... o'clock
RTC	Service	Tap roots, connection - outside service, ... % cross-sectional area loss from ... to ... o'clock
SA	Miscellaneous	Survey abandoned
SAP	Structural	Surface damage, aggregate projecting at ... (OR from ... to ...) o'clock
SAV	Structural	Surface damage, aggregate visible at ... (OR from ... to ...) o'clock
SC	Miscellaneous	Conduit shape changes at this point
SCP	Structural	Surface corrosion, metal pipe, at ... (OR from ... to ...) o'clock
SMW	Structural	Missing Wall at ... (OR from ... to ...) o'clock
SRC	Structural	Surface damage, Reinforcement corroded at ... (OR from ... to ...) o'clock
SRI	Structural	Surface damage, Roughness increased at ... (OR from ... to ...) o'clock
SRP	Structural	Surface damage, Reinforcement projecting at ... (OR from ... to ...) o'clock
SRV	Structural	Surface damage, Reinforcement visible at ... (OR from ... to ...) o'clock
SSS	Structural	Surface damage, Surface spalling at ... (OR from ... to ...) o'clock
ST	Miscellaneous	Start of conduit survey length
SZC	Structural	Surface damage, chemical at ... (OR from ... to ...) o'clock
SZM	Structural	Surface damage, mechanical at ... (OR from ... to ...) o'clock
SZZ	Structural	Surface damage, not evident at ... (OR from ... to ...) o'clock
TB	Construction	Tap, Break-In/Hammer at ... o'clock
TBC	Construction	Tap, Break-In/Hammer, capped at ... o'clock
TBI	Construction	Tap, Break-In/Hammer, Intruding at ... o'clock, ... % cross-sectional area loss
TF	Construction	Tap, factory made junction at ... o'clock
TFC	Construction	Tap, factory made junction, capped at ... o'clock
TS	Construction	Tap, saddle at ... o'clock

Water Supply Tunnel System Connection to Chattahoochee Water Treatment Plant

TSC	Construction	Tap, saddle, capped at ... o'clock
VC	Service	Vermin, cockroach
VR	Service	Vermin, rat
VZ	Service	Vermin, other
WFC	Structural	Circumferential weld failure (at joint) from ... o'clock to ... o'clock
WFL	Structural	Longitudinal weld failure (at joint) at ... o'clock
WFS	Structural	Spiral weld failure (at joint) from ... to ... o'clock
WL	Miscellaneous	Water level, ... % height/diameter
WM	Miscellaneous	Water mark, ... % height/diameter
XB	Structural	Brick pipe collapsed, ...% of cross-sectional area loss
XM	Structural	Manhole collapsed, ... % of cross-sectional area loss
XP	Structural	Pipe collapsed, ... % of cross-sectional area loss
YN	Miscellaneous	Dye test not visible, ... color
YV	Miscellaneous	Dye test visible, ... color

For the last five years the City of Atlanta has used WRc codes for describing defects. NASSCO (National Association of Sanitary Piping Contractors) has modified WRc codes, in conjunction with WRc, to reflect piping inspection nomenclature currently used throughout North America.

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DEFECT CODES SORTED ALPHABETICALLY BY TYPE

Water Supply Tunnel System Connection to Chattahoochee Water Treatment Plant

Code	Type	Definition
ISGT	Construction	Intruding grout material at ... (OR from ... to ...) o'clock
ISSR	Construction	Intruding sealing material at ... (OR from ... to ...) o'clock
ISZ	Construction	Intruding sealing material (other) at ... (OR from ... to...)
LD	Construction	Line of conduit deviates down
LL	Construction	Line of conduit deviates left
LLD	Construction	Line of conduit deviates left then down
LLU	Construction	Line of conduit deviates left then up
LR	Construction	Line of conduit deviates right
LRD	Construction	Line of conduit deviates right then down
LRU	Construction	Line of conduit deviates right then up
LU	Construction	Line of conduit deviates up
NBR	Construction	Node, branch at ... o'clock
NCOM	Construction	Node, mainline clean out, at ... o'clock
NCOP	Construction	Node, property clean out, at ... o'clock
NDP	Construction	Node, discharge point, at ... o'clock
NJB	Construction	Node, junction box
NM	Construction	Node, meter
NMH	Construction	Node, manhole
NOC	Construction	Node, other special chamber
NWA	Construction	Node, wastewater access
NWW	Construction	Node, wet well
TB	Construction	Tap, Break-In/Hammer at ... o'clock
TBC	Construction	Tap, Break-In/Hammer, capped at ... o'clock
TBI	Construction	Tap, Break-In/Hammer, Intruding at ... o'clock, ... % cross-sectional area loss
TF	Construction	Tap, factory made junction at ... o'clock
TFC	Construction	Tap, factory made junction, capped at ... o'clock
TS	Construction	Tap, saddle at ... o'clock
TSC	Construction	Tap, saddle, capped at ... o'clock
CI	Miscellaneous	Camera inverted, top of center line at ...o'clock
CU	Miscellaneous	Camera submerged
FH	Miscellaneous	Finish on conduit survey length
GO	Miscellaneous	General observation
GP	Miscellaneous	General photograph
JL	Miscellaneous	Joint length changes at ... (OR from ... to...) o'clock
LC	Miscellaneous	Conduit lining changes (starts) at this point
MC	Miscellaneous	Conduit material changes at this point
SA	Miscellaneous	Survey abandoned
SC	Miscellaneous	Conduit shape changes at this point
ST	Miscellaneous	Start of conduit survey length
WL	Miscellaneous	Water level, ... % height/diameter
WM	Miscellaneous	Water mark, ... % height/diameter
YN	Miscellaneous	Dye test not visible, ... color
YV	Miscellaneous	Dye test visible, ... color
DAE	Service	Encrustation, ...%cross-sectional area loss from ...to...o'clock
DAES	Service	Light Encrustation, ...%cross-sectional area loss from ...to...o'clock
DAEM	Service	Medium Encrustation, ...%cross-sectional area loss from ...to...o'clock

Water Supply Tunnel System Connection to Chattahoochee Water Treatment Plant

DAEL	Service	Heavy Encrustation, ...%cross-sectional area loss from ...to...o'clock
DAGS	Service	Debris (grease) ...% cross-sectional loss from ... to ... o'clock
DAR	Service	Debris (ragging) ...% cross-sectional loss from ... to ... o'clock
DAZ	Service	Debris (not silt/grease/ragging)%cross-sectional loss from... to ... o'clock
DC	Service	Deposits, hard/compacted% cross-sectional loss from ... to ... o'clock
DF	Service	Deposits, fine% cross-sectional loss from ... to ... o'clock
DGV	Service	Deposits, gravel% cross-sectional loss from ... to ... o'clock
DIF	Service	Ingressed deposit, (fine) ...%cross-sectional loss from ... too'clock
DIGV	Service	Ingressed deposit, (gravel) ...%cross-sectional loss from ... too'clock
DIP	Service	Ingressed deposit, (peat) ...%cross-sectional loss from ... too'clock
DIS	Service	Ingressed deposit, (sand) ...%cross-sectional loss from ... too'clock
DIZ	Service	Ingressed deposit, (other) ...%cross-sectional loss from ... too'clock
DS	Service	Deposits settled, ...% cross-sectional loss from ... to ... o'clock
DZ	Service	Deposits settled (other), ... % cross-sectional loss from ... to ... o'clock
ID	Service	Infiltration dripper at ... (OR from ... to ...) o'clock
IG	Service	Infiltration gusher at ... (OR from ... to ...) o'clock
IR	Service	Infiltration runner at ... (OR from ... to ...) o'clock
IW	Service	Infiltration weeper at ... (OR from ... to ...) o'clock
OB	Service	Obstruction, brick/masonry at ... o'clock and/or % cross-sectional loss
OBC	Service	Obstruction, through connection, at ... o'clock and/or % cross-sectional loss
OBI	Service	Obstruction, protruding through wall, at ... o'clock and/or % cross-sectional loss
OBJ	Service	Obstruction, wedged in joint, at ... o'clock and or % cross-sectional loss
OBM	Service	Obstruction, pipe material in invert, % cross-sectional loss
OBN	Service	Obstruction, construction debris, % cross-sectional loss
OBP	Service	Obstruction, external pipe/cable through piping, % cross-sectional loss
OBR	Service	Obstruction, rocks, % cross-sectional loss
OBS	Service	Obstruction, built into structure, % cross-sectional loss
OBZ	Service	Obstruction, other, % cross-sectional loss
RB	Service	Ball of roots, ... % cross-sectional area loss from ... to ... o'clock
RBB	Service	Ball of roots, barrel, ... % cross-sectional area loss from ... to ... o'clock
RBL	Service	Ball of roots, lateral - inside service, ... % cross-sectional area loss
RBC	Service	Ball of roots, Connection - outside service, ... % cross-sectional area loss
RF	Service	Fine roots
RFB	Service	Fine roots, barrel
RFL	Service	Fine roots, lateral - inside service
RFC	Service	Fine roots, connection - outside service
RM	Service	Medium roots, ... %cross-sectional area loss from ... to ... o'clock
RMB	Service	Medium roots, barrel, ... %cross-sectional area loss from ... to ... o'clock
RML	Service	Medium roots, lateral - inside service, ... %cross-sectional area loss from ... to ... o'clock
RMC	Service	Medium roots, connection - outside service, ... %cross-sectional area loss from ... to ... o'clock
RT	Service	Tap roots, ... % cross-sectional area loss from ... to ... o'clock
RTB	Service	Tap roots, barrel, ... % cross-sectional area loss from ... to ... o'clock
RTL	Service	Tap roots, lateral - inside service, ... % cross-sectional area loss from ... to ... o'clock
RTC	Service	Tap roots, connection - outside service, ... % cross-sectional area loss from ... to ... o'clock
VC	Service	Vermin, cockroach
VR	Service	Vermin, rat
VZ	Service	Vermin, other
B	Structural	Conduit broken at..(OR from ...to...) o'clock

Water Supply Tunnel System Connection to Chattahoochee Water Treatment Plant

BSV	Structural	Conduit broken with soil visible at .. (OR from ...to...) o'clock
BVV	Structural	Conduit broken with void visible at .. (OR from ...to...) o'clock
CC	Structural	Circumferential crack from ...to... o'clock
CL	Structural	Longitudinal crack at ...o'clock
CM	Structural	Multiple cracks from ...to ...o'clock
CS	Structural	Spiral crack from ...to...o'clock
DB	Structural	Brick displaced atto....o'clock
DH	Structural	Conduit deformed. ... % change of horizontal dimension
DI	Structural	Dropped brick invert, gap ... mm
DV	Structural	Conduit deformed, ... % change of vertical dimension
FC	Structural	Circumferential fracture from ... to ... o'clock
FL	Structural	Longitudinal fracture at ... o'clock
FM	Structural	Multiple fractures from ... to ... o'clock
FS	Structural	Spiral fracture from ... to ... o'clock
H	Structural	Hole in piping at ... (OR from ... to ...) o'clock
HSV	Structural	Hole in piping w/soil visible at ... (OR from ... to ...) o'clock
HVV	Structural	Hole in piping w/void visible at ... (OR from ... to ...) o'clock
JA	Structural	Joint Angular
JAM	Structural	Joint Angular, medium
JAL	Structural	Joint Angular, large
JO	Structural	Joint offset (displaced)
JOS	Structural	Joint offset (displaced), small/slight(< "t")
JOM	Structural	Joint offset (displaced), medium ("t" to 1.5 "t")
JOL	Structural	Joint offset (displaced), large (>1.5 "t")
JS	Structural	Joint separated (open)
JSS	Structural	Joint separated (open), small (< "t")
JSM	Structural	Joint separated (open), medium ("t" to 1.5 "t")
JSL	Structural	Joint separated (open), large (> 1.5 "t")
LFAC	Structural	Lining, abandoned connection at ... to ... o'clock
LFB	Structural	Lining/coating blistered at ... (OR from... to...) o'clock
LFBK	Structural	Lining/coating buckled at ... (OR from... to...) o'clock
LFCS	Structural	Lining, service cut shifted at ... o'clock
LFD	Structural	Lining/coating detached at ... (OR from ... to ...) o'clock
LFE	Structural	Lining, defective end at ... (OR from ... to ...) o'clock
LFOC	Structural	Lining, overcut service at ... (OR from ... to ...) o'clock
LFR	Structural	Lining/coating wrinkled at ... (OR from ... to ...) o'clock
LFUC	Structural	Lining, undercut service at ... (OR from ... to ...) o'clock
LFZ	Structural	Lining/Coating failure, other at ... (OR from ... to ...) o'clock
MB	Structural	Missing bricks at ... (OR from ... to ...) o'clock
MM	Structural	Mortar missing at ... (OR from ... to ...) o'clock, may include Slight (S), Medium (M), or Large (L)
RPL	Structural	Point repair, localized liner, at ... (OR from ... ft to ... ft)
RPP	Structural	Point repair, patch repair, at ... (OR from... to...) o'clock
RPR	Structural	Point repair, pipe replaced, at ... (OR from ... to ...) ft
RPZ	Structural	Point repair, other (including joint seal), at ... (OR from... to...) ft or o'clock
SAP	Structural	Surface damage, aggregate projecting at ... (OR from ... to ...) o'clock
SAV	Structural	Surface damage, aggregate visible at ... (OR from ... to ...) o'clock
SCP	Structural	Surface corrosion, metal pipe, at ... (OR from ... to ...) o'clock
SMW	Structural	Missing Wall at ... (OR from ... to ...) o'clock

Water Supply Tunnel System Connection to Chattahoochee Water Treatment Plant

SRC	Structural	Surface damage, Reinforcement corroded at ... (OR from ... to ...) o'clock
SRI	Structural	Surface damage, Roughness increased at ... (OR from ... to ...) o'clock
SRP	Structural	Surface damage, Reinforcement projecting at ... (OR from ... to ...) o'clock
SRV	Structural	Surface damage, Reinforcement visible at ... (OR from ... to ...) o'clock
SSS	Structural	Surface damage, Surface spalling at ... (OR from ... to ...) o'clock
SZC	Structural	Surface damage, chemical at ... (OR from ... to ...) o'clock
SZM	Structural	Surface damage, mechanical at ... (OR from ... to ...) o'clock
SZZ	Structural	Surface damage, not evident at ... (OR from ... to ...) o'clock
WFC	Structural	Circumferential weld failure (at joint) from ... o'clock to ... o'clock
WFL	Structural	Longitudinal weld failure (at joint) at ... o'clock
WFS	Structural	Spiral weld failure (at joint) from ... to ... o'clock
XB	Structural	Brick pipe collapsed, ...% of cross-sectional area loss
XM	Structural	Manhole collapsed, ... % of cross-sectional area loss
XP	Structural	Pipe collapsed, ... % of cross-sectional area loss

For the last five years the City of Atlanta has used WRc codes for describing defects. NASSCO (National Association of Sanitary Piping Contractors) has modified WRc codes, in conjunction with WRc, to reflect piping inspection nomenclature currently used throughout North America.

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Material Coding

CODE	DEFINITION
ABS	Acrylonitrile Butadiene Styrene
BR	Brick
CI	Cast Iron Pipe
CMP	Corrugated Metal Pipe
CO	Cast-In-Place Concrete Pipe
CPP	Cured-In-Place Liner
DI	Ductile Iron Pipe
FRP	Fiberglass Reinforced Pipe
NCP	Non-Reinforced Concrete Pipe
ORG	Orangeburg Pipe
PE	Polyethylene Pipe
PLP	PVC Lined Pipe (Fold/Reform)
PVC	PolyvinylChloride Pipe
RCB	Reinforced Concrete Box
RCP	Reinforced Concrete Pipe
ST	Steel
VC	Vitrified Clay Pipe
WOD	Wood
XXX	Other (state in Comments)
ZZZ	Not Known

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Shape Coding

CODE	DEFINITION
A	Arched (with flat bottom)
B	Barrel (e.g. beer barrel shape)
C	Circular
E	Egg shaped
H	Horseshoe (i.e., inverted U)
O	Oval
R	Rectangular
S	Square
T	Trapezoidal
U	U-Shaped with flat top
X	Other (state in Comments)

Existing Lining Coding

CODE	DEFINITION
BL	Bitumen
CL	Cement
IS	Soft inversion type liner
PL	Plastic
RL	Resin
XXX	Other (state in Comments)
ZZZ	Not Known

ATTACHMENT C

GENERAL INSPECTION LOGGING REQUIREMENTS

General Inspection Logging Requirements

Water Supply Tunnel System Connection to Chattahoochee Water Treatment Plant

(To be read in conjunction with other related documentation, i.e. Manual of Piping Condition Classification):

The first three lines of each set of survey details **must** have the codes ST, MH, and WL (WL is optional but is important to the City of Atlanta as it directly relates to the piping flow level at a certain time of day).

The Manhole Number must be entered in the Remarks column against the MH code (this is essential as a number of Data Interrogation packages stores the Header and Detail records separately which are “connected” by an Index. To ensure data integrity, a QC check can be run against the Detail information to confirm that the correct Details are against the relevant Header).

i.e.:

0D10230	0.0	ST	
0D1	0.0	MH	SJ34255521
0D1	0.0	WL	10

Each line of Detail (or as a minimum the first and last Detail lines) must have the video digit entered against each code, presented in the following way:

– The video digits must conform to the National elapsed time based standards (time into the tape) for Video Tape recorders:

- Always four digits (hms, where s = units of 10 seconds).
- Always right justified and zero filled.
- The following elapsed time format **MUST** be adhered to, i.e.:

0230

0 = Number of hours (Zero hours).

23 = Number of minutes (23 minutes).

0 = Units of 10 seconds each (0 seconds).

Other examples:

0032 = 3 minutes and 20 seconds into the tape.

0244 = 24 minutes and 40 seconds into the tape.

1503 = 1 hour, 50 minutes and 30 seconds into the tape.

2451 = 2 hours, 45minutes and 10 seconds into the tape.

The final detail line for each survey must end with a Termination code, either SA or FH.

i.e.

0D1	89.0	RMJ	30
0D1	89.0	F1JDS	
0D10410	89.0	SA	DUE TO ROOTS MASS

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----- or -----
0D1 33.0 D 10
0D1 34.9 MH SJ35513464
0D10670 34.9 FH

Each Survey Report MUST only contain one survey hence, in the case of Survey Abandonment or a buried or uncharted manhole being encountered, a new Header and Detail must be completed.

The above are essential for the Validation of the data to take place

DRAFT CITY OF ATLANTA – INTERNAL CONDITION ASSESSMENT LOG

Surveyors name (1) and Certificate number (1a) System Owner (2) Survey Customer (3) Drainage Area (4) P/O No. (5)

Pipeline Segment Reference (6) Date (7) Time (8) Location (Street Name) Locality

Further Location details (10) Upstream Manhole Number (11) Rim to Invert (12) Grade to Invert (13) Rim to Grade (14)

Downstream Manhole Number (15) Rim to Invert (16) Grade to Invert (17) Rim to Grade (18) Use of Piping (19) Direction (20) Flow Control (21) Height (22)

Width (23) Shape (24) Material (25) Lining (26) Method (27) Pipe Joint Length (28) Total Length (29) Year Laid (30) Year Rehabilitated (31) Tape / Media Number (32) Purpose (33)

Piping Category (34) Pre-Cleaning (35) Cleaned 35a) Weather (36) Location Code (37) Traffic Control 37a) Additional Information (38)

Distance (Feet)	Continuous Defect Code	CODE		Dimension 1	Dimension 2	Circumferential Location		Joint	Image Ref.	Video Ref.	Remarks
		• Group / Descriptor	Modifier/ severity			At/ From	To				

Distance (Feet)	Continuous Defect Code	CODE		Dimension 1	Dimension 2	Circumferential Location		Joint	Image Ref.	Video Ref.	Remarks
		• Group Descriptor	/ Modifier/ severity			At/ From	To				

ATTACHMENT D

**PIPING.DAT DATA SPECIFICATION
AND
EXAMPLE OF PIPING.DAT DATA FILE**

Piping.Dat Data Specification

To ensure that the data transfer file format is correct the following points are to be adhered to :

- The file is to be in a standard ASCII text format (i.e. no control characters) therefore each line in the file should be terminated by an ASCII carriage return/linefeed combination e.g. ASCII code 13 followed by ASCII code 10 (the default termination on most text generating programs).
- The maximum line length must not exceed 81 characters including the ASCII termination code, except for Line 1 where the Contractor can have their own reference after the 80th character.
- Decimal points must not be in any header field.
- Each Header line must start with a three character identifier “0Hn”, n being between 1 and 6.
- Each Detail line must start with a three character identifier “0D1”.
- Decimal points must be in Detail footage.
- N = Numeric

DATA TRANSFER SPECIFICATION

Line 1	“0H1	1	3	
	Inspected By	4	12	
	Contract No	16	8	
	Job Number	24	10	
	Catchment	34	10	
	Division	44	1	
	District	45	3	
	PLR	48	11	
Line 2	“0H2”	1	3	
	Date	4	6	
	Time	10	4	
	Road Name	14	30	
	Place Name	44	20	
Line 3	“0H3”	1	3	
	Start Manhole	4	10	
	Start Depth	14	4	(NNNN)
	Start Cover	18	5	(NNNNN)
	Start Invert	23	5	(NNNNN)
	Finish Manhole	28	10	

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	Finish Depth	38	4	(NNNN)
	Finish Cover	42	5	(NNNNN)
	Finish Invert	47	5	(NNNNN)
Line 4	“0H4”	1	3	
	Use	4	1	
	Direction	5	1	
	Size 1	6	4	(NNNN)
	Size 2	10	4	(NNNN)
	Shape	14	1	
	Material	15	3	
	Lining	18	3	
	Pipe Length	21	3	
	Total Length	24	4	(NNNN)
	Year Laid	28	4	
Line 5	“0H5”	1	3	
	VT No.	4	5	
	Video Recorder	9	10	
	Comments	19	40	
Line 6	“0H6”	1	3	
	Purpose	4	1	
	Weather	5	1	
	Location	6	1	
	Location Details	7	50	
	Category Code	57	1	
	Pre-Cleanse	58	1	
Details	“0D1”	1	3	
	Video No.	4	4	(NNNN)
	Photo No.	8	3	(NNN)
	Distance	11	5	(NNN.N)
	CD	16	2	
	Code	18	4	
	Diameter	22	3	(NNN)
	Clock At	25	2	(NN)
	Clock To	27	2	(NN)
	*Percentage %	29	2	(NN)
	*Intrusion	29	4	(NNNN)
	Remarks	33	30	

***Note:** The position from character 29 to 32 is a shared field in that there is no defect or feature that would have both Percentage and Intrusion. Hence, if Percentage, the Start position would be 29 for two characters (99% max), and if Intrusion, the Start position would also be 29 but zero filled (20 inches would be 0020, for instance). If it is anticipated that there would be no intrusion

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greater than 99 inches (which is likely) then the Start position for Intrusion could be 31, as the resulting output file position would be the same but just without the two preceding zeros.

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Example of Piping.Dat Data File on Diskette

Note: The 0 of 0H* and 0D1 is line character 1 and is a zero.

```
0H1ASI/DG      ASG0001 0          0          00002325021521X          6
0H20601001136HENDRIX AVENUE          LLOYD STREET BASIN
0H3232502152100000000000000000232502153107070000000000
0H4FD0012      CVC - 0202986Z
0H500008          WRONG FINISH MH ON VIDEO.
0H6 1 -          0084      ZZ
0D10900      000.0  ST
0D10900      000.0  MH          23250215201 (BURIED)
0D10900      000.0  WL          05
0D10906      004.3  JN  00612
0D10920      009.6  B    1101  REPAIRED
0D10926      011.7  DE          10  RUBBLE
0D10933      013.3  B    1101
0D10943      017.8  CN  01201
0D10943      017.8  GO          SHAFT MADE TO ACCOMODATE CN
0D10960      024.0  JN  00602  CAPPED OFF
0D10976      034.9  B    1101  REPAIRED
0D11010      037.0  JN  00602  SW
0D11030      052.6  JN  00610  SW
0D11050      074.1  B    1101  REPAIR
0D11050      074.1  RF
0D11056      079.0  JN  00602  SW
0D11076      096.3  CN  00411
0D11086      098.3  DC          0015X 15
0D11103      110.4  CLJ  10
0D11140      116.7  CNI 00610  0003
0D11203      143.3  CN  00402
0D11230      170.2  CNI 00610  0003LIVE FW
0D11233      174.7  CL    12
0D11243      180.4S1FL  12
0D11256      182.1  BJ    1201
0D11260      199.3  BJ    1101
0D11270      199.9  H     06
0D11280      206.7  JDL
0D11280      206.7  PC          0015X 4FT
0D11306      221.7  CN  00610
0D11306      221.7  V
0D11316      224.2  MC          V.C.
0D11316      224.2  PC          0015X 2FT
0D11326      238.4  BJ    1112
0D11356      266.9  BJ    1112
0D11366      279.3  JDM
0D11373      281.3  DE          10  RUBBLE
0D11383      283.6  JDL
0D11390      284.5  B    1203
0D11390      284.5S4D  10
0D11400      294.0C4D  05
0D11406      298.6F4D  05
0D11406      298.6  MH          23250215301
0D11406      298.6  FH
```

+++ END OF SECTION 02655 +++

**SECTION 02665
DUCTILE IRON PIPE
TRANSMISSION WATER MAINS
AND ACCESSORIES**

PART I GENERAL

1.1 SCOPE

- A. Furnish all labor, materials, equipment and incidentals required for the complete installation of water mains and accessories as shown on the Drawings and as specified herein. The Work of this Section also includes, but is not limited to, hydraulic testing and disinfection of the completed water mains after installation.
- B. This Section includes ductile iron pipe and fittings ranging in size from 4-inches in diameter through 64-inches in diameter.
- C. 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.
- D. Galvanized pipe and fittings shall not be used as any part of the Water Transmission and Distribution System, nor shall it be used to join any appurtenances to the System.

1.2 QUALITY ASSURANCE

- A. Reference Standards: The design, manufacturing and assembly of elements of the products herein specified shall comply with the applicable provisions and recommendations of the latest editions of the following standards, except as otherwise shown on the Drawings or otherwise specified.
 - 1. ANSI/AWWA C104/A21.4 - Cement-Mortar Lining for Ductile-Iron Pipe and Fittings
 - 2. ANSI/AWWA C110/A21.10 - Ductile-Iron and Gray-Iron Fittings
 - 3. ANSI/AWWA C111/A21.11 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
 - 4. ANSI/AWWA C115/A21.15 – Flanged Ductile-Iron Pipe with Ductile- Iron or Gray-Iron Threaded Flanges
 - 5. ANSI/AWWA C150/A21.50 - Thickness Design of Ductile-Iron Pipe
 - 6. ANSI/AWWA C151/A21.51 - Ductile-Iron Pipe, Centrifugally Cast
 - 7. ANSI/AWWA C153/A21.53 – Ductile-Iron Compact Fittings for Water Service
 - 8. ANSI/AWWA C600 - Installation of Ductile-Iron Water Mains and Their Appurtenances
 - 9. ANSI /AWS D11.2 – Guide for Welding Iron Castings
 - 10. AWWA C651 – Disinfecting Water Mains

B. (Not Used)

1.3 SUBMITTALS

- A. Submittals shall be made in accordance with the requirements of the General Conditions of the Contract Documents. In addition, the following specific information shall be provided:
1. Product data and engineering data, including shop drawings.
 2. Evidence that manufacturers have consistently produced products of satisfactory quality and performance for a period of at least two (2) years.
 3. Written certification that all products furnished comply with all applicable requirements of these specifications.
- B. For pipe 24-inches in diameter or greater, submit shop drawings to the Engineer for review showing a complete laying plan of all pipe, including all fittings, adapters, valves and specials along with the manufacturer's drawings and specifications indicating complete details of all items. The pipe details shall include stationing, pipe class or design and supporting computations; and laying schedule which specifies pipe class, class coding, pipe stationing for all changes in grade or horizontal alignment, transition stations for various pipe classes and the limits of each reach of restrained joint pipe. The above shall be submitted to the Engineer for review before fabrication and shipment of these items.

1.4 TRANSPORTATION AND HANDLING

- A. Furnish equipment and facilities for unloading, handling, distributing and storing pipe, fittings 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. Pipe handled on skids shall not be rolled or skidded against the pipe on the ground.
- B. Handle pipe, fittings, and accessories carefully to prevent shock or damage. Handle pipe by rolling on skids, forklift, or front end 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.

1.5 STORAGE AND PROTECTION

- A. Store all pipe which cannot be distributed along the route. Make arrangements for the use of suitable storage areas.
- B. Stored materials shall be kept safe from damage. The interior of all pipe, fittings and other appurtenances shall be kept free from dirt or foreign matter at all times.
- C. Pipe shall not be stacked higher than the limits recommended by the manufacturer. 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.

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- D. Stored mechanical and push-on joint gaskets shall be placed 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.
- E. Mechanical joint bolts shall be handled and stored in such a manner that will ensure proper use with respect to types and sizes.

1.6 WATER MAIN LOCATION

- A. The minimum depth of cover over the pipe shall be four (4) feet and the maximum cover shall be five (5) feet. Any deviations must be approved by the Engineer.
- B. The installation of the water main parallel to another utility in the same vertical plane is not permitted, i.e., “stacking of utilities is not permitted.”

PART 2 PRODUCTS

2.1 DUCTILE IRON PIPE

- A. Ductile iron pipe shall be manufactured in accordance with ANSI/AWWA C151/A21.51. All pipe, except specials, shall be furnished in nominal lengths of 18 to 20 feet. Sizes will be as shown on the Drawings. All pipe 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:

Pipe Sizes (inches)	Pressure Class (psi)
4 - 12	350
14 - 18	350
20	300
24	250
30 -60	200

- B. Flanged pipe minimum wall thickness shall be equal to Special Class 53. Flanges shall be furnished by the pipe manufacturer.
- C. Fittings shall be ductile iron and shall conform to ANSI/AWWA C110/A21.10 or ANSI/AWWA C153/A21.53 with a minimum rated working pressure of 250 psi.
- D. Joints
 1. Unless shown or specified otherwise, joints shall be push-on or restrained joint type for pipe and standard mechanical, push-on or restrained joints for fittings. Push-on and mechanical joints shall conform to ANSI/AWWA C111/A21.11.
 2. The only acceptable restrained joint systems are identified in the table below. No field welding of restrained joint pipe will be allowed.

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Acceptable Restrained Joints				
Pipe Dia. (inches)	ACIPCO	U.S. Pipe	McWane	Generic*
4 – 12	Fast-Grip Flex Ring	Field Lok TR Flex	Push-On Restrained Joint Type A	MJ with Retainer Gland
16 – 24	Fast-Grip Flex Ring	Field Lok TR Flex	Push-On Restrained Joint Type A	MJ with Retainer Gland
30 – 36	Flex Ring	TR Flex	Push-On Restrained Joint Type B	MJ with Retainer Gland
42 – 60	Flex-Ring	TR Flex	N/A	MJ with Retainer Gland

* Fittings and valves only, and only where specifically allowed.

3. Restrained joint pipe (RJP) on supports shall have bolted joints and shall be specifically designed for clear spans of at least 36 feet.
4. Flanged joints shall meet the requirements of ANSI B16.1, Class 125.

E. Gaskets: Gaskets for the various types of joints shall be as follows:

1. Gaskets for mechanical joints shall be made of vulcanized styrene butadiene (SBR) as specified in ANSI/AWWA C111/A21.11 unless specified otherwise. Reclaimed or natural rubber shall not be used. Gaskets shall be free from porous areas, foreign material and other defects that make them unfit for the use intended.
2. Gaskets for flanged joints shall be made of synthetic rubber, ring type or full face type and shall be 1/8-inch thick. Gaskets shall conform to the dimensions specified in ANSI/AWWA C111/A21.11.
3. Gaskets for push-on and restrained joints shall be in accordance with the pipe manufacturer’s design dimensions and tolerances. Gaskets shall be made of vulcanized styrene butadiene (SBR) as specified in ANSI/AWWA C111/A21.11 unless specified otherwise.

F. 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.
2. Bolts and nuts for mechanical joints shall be tee head bolts and nuts of high- strength

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low-alloy steel having a minimum yield strength of 45,000 psi. Dimensions of bolts and nuts shall be in accordance with the dimensions shown in ANSI/AWWA C111/ 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 A307, Grade B. Nuts for exposed service shall be zinc plated, heavy hex conforming to ASTM A563. Zinc plating shall conform to ASTM B633, Type II.
5. Bolts for submerged service shall be stainless steel machine bolts conforming to ASTM A193, Grade B8. Nuts shall be heavy hex, stainless steel conforming to ASTM A194, Grade 8.

G. Mechanical joint glands shall be ductile iron.

H. Welded Outlets: Welded outlets may be provided in lieu of tees or saddles on mains with a diameter greater than or equal to 24-inches. The pipe joint on the outlet pipe shall meet the joint requirements specified above. The minimum pipe wall thickness of the parent pipe and the outlet pipe shall be Special Thickness Class 53 (Pressure Class 350 for 60 and 64-inch sizes). The welded outlet shall be rated for 250 psi working pressure. Each welded outlet shall be hydrostatically tested at 500 psi. The welded outlet shall be fabricated by the manufacturer of the parent pipe. 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

- I. Thrust collars shall be welded-on ductile iron body type designed to withstand thrust due to 250 psi internal pressure on a dead end from either direction on that pipe size. The thrust collars shall be continuously welded to the pipe by the pipe manufacturer.
- J. Solid sleeves shall be used to connect plain end ductile iron pipe. Solid sleeves shall meet the requirements of ANSI/AWWA C110/A21.10 for long pattern and have a minimum pressure rating of 250 psi. Solid sleeves shall have mechanical or restrained joints as specified in this section or as shown on the Drawings. Solid sleeves shall be used only in

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locations shown on the Drawings or at the discretion of the Engineer. Solid sleeves shall be manufactured by American Cast Iron Pipe Company or U. S. Pipe.

K. Pipe stubs for all structure connections shall not exceed 2-feet in length. Caps shall be furnished where required.

M. Cement Lining

1. Interior surfaces of all ductile iron pipe and fittings shall be cleaned and lined with a cement mortar lining applied in conformity with ANSI/AWWA C104/A21.4. If lining is damaged or found faulty upon delivery, the damaged pipe sections shall be repaired or removed from the site as directed by the Engineer.
2. The minimum lining thickness shall be as shown in the following table. Lining shall be square and uniform with regard to the longitudinal axis of the pipe.

Pipe Diameter (Inches)	Minimum Lining Thickness (Inches)
3 - 12	1/8
14 - 24	3/32
30 - 64	1/8

N. Pipe Coating: Unless otherwise specified, pipe and fittings shall be coated with a 1 mil asphaltic coating as specified in ANSI/AWWA C151/A21.51.

O. Polyethylene Encasement: Ductile iron pipe shall be encased with polyethylene film where shown on the Drawings, specified or directed by the Engineer. Polyethylene film shall be as specified in Section 02616.

P. Pipe Insulation: Where a water main is exposed to the elements because the pipe is above ground, the Engineer shall determine whether the pipe is to be insulated or not. Where insulation is to be furnished and installed it shall conform to the following:

1. Insulating material shall be 3-inch thick polyurethane pipe covering formed to fit the pipe diameter.
2. Outer covering shall be 0.016-inch thick aluminum chiller jacket with moisture shield and secured with stainless steel wire or stainless steel straps.

Q. Acceptance will be on the basis of the Engineer's inspection and the manufacturer's written certification that the pipe was manufactured and tested in accordance with the applicable standards.

2.2 PIPING APPURTENANCES

A. Mechanical Joint Restraint

1. Design

- a. Restraint devices for pipe sizes 3 inches through 48 inches in diameter shall consist of multiple gripping wedges incorporated into a follower gland meeting the applicable requirements of ANSI/AWWA C110/A21.10.
- b. Restraint devices shall have a working pressure rating of 350 psi for 3-inch

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through 16-inch diameter pipe and 250 psi for 18-inch through 48-inch diameter pipe. Ratings shall be for water pressure and shall include a minimum safety factor of 2 to 1 for all pipe diameters.

2. Material

- a. Gland body, wedges and wedge actuating components shall be cast from grade 65-45-12 ductile iron material in accordance with ASTM A536.
- b. Ductile iron gripping wedges shall be contoured to fit on the pipe and shall be heat treated within a range of 370 to 470 BHN.
- c. Dimensions of the glands shall be such that they can be used with the standard mechanical joint bell and tee head bolts conforming to the requirements of ANSI/AWWA C111/A21.11 and ANSI/AWWA C 153/A21.53, latest editions.

3. Approvals

- a. Restraint devices shall be listed by Underwriters Laboratories (3-inch through 24-inch size) and approved by Factory Mutual (3-inch through 12-inch size).
- b. Mechanical joint restraint shall be Megalug Series 1100 as manufactured by EBAA Iron Inc., Uni-Flange Series 1400, as manufactured by Ford Meter Box Company or approved equal.

B. Tapping Saddles: Tapping saddles are not allowed.

C. Expansion Joints shall be Redflex type J-1 as manufactured by the Red Valve Company or approved equal.

D. Restrained Flange Adaptors shall be the series 2100 MegaFlange Restrained Flange Adaptor as manufactured by EBAA Iron, Inc. or approved Equal

E. Detection Tape: Detection tape shall be composed of a solid aluminum foil encased in a protective plastic jacket. Tapes shall be color coded in accordance with APWA color codes with the following legends: Water Systems, Safety Precaution Blue, "Caution Water Line Buried Below". Colors may be solid or striped. Tape shall be permanently printed with no surface printing allowed. Tape width shall be a minimum of 2-inches when buried less than 10-inches below the surface. Tape width shall be a minimum of 3-inches when buried greater than 10-inches and less than 20-inches. Detection tape shall be equal to Lineguard Type III Detectable or Allen Systems Detectatape.

PART 3 EXECUTION

3.1 LAYING AND JOINTING PIPE AND ACCESSORIES

A. Lay all pipe and fittings to accurately conform to the lines and grades as shown on the Drawings or as established by the Engineer.

B. Pipe Installation

1. Proper equipment, tools and facilities shall be provided for the safe performance of the Work. All pipe, fittings, valves and hydrants shall be lowered carefully into the trench by means of slings, ropes or other suitable tools or equipment in such a manner as to

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prevent damage to water main materials and protective coatings and linings. Under no circumstances shall water main 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 Engineer, 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 containing 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 placed 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. It is not mandatory to lay pipe with the bells facing the direction in which work is progressing.
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 detection tape for all pipe greater than 12-inches in diameter. Detection tape shall be buried 4 to 10-inches deep. Should detection tape need to be installed deeper, the Contractor shall provide 3-inch wide tape. In no case shall detection tape be buried greater than 20-inches from the finish grade surface.

C. Alignment and Gradient

1. Lay pipe straight in alignment and gradient or follow true curves 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 at the work site to lay out angles and ensure that deflection allowances are not exceeded.

D. Expediting of Work: Excavate, lay the pipe, and backfill as closely together as possible. Do not leave unjointed pipe in the trench overnight. Backfill and compact the trench as soon as possible after laying and jointing is completed. 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. If necessary to backfill over the end of an uncompleted pipe or accessory, close the end with a suitable plug, either push-on, mechanical joint, restrained joint or as approved by the Engineer.

E. Joint Assembly

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1. Push-on, mechanical, flange and restrained type joints shall be assembled in accordance with the manufacturer's recommendations.
 2. The Contractor shall inspect each pipe joint within 1,000 feet on either side of main line valves to insure 100 percent seating of the pipe spigot, except as noted otherwise.
 3. Each restrained joint shall be inspected by the Contractor to ensure that it has been "homed" 100 percent.
 4. The Contractor shall internally inspect each pipe joint to insure proper assembly for pipe 24-inches in diameter and larger after the pipe has been brought to final alignment.
- F. Cutting Pipe: 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. Only push-on or mechanical joint pipe shall be cut. Cement lining shall be undamaged.
- G. Polyethylene Encasement: Installation shall be in accordance with ANSI/AWWA C105/A21.5 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 Engineer.

3.2 THRUST RESTRAINT

- A. Provide restraint at all points where hydraulic thrust may develop.
- B. Retainer Glands: Provide retainer glands where shown on the Drawings. Retainer glands shall be installed in accordance with the manufacturer's recommendations, particularly, the required torque of the set screws. The Contractor shall furnish a torque wrench to verify the torque on all set screws which do not have inherent torque indicators.
- C. Harnessing
1. Provide harness rods only where specifically shown on the Drawings or directed by the Engineer.
 2. Harness rods shall be manufactured in accordance with ASTM A36 and shall have an allowable tensile stress of no less than 22,000 psi. Harness rods shall be hot dip galvanized or field coated with bitumastic before backfilling.
 3. Where possible, harness rods shall be installed through the mechanical joint boltholes. Where it is not possible, provide 90 degree bend eye bolts.
 4. Eye bolts shall be of the same diameter as specified in ANSI/AWWA C111/A21.11 for that pipe size. The eye shall be welded closed. Where eye bolts are used in conjunction with harness rods, an appropriate size washer shall be utilized with a nut on each end of the harness rod. Eye bolts shall be of the same material and coating as the harness rods.
- D. Thrust Collars: Collars shall be constructed as shown on the Drawings.
- E. Concrete Blocking
1. Provide concrete blocking for all bends, tees, valves, and other points where thrust may develop, except where other exclusive means of thrust restraint are specifically shown on the Drawings.

2. Concrete shall be as specified in Section 03300, Cast-in-Place Concrete.
3. Form and pour concrete blocking at fittings as shown on the Drawings and as directed by the Engineer. Pour blocking against undisturbed earth. Increase dimensions when required by over excavation.

3.3 SURFACE PREPARATION AND SHOP PAINTING

- A. All exposed, ferrous piping not specified to be galvanized or otherwise coated shall be cleaned and shop primed or coated in accordance with the requirements of Section 09900, Painting.
- B. (Not Used)

3.4 FIELD PAINTING

- A. Following installation and testing, all exposed piping, including insulated piping, shall be field primed and painted in accordance with the requirements of Section 09900, Painting. Stainless steel fittings shall not be painted.
- B. (Not Used)

3.5 PIPING IDENTIFICATION

- A. Piping Systems. Identification of piping systems shall conform to ANSI A13.1, Scheme for the Identification of Piping Systems, unless otherwise specified herein.
- B. Process Piping Code. All exposed pipe shall be identified by color and labeling to show its function. Stencil-painted labels and arrows showing the direction of flow shall be installed every 20 feet or each change of direction at each valve, and on each side of wall penetrations. Piping which is not painted shall be provided with 6-inch-wide color bands as specified. Color bands of an approved tape may be used on PVC, FRP and stainless steel pipe and other pipe which does not readily accept painted finish. The color, banding and labeling shall conform to the schedule in Section 09900, Painting.
- C. Process Valve Identification. After the painting of process piping is complete, the Contractor shall stencil the tag numbers of all valves numbered on the Process and Instrumentation Drawings, on the pipe adjacent to the valve for pipe 2 inches and over. Characters shall be 2 inches high minimum and shall be oriented to be visible from the valve operating position. When the valve has extended operator shaft or chain operator, the number shall be placed at both the operating position and at the valve, if practicable; this requirement does not apply if the valve is buried or in a pit. Valves in pipes under 2 inches shall have characters as large as the pipe will permit or at the Engineer's option on an adjacent surface. Characters shall be preferably white; however, if this would not provide sufficient contrast to the pipe, the Engineer may select another color. Paint used shall be of the same type and quality as that used for painting the pipe.

3.6 INSPECTION AND TESTING

- A. All sections of the water main shall be hydrostatically pressure tested in accordance with AWWA C600 and these Specifications. A section of main will be considered ready for testing after completion of all thrust restraint and backfilling.

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- B. Water used for flushing and testing mains and other construction purposes will be made available to the Contractor as specified in Section 01040.
- C. Each segment of water main between main valves shall be tested individually.
- D. Test Preparation
 1. For water mains less than 24-inches in diameter, flush sections thoroughly at flow velocities, greater than 2.5 feet per second, adequate to remove debris from pipe and valve seats. For water mains 24-inches in diameter and larger, the main shall be carefully swept clean, and mopped if directed by the Engineer. Partially open valves to allow the water to flush the valve seat.
 2. Partially operate valves and hydrants to clean out seats.
 3. Provide temporary blocking, bulkheads, flanges and plugs as necessary, to assure all new pipe, valves and appurtenances will be pressure tested.
 4. Before applying test pressure, air shall be completely expelled from the pipeline and all appurtenances. Insert corporation stops at high points to expel air as mains filled with water as necessary to supplement automatic air valves. Corporation stops shall be constructed with a meter box as shown on the Drawings.
 5. Fill pipeline slowly with water. Provide a suitable pump with an accurate water meter to pump the line to the specified pressure.
 6. The differential pressure across a valve or hydrant shall equal the maximum possible, but not exceed the rated working pressure. Where necessary, provide temporary backpressure to meet the differential pressure restrictions.
 7. Valves shall not be operated in either the opening or closing direction at differential pressures above the rated pressure.
- E. Test Pressure: Test the pipeline at 250 psi measured at the lowest point for at least two hours. Maintain the test pressure within 5 psi of the specified test pressure for the test duration. Should the pressure drop more than 5 psi at any time during the test period, the pressure shall be restored to the specified test pressure. Provide an accurate pressure gauge with graduation not greater than 5 psi.
- F. Testing Allowance
 1. Testing allowance shall be defined as the sum of the maximum quantity of makeup water that must be added into the pipeline undergoing hydrostatic pressure testing, or any valved section, in order to maintain pressure within 5 psi of the specified test pressure for the test duration plus water required to return line to test pressure at the end of the test. Leakage shall be the total cumulative amount measured on a water meter.
 2. The Owner assumes no responsibility for leakage occurring through existing valves.
- G. Test Results: No installed pipe shall be accepted if the quantity of makeup water exceeds the limits determined by the following formula:

$$L = \frac{SD(P)^{1/2}}$$

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148,000

Where:

L = allowable leakage, in gallons per hour

S = length of pipe tested, in feet

D = nominal diameter of the pipe, in inches

P = average test pressure during the hydrostatic test, in pounds per square inch (gauge)

As determined under Section 5 of ANSI/AWWA C600.

- H. If the water main section being tested contains lengths of various pipe diameters, the allowable leakage shall be the sum of the computed leakage for each diameter. The leakage test shall be repeated until the test section is accepted. All visible leaks shall be repaired regardless of leakage test results.
- I. After a pipeline section has been accepted, relieve test pressure. Record type, size and location of all outlets on record drawings.
- J. At the conclusion of the work, the Contractor shall thoroughly clean all new pipelines by flushing with water or other means to remove all dirt, stone, pieces of wood or other material which may have entered the pipeline during the construction period.
- K. The Contractor shall be responsible for legal disposal of all water used for flushing and testing.

+++ END OF SECTION 02665 +++

**SECTION 02667
STEEL PIPE**

PART I GENERAL

1.01 SCOPE

- A. The Work included under this section includes providing all labor, materials, equipment, tools, and incidentals required for replacement of the 78” pipe at the raw water intake and replacement of portions of the existing steel pipe near the flow control valve near Chattahoochee WTP. Work also includes hydraulic testing of the completed-piping after installation.
- B. The Contractor shall be responsible for the detailed design, installation, and commissioning of the pipe sections shown on the Drawings. These Specifications together with the Contract Drawings form the basis for the minimum performance requirements of the water transmission mains and accessories. In the event of a conflict the most stringent requirement shall apply.
- C. No separate payment shall be made to the Contractor for the cost of design or the submittal of design calculations.

1.02 QUALITY ASSURANCE

- A. Reference Standards: The Contractor shall comply with the applicable provisions and recommendations of the general standards listed below and other ANSI, ASTM and AWWA specifications referenced herein. The standards are referenced in the Specification and are applicable as noted in this document. Reference standards specific to each piping material are included in paragraphs 1.02.B, C, D and E below. Exceptions shall be shown on the Drawings or detailed in this Section.

1. General Standards

- a. American Society of Non-Destructive Testing: SNT-TC-1A - Personnel Qualification and Certification of Non-Destructive Testing.
- b. ASTM International (ASTM):
 - 1) C150 - Standard Specification for Portland Cement.
 - 2) E329 - Standard Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction.
 - 3) G62 - Test Methods for Holiday Detection in Pipeline Coatings
- c. American Water Works Association (AWWA): AWWA C651 - Disinfecting Water Mains.
- d. Steel Structures Painting Council: SSPC-SP6 – Commercial Blast Cleaning
- e. Georgia Department of Transportation (GDOT): Standard Specifications for Construction of Transportation Systems

2. (Not Used)

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B. Pipe Manufacturer (General)

1. Pipe manufacturer shall be experienced in manufacturing pipe and fittings of required diameters, lengths and individual materials and wall thicknesses required for the project.
2. Pipe manufacturer shall demonstrate current production capability for volume of Work required.
3. Manufacturer's experience shall include successful manufacturing of pipe to the referenced AWWA standards for a period of at least five (5) years at the proposed manufacturing facility.
4. Not used
5. Manufacturers of steel pipe shall be required to meet one the following requirements: Steel Pipe Fabricators Association (SPFA), Lloyd's Registry Certification or ISO 9001:2000 Certification.

C. Steel Pipe

1. Reference Standards: Comply with the applicable provisions and recommendations of the latest editions of the following standards, except as otherwise shown on the Drawings or specified herein.
 - a. American Society of Mechanical Engineers (ASME):
 - 1) B16.9 - Factory-Made Wrought Steel Buttwelding Fittings.
 - 2) B36.10M - Welded and Seamless Wrought Steel Pipe.
 - 3) BPVC SEC V - Nondestructive Examination.
 - 4) BPVC SEC VIII, Div. 1, Rules for Construction of Pressure Vessels.
 - 5) BPVC SEC IX, Qualification Standard for Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators.
 - b. American Water Works Association (AWWA):
 - 1) C200 - Steel Water Pipe - 6 in. (150 mm) and Larger.
 - 2) C205 - Cement-Mortar Protective Lining and Coating for Steel Water Pipe - 4 in. (100 mm) and Larger-Shop Applied.
 - 3) C206 - Field Welding of Steel Water Pipe.
 - 4) C207 - Steel Pipe Flanges for Waterworks Service - Sizes 4 in. Through 144 in. (100 mm Through 3,600 mm).
 - 5) C208 - Dimensions for Fabricated Steel Water Pipe Fittings.
 - 6) C209 - Cold-Applied Tape Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines.
 - 7) C210 - Liquid-Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines.

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- 8) C213 - Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines.
 - 9) C214 - Tape Coating Systems for the Exterior of Steel Water Pipelines.
 - 10) C215 - Extruded Polyolefin Coatings for the Exterior of Steel Water Pipelines.
 - 11) C216 - Heat-Shrinkable Cross-Linked Polyolefin Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines.
 - 12) C217 - Petrolatum and Petroleum Wax Tape Coatings for the Exterior of Connections, and Fittings for Steel Water Pipelines.
 - 13) C219 - Bolted, Sleeve-Type Couplings for Plain-End Pipe.
 - 14) C221 - Fabricated Steel Mechanical Slip-Type Expansion Joints.
 - 15) C222 - Polyurethane Coatings for the Interior and Exterior of Steel Water Pipe and Fittings.
 - 16) C602 - Cement-Mortar Lining of Water Pipelines in Place – 4 in. (100 mm) and Larger.
 - 17) Manual M11, Steel Pipe - A Guide for Design and Installation.
- c. American Welding Society (AWS):
- 1) A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination.
 - 2) A3.0 - Standard Welding Terms and Definitions.
 - 3) B2.1 – Specification for Welding Procedure and Performance Qualification
 - 4) D1.1 - Structural Welding Code – Steel.
 - 5) QC 1 - Standard for AWS Certification of Welding Inspectors.
- d. ASTM International (ASTM):
- 1) A1011 - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low Alloy, High-Strength Low-Alloy with Improved Formability and Ultra-High Strength
 - 2) A1018/A1018M - Standard Specification for Steel, Sheet and Strip, Heavy Thickness Coils Hot Rolled, Carbon, Structural, High-Strength and Low-Alloy, Columbium or Vanadium and High-Strength Low-Alloy with Improved Formability.
- e. International Institute of Welding (IIW).
- f. International Organization for Standardization (ISO): ISO 9001:2000, Quality Management Systems—Requirements
- g. NSF International (NSF):
- 1) 60 - Drinking Water Treatment Chemicals - Health Effects.
 - 2) 61 - Drinking Water System Components - Health Effects.

- h. Steel Pipe Fabricators Association (SPFA).
- 2. Certified Welding Inspector (CWI) for Shop and Field Welding
 - a. In accordance with AWWA C200 for Shop and AWWA C206 for Field.
 - b. In accordance with AWS QC 1, with knowledge of appropriate welding code for the Work.
 - c. After receiving CWI qualification, CWI shall have at least 5 years of professional experience related to welding inspection similar to the Work.
 - d. Responsibilities in addition to AWWA C200 and AWWA C206 shall include:
 - 1) Verify conformance to use of specified materials and their proper storage.
 - 2) Monitor conformance to approved Welding Procedure Specification (WPS).
 - 3) Monitor conformance to approved Nondestructive Testing (NDT) procedure specifications.
 - 4) Monitor conformance of Welder/Welding Operator Performance Qualification (WPQ).
 - 5) Provide 100 percent visual inspection before, during, and after shop and field welding.
 - 6) Supervise NDT personnel and evaluate test results.
 - 7) Maintain records and prepare report confirming results of inspection and testing.
- 3. Nondestructive Quality Control Personnel
 - a. In accordance with requirements of Recommended Practice No. SNT-TC-1A, Level II.
 - b. After receiving Nondestructive Testing (NDT) qualification, NDT personnel shall have at least 5 years of professional experience related to NDT inspection similar to the Work.

1.03 DESIGN REQUIREMENTS

- A. Contractor Design Responsibilities: The Contractor shall have design responsibilities (via the pipe manufacturer) for the pipeline materials provided under these Specifications. These design responsibilities shall include:
 - 1. Design pipe barrel according to the requirements detailed in these Specifications and meeting the installed conditions shown on the Drawings. The Contractor shall account for all loadings in the calculations. Criteria for calculations shall include internal pressure, external loadings, buoyancy due to groundwater conditions, soil drag forces, deflections during handling, thermal stresses, thrust forces and trench conditions.
 - 2. Design pipeline appurtenances and fittings (using the criteria above) at locations shown on the Drawings. Criteria shall also include pipe in casings and tunnels, buried crossings, vaults, air release valves, manholes, valve bypass piping and blow-offs.

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3. Design thrust restraint according to the requirements detailed in these Specifications and the field conditions shown on the Drawings. Thrust blocking will not be allowed and all restraint shall be provided by tied pipe joints, unless otherwise shown on the Drawings.
 4. Development of the pipe laying plan. The Contractor shall verify that the alignment can be achieved by the provision of pipe fittings and allowable deflections and shall submit a detailed pipe schedule or lay-down drawings for review.
 5. In the case of a conflict between the installed conditions shown on the Drawing and the performance requirements of these Specifications, the more stringent design criteria shall apply.
- B. Service Conditions: Minimum design and material requirements for nominal pipe diameter of 64-inches are provided in these Specifications. Even where pipe class or wall thickness is indicated, the Contractor shall design piping systems based on the factors specified in the design requirements. The following service conditions apply to all pipe materials in these specifications. Parameters that are specific to individual pipe materials are specified in paragraphs 2.01.A, 2.02.A, and 2.03A of this Section.

	RIPS
Service Life (years)	100
Working Pressure (psi):	54
Surge Pressure (psi - above working):	81
Pressure Class (psi):	100
Hydrostatic Field Testing (psi):	100
Vacuum Condition (psi):	-14.7
Max. Field Welded Joint Installation Temp. (F):	80
Minimum Water/Service Temp.(F):	40
Thermal Loading (Delta T):	40
Minimum Depth of Cover:	4-feet 6-inches Unless shown otherwise on the Drawings
Traffic Loading Condition:	HS 20
Max. Modulus of Soil Reaction:	100 psi
Construction Traffic Loading:	None

C. Thrust Restraint Design:

1. Thrust restraint calculations shall be performed for all fittings, tees, valves, and dead ends.
2. Wall penetrations at valve vaults and junction boxes shall be restrained by the use of wall pipes.
3. The Contractor shall use the dead end assumption at both sides of valves.

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4. Where shown on Drawings, valve vaults and junction boxes shall account for the thrust of the vault/box bearing on the surrounding soil in the thrust restraint calculations.
5. The Contractor shall consider high groundwater conditions in the thrust calculations for creek crossings, wetlands, floodplain, low points in the alignment and adjacent to the Chattahoochee River and any additional areas identified on the Drawings.
6. No lateral resistance from the bearing resistance of soil shall be used when calculating restrained lengths.
7. Calculations for the coefficient of friction between the pipe wall and the pipe bedding material shall be submitted for review by the Engineer.
8. The following criteria shall be applied in the development of restrained joint lengths:

Safety Factor on Thrust Restraint Calculated length: 1.5

Thrust Load for Fittings: By AWWA M11 (Eqn. 13-4)

Required Restraint Length: By AWWA M11 (Eqn. 13-6)

Maximum Soil Bearing Capacity for Thrust: Not Allowed

Min. Thrust Force for All Restrained Pipe: 250 psi x pipe area

Max. Soil Friction Angle: 30 degrees

Max. Allowable Soil Weight for Calculations: 120 lbs./cu. ft

Soil Drag:

By design grade.

Groundwater Table:

Design for conditions provided in the geotechnical report, if available.

Coefficient of Friction for Pipe / Soil Interaction:

Submit for review with references.

- D. Strength of Restrained Joints: The Contractor (via the pipe supplier) shall submit to the Engineer for review loadings, allowable stresses, and proof test of design test data for restrained joints. These requirements shall apply to all pipe materials.

1. Loading Calculations

- a. Structural Load Path: Submit free body diagrams for each type of joint showing the path of load transmission from one pipe to another via a restrained joint and identify each component in the load path.
- b. Loads: Submit calculations of axial loading cases (Thermal and thrust loads are not additive, greatest loading case shall govern pipe and joint design), including:
 - 1) Thermal + Poisson (at test pressure) + Soil Drag Loading: Welded joints shall be designed to resist thermal forces for a temperature change of 40 degrees F. Mechanically restrained gasketed joints may be considered as not transmitting thermal or Poisson load from one pipe to another.

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- 2) Thrust (PA) + Soil Drag Loading: All restrained joints shall be designed to resist forces resulting from the field test pressure (Pt) across the cross sectional area of the pipe.
2. Allowable Stress Calculations: Submit calculations for allowable stresses and verify that the loading conditions can be met by the manufacturer's design:
 - a. Pipe Barrel: Allowable stress in the pipe barrel shall be no greater than 0.5 times the yield strength of the pipe barrel material for working pressure plus surge pressure.
 - b. Single Fillet Welded Field Joints: Allowable stress in single fillet welded joints shall meet the requirements of the following welding codes:
 - 1) AWS D1.1 for steel sheet materials 1/8-inch thickness and greater
 - 2) ASME BPVC SEC VIII, Div. 1
 - a. Double Fillet Welded Field Joints: Allowable stress in fillet double welded joints shall meet the requirements of the following welding codes:
 - 1) AWS D1.1 for steel sheet materials 1/8-inch thickness and greater
 - 2) ASME BPVC SEC VIII, Div. 1
3. Proof of Design Testing
 - b. Required Tests: Proof of Design Tests (or previously performed Proof of Design Tests that were witnessed and certified by an independent testing laboratory) shall be required for each restrained joint configuration for each diameter of pipe to be supplied for under these Specifications.
 - c. Test Conditions:
 - 1) Restrained joints shall be proof tested to at least 100 psig.
 - 2) During the test, the pipe sections joined by the restrained joints shall be otherwise unanchored longitudinally, and free to move in the axial direction.
- E. Pipe Trench and Bedding: The pipe bedding condition and trench construction shall be considered part of the piping design. All pipe trench work, bedding, and backfill (regardless of pipe material) shall be as follows:
 1. Trench Stabilization: If soft sub-grade conditions are encountered, the Contractor shall stabilize the trench below the pipe zone with well-graded clean gravel or crushed rock, compacted in 6-inch lifts.
 2. Pipe Zone: The pipe shall be bedded in Group 1 graded aggregate material in accordance with GDOT Section 815.2.01, with at least 12% of material by weight passing a 200-sieve. Place pipe on a minimum of 8 inches compacted pipe zone material, as measured below the widest part of the pipe joint. Pipe zone material shall be consolidated to 12 inches above the top of pipe (after removal of trench boxes) and compacted to 95% Standard Proctor. Pipe zone material shall be compacted to 95% of theoretical dry density as determined by GDOT test method GDT 7 and tested once per day. If material fails the GDT 7 test, the Contractor shall test pipe zone material

- for the previous day's work in 100 linear foot increments and replace material which does not meet the Specification.
3. Protection of Coatings: The Contractor shall protect pipe coatings from damage during the installation of pipe zone material.
 4. Trench Backfill: Fill above the pipe zone shall be pipe zone Material or Class 1 roadway foundation backfill material conforming GDOT Section 812.2.01, with at least 12% of material by weight passing a 200-sieve. Trench backfill execution shall be according to GDOT Section 207 – EXCAVATION AND BACKFILL FOR MINOR STRUCTURES. Backfill shall be compacted to 95% of theoretical dry density as determined by GDOT test method GDT 7 and tested once per day. If material fails the GDT 7 test, the Contractor shall test trench backfill material for the previous day's work in 100 linear foot increments and replace material which does not meet the Specification.
 5. Trench Width: All trenches shall have vertical walls. The minimum width of the trench shall be equal to the outside diameter plus 24-inches or as needed to obtain proper compaction of pipe zone material around haunches of pipe. The maximum width of trench shall be equal to the outside diameter plus 64-inches. These trench requirements are to be maintained throughout the project and can only be modified with the specific approval of the Engineer.
 6. Not used.

1.04 SUBMITTALS

- A. Submittals shall be made in accordance with the requirements of the General Conditions of the Contract Documents. All submittals shall be delivered in both hard copy and electronic format (such as *.PDF or *.DWG files) and shall be titled with the date, description, and version of the submittal. In addition, the following specific information shall be provided for all materials:
 1. Complete product data and engineering data, including shop drawings.
 - a. Pipe barrel, fitting, specials and thrust design calculations for all load combinations. Submit thrust calculations for all pipe restraint lengths, as well as joint strength calculations. Design calculations shall be signed and sealed by a Registered Professional Engineer licensed to practice in the State of Georgia. Further details of material specific submittals are included in paragraphs 2.01.B, 2.02.B, and 2.03.B of this Section. All pipe design services shall be performed by the pipe manufacturer.
 - b. All variables, assumptions, and design criteria shall be clearly defined in pipe barrel, fitting, specials, and thrust design calculations. All materials manufacturing tolerances that are allowed by underlying standards shall be explicitly disclosed and included into all design calculations. Missing definitions will be cause for rejection of the submittal.
 2. Evidence that the manufacturer has successfully manufactured pipe to the specific AWWA standard submitted for a period of at least five (5) years at the proposed

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manufacturing facility. In lieu of the minimum experience requirement, the Contractor shall submit an action plan that conforms to paragraph 1.02.B of this Section.

3. Written vendor certifications to the Engineer that all products furnished comply with all applicable requirements of these Specifications.
4. Manufacturer's instructions on transportation, handling and storage.
5. Information on coatings, linings, and base materials. Special requirements for protection of weathering and UV damage shall also be provided.
6. Test documentation forms and results for factory and field testing.

B. Warranties

1. Manufacturer shall certify (for the project specified herein regardless of any previous submittals) that design, materials, and required installation practices will result in finished system with a 100-year service life.
2. The Contractor shall transfer to the Owner the following notarized warranties at the end of construction period:
 - a. One (1) year warranty on correction to defects.
 - b. Two (2) year warranty on labor, workmanship and materials.
 - c. Warranty periods shall begin following completion of the project and receipt of final payment.

C. Field Hydrostatic Testing Plan

1. Submit at least 15 days prior to testing and at a minimum, include the following:
 - a. Testing dates
 - b. Piping systems and section(s) to be tested
 - c. Method of isolation
 - d. Method of conveying water from source to system being tested
 - e. Calculation of maximum allowable leakage for piping section(s) to be tested
2. Certifications of Calibration: Approved testing laboratory certificate if pressure gauge for hydrostatic test has been previously used. If pressure gauge is new in a manufacturer sealed package, no certificate is required.

D. Not used.

E. Marking Plan and Laying Schedule

1. Marking plan and details for entire pipeline section showing dimensions, pipe joints, fittings and special fitting pressure rating and thickness, size, coating and lining data and other pertinent information.
2. The laying schedule shall be prepared based on the contract drawings and shall show the direction of pipe laying, pipe class, stations, elevations, fittings, and all elements.

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3. The submittals shall also include drawings of fitting combinations, specials, ties at wall penetrations, blow-off outlets, air vents, and valve connections.
4. The above shall be submitted to the Engineer for approval before manufacture and shipment. The location of all pipes shall conform to the locations shown on the Drawings except for resolution of identified utility conflicts.

1.05 TRANSPORTATION, HANDLING, AND STORAGE

A. General Instructions

1. The Contractor shall furnish equipment and facilities for unloading, handling, distributing and storing pipe, fittings, valves, and accessories. The Contractor shall make equipment available at all times for use in unloading. The Contractor shall not drop or dump materials. Any materials dropped or dumped will be subject to rejection without additional justification.
2. The Contractor shall handle pipe, fittings, valves, and accessories carefully to prevent shock or damage. The Contractor shall handle pipe by forklift or front end loader. The Contractor shall not use material damaged in handling. Special care shall be taken to protect exterior coatings, including shading to protect coatings that may be damaged by the sun. 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.

B. Steel Pipe

1. Pipe Marking:
 - a. Legibly mark installation sequence number on pipe, fittings, and specials in accordance with piping layout.
 - b. Special pipe sections, fittings and compound bends shall be marked at each end with notation "TOP FIELD CENTERLINE" in accordance with AWWA C208 so end rotations can be easily oriented in field.
2. Delivery:
 - a. Securely bulkhead or otherwise seal ends of pipe, specials, and fittings prior to loading at the manufacturing site.
 - b. Pipe ends shall remain sealed until installation.
 - c. Damage to pipe, fittings, or specials, including linings and coatings, found upon delivery to the project site shall be repaired to Engineer's satisfaction and applicable AWWA standards, or removed from site and replaced.
3. Storage:
 - a. Support pipe securely to prevent accidental rolling and to avoid contact with mud, water, or other deleterious materials.
 - b. Support on sand or earth berms free of rock exceeding 3 inches in diameter.
 - c. Storage practices shall be modified as required to achieve installation pipe temperature per paragraph 3.02.C.6 of this Section.

PART 2 PRODUCTS

2.01 STEEL PIPE AND FITTINGS

- A. Design Requirements: Design AWWA C200 piping in accordance with AWWA M11 and AWWA C208 with exceptions as noted in this Section. Performance criteria are as shown on the Drawings, in paragraph 1.03 of this Section, and as supplemented by the following:
1. Unrestrained Joint: Rubber Gasket Carnegie Bell and Spigot or Rolled Groove Joint
 2. Field Installed Restrained Joint: Welded Lap Joints
 3. Settlement Joint at Valve Vaults: Bolted Sleeve-Style Coupling with Joint Harness
 4. Minimum Yield Strength of Steel: 36,000 psi
 5. Minimum Tensile Strength of Steel: 53,000 psi
 6. Maximum Allowable Hoop Stress at Surge Pressure (300 psig): Less than or equal to 0.5 times Yield Strength or 0.35 times Tensile Strength (whichever ever is less)
 7. Maximum Allowable Longitudinal Stresses for restrained pipes (except for thermal stress) shall be allowable hoop stresses multiplied by a Joint Efficiency Factor, 0.60 for Double Welded Lap Joints, and 0.50 for Single Welded Lap Joints.
 8. Thermal Stress: The sum of forces Thermal + Poisson + Soil Drag, where thermal stress is the majority component, shall be limited by 75% of steel yield strength and the joint efficiency reductions required above.
 9. Allowable Vertical Deflection: 3% of pipe diameter
 10. Interior Mortar Lining Thickness: 0.50-inch
- B. 78" Steel Pipe Coupling:
1. Coupling shall be AWWA C219 rated, Victaulic Style 230 Bolted Split Sleeve Coupling System, or equal.
 2. Gaskets shall be EPDM.
 3. Hardware shall be Zinc Plated Carbon Steel.
 4. Coupling shall be Fusion Bonded Epoxy Coated, Corvel 10-7208 or equal
- C. 42" and 60" Steel Pipe Couplings:
1. Couplings shall be AWWA C219 rated, Victaulic Style 232 Restrained Bolted Split Sleeve Coupling System, Type 3, or equal.
 2. Gaskets shall be EPDM.
 3. Hardware shall be Zinc Plated Carbon Steel.
 4. Coupling shall be Fusion Bonded Epoxy Coated, Corvel 10-7208 or equal.
 5. Coupling system shall include restraint rings to be welded to the pipe exterior at the connection points allowing the coupling housing to straddle the restraint rings and engage

the joint, providing thrust restraint. Contractor to coordinate as needed to ensure the rings are provided and installed properly as part of the complete coupling system

- D. Submittals: In addition to the submittals required in paragraph 1.02 of this Section, the following submittals shall be made in accordance with the requirements of the General Conditions of the Contract Documents.
1. Design: Pipe material design calculations shall be submitted based upon the manufacturing or installation tolerance limit which represents the maximum loading (or minimum material strength) condition. Detailed calculations shall be according to AWWA M11 and shall include the following:
 - a. Determination of pipe wall thickness to resist of external loads
 - b. Determination of pipe wall thickness to resist internal loads
 - c. The greater of a) or b) above shall govern design
 - d. Barlow Formula for wall thickness for internal pressure
 - e. Spangler Formula for pipe wall thickness determination for buried pipe deflection
 - f. Minimum Handling Formula for pipe wall thickness determination
 - g. Soil Buckling Formula for pipe wall thickness determination
 - h. Mitered Bend formula for wall thickness determination
 2. Fabrication Details: The following submittals shall be required in addition to the strength design calculations:
 - a. Material list and steel reinforcement schedules for materials specified.
 - b. Design calculations for fittings and specials including opening reinforcement details of collars, wrappers, and crotch plates.
 - c. Pipe and fitting details for temporary and permanent facilities indicating:
 - 1) Cylinder thickness.
 - 2) Manufacturing tolerances.
 - 3) Maximum angular deflection limitations of field joints.
 - 4) Closure sections and cutoffs for field length adjustment.
 - 5) Bulkheads, including details for removal of test bulkheads and repair of lining.
 - 6) Weld lead outlets and plugs.
 - 7) Stulling size, spacing, and layout.
 - d. Welded joint details including:
 - 1) Butt joints.
 - 2) Miter ends cuts for alignment conformance.

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- 3) Lap joints.
 - 4) Deep bell lap joints required for control of temperature stresses.
 - 5) Butt strap joints.
- e. Temperature Control Procedure for Welded Steel Pipeline Segment: Submit procedure for a typical restrained pipeline segment that includes methods that will be utilized to achieve the maximum temperature installation limit for temperature control joints. The Procedure may include, but not limited to:
- 1) Detailed temperature measurement protocol and device data sheet
 - 2) Storage yard, trench, or pipe shading
 - 3) Water application
 - 4) Backfill sequencing and backfill amendments
 - 5) Contingency measures for pipe that does not cool as anticipated
 - 6) Traffic management around open temperature control joint trench
 - 7) Example time and event sequence of temperature control measures, such as measures employed during shipment, storage, placement, welding, backfill, etc.
- f. Welding Data (Shop and Field Welding):
- 1) Show on a weld map complete information regarding base metal specification designation, location, type, size, and extent of welds with reference called out for Welding Procedure Specification (WPS) and Nondestructive Examination (NDE) numbers in tail of welding symbol.
 - 2) Distinguish between shop and field welds.
 - 3) Indicate, by welding symbols or sketches, details of welded joints and preparation of base metal. Provide complete joint welding details showing bevels, groove angles, and root openings for all welds.
 - 4) For pipe fittings, provide a joint weld beveling diagram. Refer to AWS D1.1, Annex G Local Dihedral Angle that can be used to calculate bevels for weld joint details of intersecting pipes.
 - 5) Welding and NDE symbols shall be in accordance with AWS A2.4.
 - 6) Welding terms and definitions shall be in accordance with AWS A3.0.
- g. Product Data for the following:
- 1) Pipe Material Data: Includes chemical and physical test reports showing data consistent with specified requirements for each heat of steel proposed for use.
 - 2) Coatings and Linings: Includes technical data sheets itemizing technical and performance information that indicates compliance with this Specification. Include manufacturer's name, product number or trade name, and thickness.

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- 3) Rubber Gasket Joint: Include details with dimensions, fabrication tolerances for both bell and spigot ends, material of construction, and performance history with test data.
- h. Certificates:
 - 1) Manufacturer's Certificate of Compliance that products furnished meet requirements of this Specification.
 - 2) Lining Materials: Certificate that lining system is currently approved for potable water contact in accordance with NSF 61 and satisfies current applicable governmental health and safety requirements for use in potable water.
 - i. Pipe Manufacturer's written Quality Assurance/Control Plan.
 - j. Statements of Qualification:
 - 1) Pipe manufacturer.
 - 2) Evidence of Steel Pipe Fabricators Association (SPFA), Lloyd's Registry Certification, or ISO 9001:2000 Certification
 - 3) Fittings and specials fabricator.
 - 4) Welders or Welding Operators:
 - a) Name of welder.
 - b) Welding procedures/positions for which welder is qualified to weld.
 - c) Assigned certification stamp number.
 - d) Certification date.
 - e) Current certification status.
 - k. Certified Welding Inspector.
 - l. Non Destructive Test Quality Control Personnel.
 - m. Procedures for Shop and Field Welding: At a minimum include a complete welding code paper trail with linkage to Shop Drawings that includes the following:
 - 1) Written Welding Procedure Specification (WPS) and Procedure Qualification Record (PQR).
 - a) Provide complete joint dimensions and details showing bevels, groove angles, root face, and root openings for all welds.
 - b) Notch-tough welding shall be required for pipe greater than 0.375-inch thickness. For shop welding, address supplementary essential variables in addition to essential variables as indicated in ASME Section IX, QW-251.2. For field welding, heat-input, control PQR essential variables as indicated in AWS D1.1 shall be included. For shop and field welding, provide heat-input table on WPSs for welder guidance.

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- c) PQRs for notch-tough welding shall document heat-input control by monitoring volts, amps, and travel speed or time-rate of change of weld metal volume as calculated by measuring change in electrode length over a period of time. Charpy V-notch tests shall be conducted on weld metal and heat affected zone. Test coupons shall be oriented transverse to final direction of rolling. Full size Charpy specimen test acceptance shall be same as base metal specified herein. In all size materials, use the largest Charpy feasible. If metal thickness not adequate for full size Charpy specimen, reduced section Charpy specimen test will be acceptable if scaled linear with size.
- 2) Written Nondestructive Testing (NDT) procedures.
- 3) Current Welder/Welding Operator Performance Qualification (WPQ).
- 4) Written description of proposed sequencing of events or special techniques such as:
 - a) Controlling pipe wall temperature stress during installation.
 - b) Minimizing distortion of steel.
 - c) Shop-Applied Cement-Mortar Lining: Include description of machine to be used and list of similar projects where machine was used. Identify pipe size and total footage.
 - d) Monitoring pipeline temperatures during installation.
- n. Written weld repair procedures for the Work.
- o. Field coating application and repair.
- p. Field lining application and repair.
- q. Written consumable control procedure for welding materials demonstrating:
 - 1) How consumables will be stored to comply with manufacturer's written instructions.
 - 2) How consumables will be dried in ovens prior to use.
 - 3) How consumables which become wet will be reconditioned.
- 3. Reports:
 - a. Source Quality Control Test Reports:
 - 1) Hydrostatic testing.
 - 2) Destructive weld testing.
 - 3) Nondestructive weld testing.
 - 4) Steel impact testing using Charpy V-notch method.
 - 5) Coating and lining factory Site visit letter by qualified manufacturer's technical representative.

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- b. Coating and lining: Site visit letter by qualified technical representative. Applicator's quality control records, including environmental conditions, dry film thickness, and adhesion tests, when requested by Engineer.
- c. Cement-mortar lining compressive strength tests in accordance with AWWA C205.
- d. Cement-mortar coating absorption tests in accordance with AWWA C205.
4. Manufacturer's Certificate of Compliance, in accordance with Manufacturer's Field Services, stating that inspections and specified tests have been made and that results thereby comply with requirements of Article Source Quality Control.
- E. Pipe: Pipe shall conform to requirements of AWWA C200 and shall be as supplied by American Steel Pipe (ACIPCO), Northwest Pipe Company, or proven equal.
 1. Minimum Elongation in 2-inch Gauge Length: 21%
 2. Weldability: Maximum carbon equivalent of 0.45, as measured using AWS D1.1/D1.1M, Annex XI, Guideline on Alternative Methods for Determining Preheat formula: $CE=C+((Mn+Si)/6)+(Cr+Mo+V)/5+(Ni+Cu)/15$
 3. Pipe shall be pressure vessel quality as follows:
 - a. Coils:
 - 1) Continuous cast process, fully-killed, fine grained practice conforming to physical, manufacturing, and testing requirements ASTM A1018/A1018M, SS.
 - 2) Grades of steel for coils shall be:
 - a) A1018, SS Grade 36, Type 1
 - b) A1018, SS Grade 36, Type 2
 - c) A1018, SS Grade 40
 - 3) Steel chemistry shall be:
 - a) Carbon: 0.20 percent maximum
 - b) Manganese: 1.35 percent maximum
 - c) Aluminum: 0.020 percent minimum
 - d) Phosphorus: 0.025 percent maximum
 - e) Sulfur: 0.015 percent maximum
 - b. Plate:
 - 1) Plate shall conform to ASTM A20, fine-grained practice conforming to physical, manufacturing, and testing requirements of ASTM A516/A516M, Grade 70.
 - 2) Steel Chemistry shall conform to ASTM A516/A516M, Grade 70. Steel plates that are 0.75 inch thick or greater shall be normalized.

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- c. Charpy V-notch Acceptance Criteria: Transverse specimen orientation, full size specimens, 25-foot pounds energy at test temperature of 30 degrees F test outside diameter wrap of two coils minimum per heat load.
 4. Steel pipe wall thickness determined by requirements of this Specification shall be net of any allowable negative manufacturing or material tolerances.
 5. Minimum steel cylinder wall thickness shall be the greater of:
 - a. 0.1875-inches
 - b. Outer Diameter / 200
 - c. The thickness required by structural design calculations specified in this Section.
- F. Pipe and Fitting Linings:
 1. General:
 - a. Notify Engineer at least 3 days prior to application of lining products
 - b. Holdback of lining from field welded joints shall be 8-inches from lap-welded and gasketed joints.
 - c. Cement for mortar lining shall meet NSF 61.
 2. Shop Applied Cement-Mortar Lining:
 - a. Lining shall be applied centrifugally in conformance with AWWA C205. Thickness shall be 0.5-inches.
 - b. Lining machine shall be type that has been used successfully for similar work and approved by Engineer.
 - c. Maintain pipe in round condition during lining operation and thereafter by suitable bracing or strutting.
 - d. Provide polyethylene or other suitable bulkhead on ends of pipe and on special openings to prevent drying out of lining. Bulkheads shall be substantial enough to remain intact during shipping and storage until pipe is installed.
 - e. Pipe shall be left bare where field joints occur.
 - f. Ends of lining shall be left square and uniform. Feathered or uneven edges will not be permitted.
 3. Field-Applied Cement-Mortar Lining;
 - a. Hand-applied mortar shall be used at the interior of all pipe joints.
 - b. Materials shall conform to AWWA C602.
 - c. Do not use pozzolanic material in mortar mix.
 - d. Admixtures shall contain no calcium chloride.

G. Pipe and Fitting Coatings:

1. General:

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- a. Notify Engineer at least 3 days prior to application of coating products.
 - b. Holdback of coating from field-welded joints shall be 3-inches from lap-welded and gasketed joints.
 - c. Furnish inspection devices that are calibrated and in good working condition for detection of holidays and measurement of coating film thickness and adhesion testing.
 - d. Unless otherwise indicated, coat exterior surfaces of pipe and fittings passing through structure walls from center of wall or from wall flange to end of underground portion.
2. Tape Coating:
- a. Coating system for straight pipe shall conform to AWWA C214:
 - 1) Primer layer.
 - 2) Filler tape for irregular surfaces and welded joints, extruded butyl rubber compound compatible with primer and tape.
 - 3) Weld stripping tape, if required (25 mils).
 - 4) Inner layer, corrosion protection tape (20 mils).
 - 5) Middle layer, mechanical protection tape (30 mils).
 - 6) Outer layer, mechanical protection tape (30 mils) with ultraviolet light stabilizers.
 - 7) Total system thickness shall be 72 mils minimum, 80 mils nominal, not including filler tape or weld stripping tape.
 - 8) System shall be supplied by single manufacturer.
 - 9) Perform following to reduce potential for development of voids under tape coating at weld seams:
 - a) Prior to application of tape coating system, grind welds smooth within 18 inches of pipe end, in accordance with AWWA C214.
 - b) Weld Strip Tape:
 - i. 4-inches wide, minimum, and 25-mils thick
 - ii. Coat weld seams with weld strip tape prior to application of inner wrap.
 - iii. Center weld strip tape over seam.
 - iv. Apply pressure to strip tape with multiple-pressure roller to ensure adhesion to pipe surface.
 - v. Product: Polyken 933 or Tek-Rap 280
 - c) Inner wrap and outer wrap shall be applied using neck-down amount recommended by tape manufacturer to conform tape to weld seam.

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- 10) Abrasive blasting, priming, and inner tape application shall be done during same working day for each pipe section.
 - 11) Successful application and service history on pipe fabricated in accordance with AWWA C200.
- b. Coating system for fittings and specials shall conform to AWWA C209. System shall consist of primer and two layers of wrap. Outer wrap shall be white. The materials shall be as follows:
- 1) Primer layer.
 - 2) Filler tape for irregular surfaces and welded joints, extruded butyl rubber compound, Type II per AWWA C209, compatible with primer and tape.
 - 3) Inner layer, corrosion protection tape (50 mils).
 - 4) Outer layer, mechanical and ultraviolet light protection tape (30 mils).
 - 5) Total system thickness shall be at least 80 mils not including filler tape.
 - 6) Supplied by same manufacturer as for straight pipe materials.
- c. Coating system for field-welded joints shall be tape coating conforming to AWWA C209 or heat shrink sleeves per AWWA C216. Tape thickness shall be 80 mils, nominal.

H. Fittings:

1. Fabrication:
 - a. Fittings shall be shop fabricated. No field fabrication will be allowed, unless approved by the Engineer.
 - b. Fittings shall be fabricated from materials or straight pipe in full conformance with requirements of these Contract Documents and dimensions of AWWA C208, unless otherwise indicated.
2. Crotch Plate: Fabricate from fine grain, pressure vessel steel conforming to ASTM A516/A516M, Grade 70, and as follows:
 - a. Plates shall be normalized.
 - b. Sulfur content shall not exceed 0.005 percent. Carbon shall not exceed 0.20 percent. Manganese shall not exceed 1.20 percent.
 - c. Charpy V-notch tests in direction transverse to final rolling shall be performed per ASTM A370 on full size specimens of coupons taken from each plate. Acceptance shall be 25 foot-pounds at 30 degrees F
 - d. Carbon equivalent shall not exceed 0.45 percent.
3. Wall Thickness:
 - a. Refer to ASME B36.10M for definitions of wall thickness for standard weight pipe and nominal pipe size (NPS).

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- b. Reinforce to withstand either internal pressures, both circumferential and longitudinal, or external loading conditions, whichever is greater.
- 4. Elbows, Unless Otherwise Indicated:
 - a. Minimum Radius: 1.0 times pipe diameter or as indicated on the Drawings
 - b. Minimum Bend Wall Thickness: Greater of Table 1 above or as calculated for straight pipe under internal pressure multiplied by the following stress intensities: For “n” greater than 2.5 the stress intensity factor may be ignored as indicated in AWWA C208.

Bend Radius Multiplier “n”	AWWA C208 Bend Stress Intensity
1.0	1.67
1.5	1.33
2.0	1.22
2.5	1.17
3.0	1.13
3.5	1.11
4.0	1.10
4.5	1.08
5.0	1.07
5.5	1.07

- c. Maximum Miter Angle: 11-1/4 degrees on each section resulting in a maximum deflection angle of 22.5 degrees per miter weld as recommended in AWWA C208.
- d. Bevels: Vary bevels on miters to provide a constant weld groove angle. For a 11-1/4 degree miter, (22.5 degrees miter weld) bevels must vary from 18.75 degrees on OD of bend to 41.25 degrees on ID of bend to provide a constant 60 degree groove angle for CJP welding.
- e. Complete joint penetration (CJP) welds on miter welds.
- 5. Outlets:
 - a. Larger than 24 Inches: Fabricate from ASTM A106, Grade B, standard weight pipe.
 - b. Fabricate collar or wrapper reinforcement using same steel as specified for main pipe barrel.

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I. Joints:

1. Shop Welded Joints:

- a. Fabricate in accordance with AWWA C200 as modified herein.
- b. Complete joint penetration (CJP) butt joints shall be used for longitudinal, girth, and spiral welds.
- c. Lengths of pipe shall not be shop-joined using lap joints.

2. Field Welded Lap Joints:

- a. Restrained joints shall be lap welded slip joints.
- b. Double fillet lap joints in preparation for field welding shall be in accordance with AWWA C200.
- c. Mark pipe or provide stops at equal intervals around inside circumference of bell ends to indicate location at which spigot end has reached maximum penetration into bell. Remove stops after joint has been fixed in place.
- d. Double welded lap joints and butt-strap joints shall be tapped and drilled for testing in accordance with AWWA C206 to air-test the joints.

3. Testing: Each joint shall be tested by the Contractor at the time of installation. The joints may be tested either with feeler gauges in accordance with paragraph 3.02 of this section, or with air testing.

4. Rubber Gasket Joints:

a. General:

- 1) Joints shall be in accordance with AWWA C200.
- 2) Clearance between bell and spigot shall, when combined with gasket groove configuration and gasket itself, provide watertight joints under operating conditions.
- 3) Unrestrained joints for 24-inch to 60-inch nominal pipe diameters shall be rubber gasket Carnegie bell and spigot joints, or rolled groove joints.

J. Gaskets:

1. Gaskets shall be in accordance with AWWA C200.
2. Clearance between bell and spigot shall, when combined with gasket groove configuration and gasket itself, provide watertight joints under operating conditions.
3. Contractor shall furnish sufficient feeler gauges for use throughout the complete project.

PART 3 EXECUTION

3.01 EXISTING UTILITIES AND OBSTRUCTIONS

A. Field Alignment Changes:

All alignment changes arising from utility conflicts in the field shall be the responsibility of the Contractor. The Contractor shall locate utility conflicts prior to acceptance of pipe material on site.

1. Minor Alignment Changes:

Alignment changes of less than five (5) feet vertical or horizontal from the Drawings that can be controlled by allowable pipe deflections, and the addition or subtraction of trench depth shall be considered minor alignment changes and will be treated as field changes. These alignment changes can be approved by the Engineer in the field with a written "field variance" and detailed submittals will not be required. Only changes where there is no chance of violating thrust restraint design assumptions or pipe wall thickness design assumptions may be considered minor alignment changes. The Contractor shall record the change on as-built drawings.

3.02 LAYING AND JOINTING PIPE AND ACCESSORIES

A. General:

1. Sleeve-type mechanical pipe couplings shall conform to the requirements of applicable AWWA standard.
2. Unless otherwise specified, buried mechanical couplings and valves shall be field coated as shown on the Drawings, specified in these Specifications, or as directed by the Engineer.
3. Anchorage shall be provided as shown on the Drawings, specified in these Specifications, or as directed by the Engineer.
4. Proper equipment, tools and facilities shall be provided for the safe performance of the Work. All pipe, fittings, valves, and hydrants 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 water main materials and protective coatings and linings. Under no circumstances shall water main materials be dropped or dumped into the trench.
5. 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 Engineer, who may prescribe corrective repairs or reject the materials.
6. 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 containing dirt shall be laid.
7. 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 placed in the pipe at any time.

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8. 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.
9. 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.
10. The Contractor shall provide detection tape for all pipe. Detection tape shall be buried four (4) to ten (10) inches deep below the road-base material. Should detection tape need to be installed deeper, the Contractor shall provide three (3) inch wide tape. In no case shall detection tape be buried greater than twenty (20) inches below the road base material.

11. Installation

a. General:

- 1) Provide and use proper equipment, tools, and facilities for safe and proper prosecution of Work.
- 2) Lower pipe, fittings, and appurtenances into trench, piece by piece, by means of a crane, slings, or other suitable tools and equipment, in such a manner as to prevent damage to pipe materials, protective coatings and linings.
- 3) Do not drop or dump pipe materials into trench.

b. Cleaning Pipe and Fittings:

- 1) Remove lumps, blisters, and excess coal tar coating from bell and spigot ends of each pipe. Wire brush outside of spigot and inside of bell and wipe clean, dry, and free from oil and grease before pipe is laid.
- 2) Wipe ends of mechanical joint pipe and fittings and of rubber gasket joint pipe and fittings clean of dirt, grease, and foreign matter.

c. Cutting Pipe:

- 1) General: Cut pipe for inserting valves, fittings, or closure pieces in a neat and workmanlike manner without damaging pipe or lining and so as to leave a smooth end, at right angles to axis of pipe.
- 2) Pipe: Cut pipe with milling type cutter or saw. Do not flame cut.
- 1) Dressing Cut Ends: Dress cut end of mechanical joint pipe to remove sharp edges or projections, which may damage rubber gasket. Dress cut ends of push-on joint pipe by beveling, as recommended by manufacturer.

d. Field Welding:

- 1) Field welding of bars for restrained joint systems will not be allowed.
- 2) (Not Used)

e. Polyethylene Encasement: Polyethylene shall be installed around pipe utilizing Method A as specified in Section 02616.

B. Welded Steel Pipe:

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1. Installation

- a. Joints and related work for field assembly of fittings and specials shall conform to requirements for straight pipe, unless otherwise shown.
- b. Make minor field adjustments by pulling standard joints.
- c. Maximum Allowable Angle: 75 percent of manufacturer's recommended or angle that result from 3/4-inch pull out from normal joint closure, whichever is less.
- d. Maximum Allowable root opening: 1/8-inch between faying surfaces of bell and spigot at field weld location.
- e. Horizontal deflections or fabricated angles shall fall on alignment, as shown.
- f. Vertical deflections shall fall on alignment, and pipe angle point locations shall match those indicated on Drawings.
- g. Pipe 30-inches in Diameter and Larger:
 - 1) Assure that maximum penetration of spigot end into bell end is achieved through use of shop-welded tabs on inside circumference of bell end or other method approved by Engineer.
 - 2) Remove welded metal tabs prior to welding inside of joint.
 - 3) Maintain stulling in place until pipe is backfilled.

2. Welding

- a. Conform to AWS D1.1/D1.1M, AWWA C206, approved welding procedures, and referenced welding codes. In case of conflict AWS D1.1 shall govern.
- b. Preheat and interpass temperature requirements for unlisted base metals shall be determined according to AWS D1.1/D1.1M, Annex XI Guideline on Alternative Methods for Determining Preheat.
- c. Rejected or defective welds shall be repaired or redone, and retested until sound weld metal has been deposited in accordance with appropriate welding codes.

3. Repair of Shop-Applied Coatings

- a. Exterior surfaces of steel pipe, specials, and fittings shall be inspected upon delivery to Job Site and just prior to backfilling trench.
- b. Repair of Tape Coating:
 - 1) Repairs shall be in accordance with AWWA C209 and AWWA C214, as applicable, except as modified herein.
 - 2) Repair areas where tape coating is visually damaged or where electrical holiday testing indicates defects. Repair tape system shall consist of field primer and 4- or 6-inch wide repair tape.
 - 3) Number of tape repair layers shall either be two or four, depending on depth of coating damage. Minimum number of repair tape layers shall be two where only existing outer coating or middle wraps were damaged. Where coating damage

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extends to inner wrap or base metal, number of repair tape layers shall be four. Thickness of repair coatings shall equal or exceed thickness of factory-applied coatings.

- 4) Clean and prepare pipe surface, remove damaged coating layers, and apply primer and repair tape in accordance with tape manufacturer's written instructions. Extend repair coating minimum of 4 inches in all directions onto undamaged coatings. When damaged area is wider than repair tape width, provide minimum of 4-inches coverage in all directions by lapping first tape layer with additional repair tape layers.
 - 5) If area of tape, 6-inches or larger, is damaged through to inner wrap or to metal, apply repair tape in a cigarette wrap around entire pipe circumference. Overlap wrap ends minimum of 6 inches and point downward at spring line.
 - 6) Completed tape repair shall adhere tightly to factory coating and present smooth, unwrinkled appearance.
 - 7) Field coatings shall have complete holiday detection and repair of defects.
 - 8) Repair of Cement Mortar Coating: Field repairs shall be made in accordance with AWWA C205.
 - 9) Repair of Polyurethane Coating: Field repairs shall be made in accordance with AWWA C222.
4. Coating of Field-Welded Pipe
- a. Using Tape Wrap:
 - 1) Field-welded joints shall be coated with tape wrap in accordance with AWWA C209, or heat-shrink sleeves in accordance with AWWA C216. Tape thickness shall be 80 mils, nominal.
 - 2) Preparation:
 - a) Roughen surface of epoxy coatings where they are overlapped with tape. Overlap of tape onto other coatings shall be 12 inches, minimum.
 - b) Pipe at field joints shall be prepared in accordance with requirements stated herein for shop-coated pipe, except that shop-blasted surfaces that have been coated with storage primer may be power tool cleaned instead of abrasive blast cleaned. Pipe ends that exhibit rust or are otherwise not effectively protected with storage primer shall be abrasive blasted to SSPC-SP6.
 - b. Using Heat Shrink Sleeves:
 - 1) Apply in accordance with AWWA C216 and sleeve manufacturer's written instructions.
 - 2) Cover pipe surfaces not coated by shop-applied coating system.
 - 3) Clean and prepare pipe surface in accordance with AWWA C216.
 - 4) Clean 8 to 10 inches onto shop-applied coating as recommended by sleeve manufacturer.

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- 5) Preheat pipe and apply sleeve in with manufacturer's recommended heating equipment.
 - 6) Holiday test completed sleeve installation and repair defects in accordance with AWWA C216 and manufacturer's written instructions.
5. Lining Application at Joints
- a. Cement-Mortar Lining: For pipe with shop-applied cement-mortar lining, place lining at joints in accordance with AWWA C205.
 - b. Polyurethane Lining: Conform to AWWA C222, as modified herein. Abrasive blast exposed metal at field-welded joints to Near White Metal (SSPC-SP-10). Brush blast shop-applied polyurethane to roughen surface prior to application of joint coating.
6. Field Quality Control
- a. Field Welding:
 - 1) All welds (100-percent inspection) shall be VT inspected by Contractor's CWI and marked to indicate acceptance or rejection
 - 2) Test butt strap or double welded lap joint welds by pressurizing connection between the two fillet welds in accordance with AWWA C206.
 - 3) Apply air or other Engineer approved gas into connection between the two fillet welds.
 - 4) Paint welds with soap solution.
 - 5) Mark leaks indicated by escaping gas bubbles.
 - 6) Close threaded openings with flush pipe plugs or by welding them.
 - b. Inspect 10 percent of all butt joint welds with full circumference RT.
 - c. Inspect at least 10 percent of all lap joint welds PT or MT
 - d. Weld Acceptance:
 - 1) If, in the opinion of Engineer, inspections indicate inadequate quality of welds, the above percentage of welds inspected shall be increased.
 - 2) Welds to be inspected, if less than 100 percent rate, shall be selected at random by Engineer.
 - 3) VT: Perform VT per AWS D1.1/D1.1M Paragraph 6.9, Visual Inspection, Statically Loaded Nontubular Connections.
 - 4) UT: Perform UT of CJP groove welds in accordance with AWS D1.1/D1.1M, Paragraph 6.13.1.
 - 5) RT: Perform RT of CJP butt joint welds in accordance with AWS D1.1/D1.1M, Paragraph 6.12.1.
 - 6) PT or MT:
 - a) Perform on fillet and PJP groove welds in accordance with AWS D1.1/D1.1M, Paragraph 6.10.

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- b) Acceptance shall be in accordance with VT standards specified above.
- 7) Remove in manner that permits proper and complete repair by welding.
- 8) Caulking or peening of defective welds is not permitted.
- 9) Retest unsatisfactory welds.
- e. Submit test results to Engineer.
- f. Engineer will conduct random nondestructive inspections of field-welded joints. Inspections will be of an appropriate type for weld being evaluated. Possible types of inspection include, but are not limited to, radiographs, magnetic particle, and ultrasonic. Testing will be performed and evaluated per AWS D1.1/D1.1M for Statically Loaded Nontubular Connections. Provide CWI access to the Work.

3.03 ALIGNMENT AND GRADIENT

- A. Minimum pipe cover shall be 4-feet unless otherwise indicated on the Drawings.
- B. Maintain pipe grade between invert elevations to provide minimum clearance at air valve locations from existing ground surface to top of pipe as shown on the Drawings.
- C. Install air valves as shown and field verify intervening low points. When field conditions warrant, exceptions may be made upon approval of Engineer.
- D. Deviations exceeding 6 inches from specified line or 1 inch from specified grade will not be allowed without express approval of Engineer.
- E. Pipeline sections that are not installed to elevations shown or installed as approved by Engineer shall be reinstalled to proper elevation.

3.04 EXPEDITING OF WORK

- A. The Contractor shall excavate, lay the pipe and backfill as closely together as possible. The Contractor shall not leave un-jointed pipe in the trench overnight. The Contractor shall backfill and compact the trench as soon as possible after laying and jointing is completed.
- B. The Contractor shall 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. If necessary to backfill over the end of an uncompleted pipe or accessory, the Contractor shall close the end with a suitable plug, either push-on, mechanical joint, restrained joint, or as approved by the Engineer.

3.05 THRUST RESTRAINT

- A. The Contractor shall provide restraint at all points where hydraulic thrust may develop. Restrained joint lengths shall be as calculated by the Contractor according to paragraph 1.03 of this Section and as approved by the Owner by submittal.
- B. (Not Used)

3.06 CATHODIC PROTECTION SYSTEM – NOT USED

3.07 PIPE INSPECTION AND ACCEPTANCE

- A. Joint Inspection

1. The Contractor shall notify the Engineer at least 48 hours prior to the anticipated completion of a full pipe section between isolation valves. Once the section is completely installed, the Contractor shall participate in a joint inspection walkthrough with the Engineer or his appointed agent.
2. For unrestrained gasketed joints, the Contractor shall demonstrate the soundness of each joint to the inspector using a feeler gauge. The Engineer shall witness each joint test. The Contractor may grout joints with mortar lining (where required) as the feeler gauge tests are completed for that joint.
3. For welded steel joints, the Contractor shall verify prior to closure that weld inspection has been performed for all welded joints in that section according to the requirements of paragraph 3.02.C.7 of this Section.
4. If the Contractor has provided double gasketed joints fitted for air-pressure testing, the joints shall be tested according to AWWA C206 during the joint inspection walkthrough. This test will be required at the time of joint inspection regardless of any earlier testing to verify weld soundness.
5. The Contractor shall remove all construction debris, shipping braces, trash, rocks, and soil from the subject pipe section at the completion of the joint inspection walkthrough. Loose dirt shall be swept from the pipe, and the pipe shall be ready for final acceptance inspection, section closure, and subsequent filling.

C. Final Acceptance Inspection and Closure of Pipe Sections

1. The Contractor shall allow sufficient time for the mortar in newly grouted joints to cure before conducting the final acceptance inspection.
7. After the joint mortar is cured, the Contractor shall participate in the final acceptance inspection walkthrough with the Engineer. After completion of the final acceptance inspection, the Engineer or his appointed agent shall confirm to the Contractor in writing that the pipe section is accepted and ready for closure.
8. The Contractor shall then close and seal the pipe section, preventing reentry of personnel or the introduction of debris and contaminants to the pipe.

3.08 HYDROSTATIC TESTING

- A. The Contractor may install double gasketed testable joints for the purpose of air-pressure testing of joints in lieu of full hydrostatic testing. Double gasketed or double welded joints shall be air tested. Pipe sections tested in this way will not be required to comply with paragraph 3.08.F.1, Hydrostatic Testing, but will be required to comply with all other requirements of this section, including paragraph 3.08.G, Leakage.
- B. All sections of the water main subject to internal pressure shall be pressure tested in accordance procedures outlined in AWWA C600 and these Specifications. A section of main will be considered ready for testing after completion of all thrust restraint and backfilling.
- C. Water used for flushing and testing mains and other construction purposes shall be made available to the Contractor as specified.

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D. Each segment of water main between main valves shall be tested individually.

E. Test Preparation:

1. Cleaning procedures shall meet the procedures in AWWA C651. Procedures for cleaning shall include sweeping and vacuuming of debris, low-pressure washing and mopping of pipe lining.
2. The Contractor shall partially operate valves and hydrants to clean out seats.
3. The Contractor shall provide temporary blocking, bulkheads, flanges, and plugs as necessary, to assure all new pipe, valves, and appurtenances will be pressure tested.
4. The Contractor shall fill pipeline slowly with water. The Contractor shall provide a suitable pump with an accurate water meter to pump the line to the specified pressure at a filling velocity not to exceed 0.25 foot per second.
5. The differential pressure across a valve or hydrant shall equal the maximum possible, but not exceed the rated working pressure. Where necessary, the Contractor shall provide temporary backpressure to meet the differential pressure restrictions.
6. Valves shall not be operated in either the opening or closing direction at differential pressures above the rated pressure.

F. Hydrostatic Testing:

1. High Pressure Test: The Contractor shall test the pipeline at one-hundred (100) psi measured at the lowest point for at least two (2) hours. The Contractor shall maintain the test pressure within five (5) psi of the specified test pressure for the test duration. Should the pressure drop more than five (5) psi at any time during the test period, the pressure shall be restored to the specified test pressure. The Contractor shall provide an accurate pressure gage with graduation not greater than five (5) psi.

G. Leakage:

1. Leakage shall be defined as the sum of the quantity of water that must be pumped into the test section, to maintain pressure within five (5) psi of the specified test pressure for the test duration plus water required to return line to test pressure at the end of the test. Leakage shall be the total cumulative amount measured on a water meter.
2. The City assumes no responsibility for leakage occurring through existing valves if the Contractor chooses to test against an existing valve.
3. Test Results: No test section shall be accepted if the leakage exceeds the limits established for each of the materials:
 - a. Steel Pipe: Maximum allowable leakage for pipe with O-ring rubber gasket joints shall not exceed 1.0 gallons per inch of diameter per fractional mile per 2 hours. There is no allowable leakage for pipe with welded joints. Where the pipeline combines welded and gasketed joints, the percentage of gasketed joints to total joints multiplied times the allowable leakage formula for gasketed joints shall apply.

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- H. Completion: After a pipeline section has been accepted, the Contractor shall relieve test pressure. The Contractor shall record type, size, and location of all outlets on the Record Drawings.

+++ END OF SECTION 02667 +++

**SECTION 02700
REMOVING AND REPLACING PAVEMENT**

PART 1 GENERAL

1.01 SCOPE

- A. The work under this Section includes, but it is not necessarily limited to, the removal and replacement of all asphalt paving materials as necessary for the completion of the Work.
- B. This section also includes pavement milling and application of a new surface course over the entire width of existing pavement or to other widths as directed by the Engineer.
- C. Not Used.
- D. Not Used.

1.02 SUBMITTALS

- A. Submittals shall be made in accordance with the requirements of the General Conditions of the Contract Documents. In addition, the following specific information shall be provided:
 - 1. Batch design.
 - 2. Density and viscosity tests on each run.
 - 3. Weight slips for pavement base and asphalt paving materials.
- B. Provide certificates stating that materials supplied comply with Specifications. Certificates shall be signed by the asphalt producer and the Contractor.

1.03 CONDITIONS

- A. Weather Limitations
 - 1. Apply bituminous tack coat only when the ambient temperature in the shade has been at least 40 degrees F for 12 hours immediately prior to application.
 - 2. Do not conduct paving operations when surface is wet or contains excess moisture that would prevent uniform distribution and required penetration.
 - 3. Construct asphaltic courses only when atmospheric temperature in the shade is above 40 degrees F, when the underlying base is dry and when weather is not rainy.

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4. Place base course when air temperature is above 40 degrees F and rising. Do not place base on a frozen or muddy subgrade.
- B. Grade Control: Establish and maintain the required lines and grades for each course during construction operations.
- C. Traffic Control
 1. The Contractor shall maintain vehicular and pedestrian traffic during paving operations and as required for other construction activities.

1.04 QUALITY ASSURANCE

- A. All work under this Section shall be performed in accordance with the current Georgia Department of Transportation Standard Specifications.
- B. The Contractor shall use only materials which are furnished by a bulk asphalt concrete producer regularly engaged in production of hot-mix, hot-laid asphalt concrete and shall be a GDOT approved facility.

1.05 PRODUCT HANDLING

- A. Protection: Use all means necessary to protect the materials of this Section before, during and after installation and to protect the installed work and materials of all other trades.
- B. Replacement: In the event of damage, immediately make all repairs and replacements necessary to gain the approval of the Engineer at no additional cost to the City.

1.06 FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed in accordance with the requirements of the General Conditions.
- B. The City's independent testing laboratory shall take samples and perform tests in accordance with the Georgia Department of Transportation Standard Specifications

PART 2 PRODUCTS

2.01 MATERIALS

- A. General: All materials and products for the work under this Section shall conform to the current Georgia Department of Transportation Standard Specifications except as otherwise specified herein.

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- B. Graded Aggregate Base: Graded aggregate base shall be Class A meeting the requirements of the Georgia Department of Transportation Specification Section 815.01. Graded aggregate base shall be compacted to a minimum of 95% Standard Proctor Density (ASTM D698).
- C. Prime Coat: Prime coat shall be in accordance with Section 412 of the Georgia Department of Transportation Standard Specifications.
- D. Base: The base for all paved roadways shall conform to the requirements of the Georgia Department of Transportation Specifications for the hot mix asphalt Section 828, Type "B".
- E. Tack Coat: Tack coat shall conform to Section 413 of the Georgia Department of Transportation Standard Specifications.
- F. Surface Course
 - 1. The surface course for all pavement not within GDOT right-of-way, including prime and tack coat, shall conform to the requirements of the Georgia Department of Transportation Specifications for Asphaltic Concrete, Section 828, Type "E".
 - 2. Surface course for pavement within GDOT right-of-way shall be 12.5 mm Superpave as specified in Section 828 of the GDOT Standard Specifications.
- G. Special Surfaces: Not Used.

2.02 PAVEMENT MARKINGS (Not Used)

PART 3 EXECUTION

3.01 REMOVING PAVEMENT

- A. General: Remove existing pavement and base as necessary for trench excavation and installation of pipeline and appurtenances.
- B. Remove and replace pavement and base beyond pipeline trench to outer edge of existing pavement if remaining existing pavement width is 24-inches or less from side of trench to outer edge of pavement or roadway.
- C. Marking: Before removing any pavement, mark the pavement neatly paralleling pipelines and existing street lines.
- D. Saw Cutting: Under no circumstances shall the Contractor be allowed to remove concrete or asphalt without prior saw cutting. Asphalt pavement shall be saw cut along the marks

using suitable equipment. The saw cutting shall be deep enough to produce an even, straight cut.

- E. Machine Pulling: Do not pull pavement with machines until the pavement is completely broken and separated from pavement to remain.
- F. 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.

3.02 TYPES OF PAVEMENTS

- A. General: All existing pavement removed, destroyed or damaged by construction shall be replaced with the same type and thickness of pavement as that existed prior to construction, unless otherwise directed by the Engineer. 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. Graded Aggregate Base: Aggregate base shall be constructed in accordance with the requirements of the Georgia Department of Transportation Standard Specifications. 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. 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: Concrete pavement or base courses shall be replaced with concrete. The surface finish, joint pattern and joint sealant of the replaced concrete pavement shall conform to that of the existing pavement. The surface of the replaced concrete base course shall be left rough. The slab depth shall be equivalent to the existing concrete pavement or base course, but in no case less than 6-inches thick. 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. Concrete pavements or concrete base courses shall be reinforced. Reinforcing bars and concrete shall conform to the requirements of Section 03200, Concrete Reinforcement and Section 03300, Cast-In-Place Concrete. Concrete for pavement shall be 3000 psi.
- D. Asphaltic Concrete Base, Bituminous Tack Coat, and Surface Course: Asphaltic concrete base, tack coat, and surface course construction shall conform to Georgia Department of Transportation Standard Specifications. The pavement mixture shall not be spread until the designated surface has been previously cleaned and prepared; surface is intact, firm, properly cured, dry and the tack coat has been applied. Apply and compact the base in maximum layer thickness by asphalt spreader equipment of design and operation approved by the Engineer. After compaction, the black base shall be smooth and true to established

profiles and sections. Apply and compact the surface course in a manner approved by the Engineer. 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: Bituminous penetration surface treatment pavement shall be replaced with the thickness indicated on the Drawings.
- F. Gravel Surfaces: Existing gravel road, driveway and parking area replacement shall meet the requirements of graded aggregate base course. This surfacing may be authorized by the Engineer as a temporary surface for paved streets until replacement of permanent pavement is authorized.

3.03 TEMPORARY ROADWAY SURFACES

- A. After installation of pipeline and appurtenances, the trench shall be backfilled in accordance with the requirements of Section 02225, Trench Excavation and Backfill.
- B. The Contractor shall be required to install and maintain temporary roadway surfaces over all roadway cuts at the end of each day's work if the road is to be opened for traffic when work is not in progress. Temporary roadway surfaces shall consist of either temporary cold asphalt patch, aggregate base course or steel plates over the trench. The surface to be installed shall be selected by the Contractor and approved by the Engineer.
 - 1. Temporary Patch Paving: Temporary patch paving shall be placed on the aggregate base course and shall conform to the existing road surface. Prior to installation of permanent pavement, the temporary patch, and aggregate base course, if necessary, shall be removed to the required depth and leveled to allow for permanent pavement replacement of the thickness as shown on the Drawings.
 - 2. Aggregate Base Course: Aggregate base course surface shall conform to the existing road surface and shall be maintained at grade, dust free, by the Contractor. Prior to installation of permanent pavement, the aggregate base course shall be removed to the required depth and leveled to allow for permanent pavement replacement of the thickness as shown on the Drawings.

3.04 STEEL TRAFFIC PLATES

- A. Following completion of pipeline installation including backfilling but prior to replacement of pavement, steel plates may be used to temporarily carry vehicular traffic if approved by the Engineer. Requirements for utilization of steel plates shall be as follows:
 - 1. Steel plates shall not be allowed in GDOT right of way where the posted speed limit is 45 mph or greater.

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2. Trench shall be backfilled and compacted to within ten (10) inches from top of existing pavement prior to placing the steel plate.
3. Steel plates shall meet ASTM structural specifications having “A36” designation with minimum yield stress of 36 ksi (ksi = kilopounds per square inch).
4. Steel plates shall extend a minimum of 12-inches beyond all edges of the trench.
5. In streets and roads where the posted speed is 44 mph or less, asphaltic patching material (cold mix) shall be used to secure the steel plate around its edges. The asphaltic concrete shall be compacted to form ramps with a minimum 12-inch taper to cover all edges of the steel plate.
6. Not Used.
7. No plate shall be allowed over a trench having a width greater than 48 inches when adequate soil conditions are present. When the trench is greater than 48 inches, the entire lane containing the trench shall be closed. Before closing a lane, a Lane Closure Permit shall be obtained from the City of Atlanta, Department of Public Works, Bureau of Traffic and Transportation. At least 24 hours prior notification is required for the Lane Closure Permit.
8. The width of a trench is measured normal to the length of the trench. The largest reading of the measurements is the determining factor for width. For a series of steel plates on any continuous trench, all plates shall have the same thickness.
9. All necessary warning signs, barricades, and lights shall be adequately provided and placed for the safety of the public and in full conformity with the latest edition of the MUTCD at no additional cost to the City.
10. Trench shall be fully covered with a minimum of twelve (12) inches of asphalt taper on all sides of the plate.
11. Upon the completion of the work and removal of the steel plates, the existing surface shall be cleaned and pavement replaced as specified hereinafter.

B. (Not Used)

3.05 TESTING OF SUBGRADE

- A. Trench backfill shall be compacted for the full width and depth of the trench as specified in Section 02225, Trench Excavation and Backfill.

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- B. Upon completion of backfilling and compaction of the backfill, the Contractor shall arrange to have the compaction tested by an independent testing laboratory approved by the Engineer. Compaction testing shall be as specified in Section 02225.
- C. After compaction testing has been satisfactorily completed, replace all pavements, sidewalks, and curbs and gutters removed.
- D. Tests repeated because the compacted backfill, subgrade or base does not meet the specified compaction shall be paid for by the Contractor and will not be reimbursed by the City.

3.06 PAVEMENT REPLACEMENT

A. Limits of Pavement Replacement

1. Existing Raw Water Intake Access Road

- a. The existing street pavement or surface shall be milled for the full width of the affected travel lane where indicated on the Drawings. The depth of milling shall be at least 3 and 1/2 inches.
- b. Milling shall be performed as specified in Section 432 of the GDOT Standard Specifications.
- c. 3 and 1/2 inch thick pavement shall be applied over entire milled area to restore the existing roadway to the same elevation that existed prior to construction.

B. Preparation of Subgrade

- 1. If the temporary aggregate base surface is to be replaced, it shall be removed and the graded aggregate base surfacing for unpaved streets or the base for the bituminous surface shall be placed.
- 2. Following this preparation, the graded aggregate base shall be primed with a suitable bituminous material and surfaced with the proper type of bituminous surface treatment.
- 3. 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 aggregate base surface and any necessary backfill material, additional existing paving and new excavation shall be removed to the depth and width shown on the Drawings. All edges of the existing pavement shall be cut to a straight, vertical edge. 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. Concrete base slabs and graded aggregate bases, if required, shall be placed and allowed to cure for three days before bituminous concrete surface courses are applied. Expansion joints, where applicable, shall be replaced in a manner equal to the original joint.

C. Pavement Placement and Resurfacing

1. After all pipe line installations are complete and subgrade has been placed as specified in Paragraph 3.06.B above, apply tack coat and surface course as specified herein.
2. Resurfacing limits shall be perpendicular to the road centerline.
3. Where pavement is 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.
4. Placement of pavement shall conform to the Standard Details shown on the Drawings and GDOT standard specifications.

3.07 ADJUSTING EXISTING STRUCTURES

- A. Existing manholes, inlets, valve boxes etc. within the limits of construction, which do not conform to the finished grade of the proposed pavement or the finished grade designated on the Drawings shall be cut down or extended and made to conform to the finished grade. The materials and construction methods for this work shall be approved by the Engineer.
- B. (Not Used)

3.08 SIDEWALK, WHEELCHAIR RAMP AND CURB AND GUTTER REPLACEMENT (Not Used)

3.09 TRAFFIC DETECTION LOOPS (Not Used)

3.10 PAVEMENT MARKINGS (Not Used)

3.11 INSTALLATION

- A. Asphaltic construction shall be performed in accordance with Section 400 of the Georgia Department of Transportation Standard Specifications.
- B. Place each course in the required quantities so that when compacted, they will conform to the indicated grade, cross section and minimum thickness as specified or as indicated on the Drawings (see section 3.01-3.06).

3.12 CLEANING AND PROTECTION

- A. Prior to acceptance of the work of this Section, clean the pavement and related areas in accordance with the requirements of the General Conditions of the Contract Documents. 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.
- B. (Not Used)

3.13 APPROVAL AND ACCEPTANCE

- 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 Engineer's approval of restoration of pavement, such as private roads and drives that are not the responsibility of a regulatory agency.
- C. Should any pavement restoration or repairs fail or settle during the life of the Contract, including the bonded period, promptly restore or repair defects.
- D. Prior to acceptance and approval of any asphaltic concrete binder and/or topping which is installed for the purpose of City maintenance, a representative of the City of Atlanta's Department of Traffic and Transportation may require one or all of the following tests: 1) coring, 2) extraction, 3) compaction and 4) density. The frequency and location of these tests will be at the discretion of the Engineer.

3.14 MAINTENANCE

- A. The Contractor shall maintain the surfaces of roadways and pavements replaced until the acceptance of the Project. Maintenance shall include replacement, scraping, reshaping, milling, overlapping, and re-rolling as necessary to prevent raveling of the road material, the preservation of smooth surfaces and the repair of damaged or unsatisfactory surfaces, to the satisfaction of the Engineer.
- B. Maintenance shall also include sprinkling as may be necessary to abate dust from the gravel surfaces.

+++ END OF SECTION 02700 +++

**SECTION 02900
TREES, PLANTS, AND GROUND COVERS**

PART 1 GENERAL

1.01 SCOPE

- A. The Contractor shall furnish and plant trees, plants and ground covers as shown on the Drawings and as specified herein.
- B. Under this section, the Contractor shall also replace trees, plants and ground covers damaged by his operations. Existing trees, plants and ground covers damaged by the Contractor's operations shall be replaced as directed by the Engineer, to the satisfaction of the Engineer and at no additional cost to the Owner.
- C. Work under this Section shall include, but not be limited to:
 - 1. Soil preparation.
 - 2. Planting mixes.
 - 3. Mulch and planting accessories.
 - 4. Furnishing and installing trees, plants and ground covers.
 - 5. Existing tree care.
 - 6. Filling around trees to remain.
 - 7. Maintenance.

1.02 QUALITY ASSURANCE

- A. Comply with requirements of Section 02000, Site Work.
- B. Plant names shall comply with "Standardized Plant Names" as adopted by the latest edition of the American Joint Committee of Horticultural Nomenclature. Names of varieties shall conform generally with names accepted by the nursery trade. Provide stock true to botanical name and legibly tagged.
- C. Comply with sizing and grading standards of the latest edition of "American Standard for Nursery Stock". A plant shall be dimensioned as it stands in its natural position.
- D. All plants shall be nursery grown under climatic conditions similar to those in the locality of the project.

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- E. Stock furnished shall be at least the minimum size as stock to be replaced. Larger stock is acceptable, at no additional cost, and providing that the larger plants will not be cut back to the existing plant size.
- F. Provide "specimen" plants with height, shape and character of growth. Tag specimen trees or shrubs at the source of supply. The Engineer will inspect specimen selections at the source of supply for suitability and adaptability to selected location. When specimen plants cannot be purchased locally, provide sufficient photographs of the proposed specimen plants for approval.
- G. Plants may be inspected and approved at the place of growth, for compliance with specification requirements for quality, size, and variety. Such approval shall not impair the right of inspection and rejection upon delivery at the site or during the progress of the work.
- H. Contractor shall provide and pay for material testing. Testing agency shall be acceptable to the Engineer. Provide the following data:
 - 1. Test representative material samples proposed for use.
 - 2. Topsoil:
 - a. pH factor.
 - b. Mechanical analysis.
 - c. Percentage of organic content.
 - d. Recommendations on type and quantity of additives required to establish satisfactory pH factor and supply of nutrients to bring nutrients to satisfactory level for planting.
 - 3. Peat Moss:
 - a. Loss of weight by ignition.
 - b. Moisture absorption capacity.

1.03 SUBMITTALS

- A. Submittals shall be made in accordance with the requirements of the General Conditions of the Contract Documents. In addition, the following specific information shall be provided:
 - 1. Mulch samples.
 - 2. Planting accessories samples.
 - 3. Certification for topsoil source and pH value; peat moss and plant fertilizer.

4. Material test reports.
5. Upon plant material acceptance, submit written instructions recommending procedures for maintenance of plant materials.

B. (Not Used)

1.04 DELIVERY, STORAGE AND HANDLING

- A. Deliver fertilizer materials in original, unopened, and undamaged containers showing weight, analysis, and name of manufacturer. Store materials in a manner to prevent wetting and deterioration.
- B. Take all precautions customary in good trade practice in preparing plants for moving. Workmanship that fails to meet the highest standards will be rejected. Spray deciduous plants in foliage with an approved "Anti-Desiccant" immediately after digging to prevent dehydration. Dig, pack, transport, and handle plants with care to ensure protection against injury. Inspection certificates required by law shall accompany each shipment invoice or order to stock and on arrival, the certificate shall be submitted to the Engineer.
- C. Protect all plants from drying out. If plants cannot be planted immediately upon delivery, properly protect them with soil, wet peat moss, or in a manner acceptable to the Engineer. Water heeled-in plantings daily. No plant shall be bound with rope or wire in a manner that could damage or break the branches.
- D. Cover plants transported on open vehicles with a protective covering to prevent wind burn.
- E. Provide dry, loose topsoil for planting bed mixes. Frozen or muddy topsoil is not acceptable.

1.05 PROJECT CONDITIONS

- A. Notify Engineer at least 7 working days prior to installation of plant material.
- B. Protect existing utilities, paving, and other facilities from damage caused by landscaping operations.
- C. Locate and protect existing irrigation system(s) during planting operations. Repair irrigation system components, damaged during planting operations, at Contractor's expense.

1.06 WARRANTY

- A. Warrant plant material to remain alive and be in healthy condition for a period of 1 year after planting and acceptance. Inspection of plants will be made by the Engineer at completion of planting.
- B. Replace, in accordance with these specifications, all plants that are dead or, as determined by the Engineer, are in an unhealthy or unsightly condition, and have lost their natural shape due to dead branches, or other causes due to the Contractor's negligence. The cost of such replacement is at Contractor's expense. Warrant all replacement plants for 1 year after installation.
- C. Warranty shall not include damage or loss of trees, plants, or ground covers caused by fires, floods, freezing rains, lightning storms, or winds over 75 miles per hour, winter kill caused by extreme cold and severe winter conditions not typical of planting area; acts of vandalism or negligence on the part of the Owner.
- D. Remove and immediately replace all plants, as determined by the Engineer to be unsatisfactory during the initial planting installation.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Plants: Provide plants typical of their species or variety; with normal, densely-developed branches and vigorous, fibrous root systems. Provide only sound, healthy, vigorous plants free from defects, disfiguring knots, sunscald injuries, frost cracks, abrasions of the bark, plant diseases, insect eggs, borers, and all forms of infestation. All plants shall have a fully developed form without voids and open spaces. Plants held in storage will be rejected if they show signs of growth during storage.
 - 1. Dig balled and burlapped plants with firm, natural balls of earth of sufficient diameter and depth to encompass the fibrous and feeding root system necessary for full recovery of the plant. Provide ball sizes complying with the latest edition of the "American Standard for Nursery Stock". Cracked or mushroomed balls are not acceptable.
 - 2. Container-grown stock: Grown in a container for sufficient length of time for the root system to have developed to hold its soil together, firm and whole.
 - a. No plants shall be loose in the container.
 - b. Container stock shall not be pot bound.

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3. Provide new tree species to match existing tree species. New species shall be provided with a single main trunk. Trees that have the main trunk forming a "Y" shape are not acceptable.
4. Plants planted in rows shall be matched in form.
5. Plants larger than those existing may be used when acceptable to the Engineer. If the use of larger plants is acceptable, increase the spread of roots or root ball in proportion to the size of the plant.
6. No pruning wounds shall be present with a diameter of more than 1-inch and such wounds must show vigorous bark on all edges.
7. Shrubs and small plants shall meet the requirements for spread as follows:
 - a. The measurements for height shall be taken from the ground level to the height of the top of the plant and not the longest branch.
 - b. Single stemmed or thin plants will not be accepted.
 - c. Side branches shall be generous, well-twigged, and the plant as a whole well-bushed to the ground.
 - d. Plants shall be in a moist, vigorous condition, free from dead wood, bruises or other root or branch injuries.

B. (Not Used)

2.02 ACCESSORIES

- A. Topsoil for Planting Beds and Tree Pits: Fertile, friable, natural topsoil of loamy character, without admixture of subsoil material, obtained from a well-drained arable site, reasonably free from clay, lumps, coarse sands, stones, plants, roots, sticks, and other foreign materials, with acidity range of between pH 6.0 and 6.8.
 1. Topsoil that has been stripped and stockpiled on site shall be the topsoil to be utilized on this project. Provide additional topsoil if necessary.
 2. Provide topsoil free of substances harmful to the plants which will be grown in the soil. Provide 12-inches of topsoil in all plant beds and tree pits.
- B. Planting mixture shall be composed of four (4) parts topsoil, two (2) parts peat moss, one (1) part sand and one (1) part well-rotted manure, mixed together thoroughly, and worked into existing soil.
- C. Peat Moss: Brown to black in color, weed and seed free granulated raw peat or baled peat, containing not more than 9% mineral on a dry basis. Provide ASTM D2607 sphagnum peat moss with a pH below 6.0 for ericaceous plants.

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D. Fertilizer:

1. Plant Fertilizer Type "A": Commercial type approved by the Engineer, containing 5% nitrogen, 10% phosphoric acid, and 5% potash by weight, 1/4 of nitrogen in the form of nitrates, 1/4 in form of ammonia salt and 1/2 in form of organic nitrogen.
2. Plant Fertilizer Type "B": Approved acid-base fertilizer.

E. Anti-Desiccant: Protective film emulsion providing a protective film over plant surfaces; permeable to permit transpiration. Mixed and applied in accordance with manufacturer's instructions.

1. Premium grade shredded pine bark $\frac{3}{4}$ -inch to 1-1/2-inch diameter. Furnish in 3 cubic feet bags or bulk.

F. Water: Free of substances harmful to plant growth. Hoses or other methods of transportation shall be furnished by the Contractor.

G. Stakes for Staking: Hardwood, 2-inch x 2-inch x 8-feet long.

H. Stakes for Guying: Hardwood, 2-inch x 2-inch x 36-inches long.

I. Guying/Staking/Wire: No. 10 or 12, gage galvanized wire.

1. For large trees (4-inch caliper and greater) use turnbuckles and heavier gage wire as indicated below
 - a. Stakes for Staking: Hardwood, 4-inches x 4-inches x 8-feet long.
 - b. Guying/Staking/Wire: No. 6 or 8 gage galvanized wire.
2. Turnbuckles: Galvanized steel of size and gage required to provide tensile strength equal to that of the wire. Turnbuckle openings shall be at least 3-inches.

J. Staking and Guying Hose: Two ply, reinforced garden hose not less than $\frac{1}{2}$ -inch inside diameter.

K. Tree Wrap: Standard waterproofed tree wrapping paper, 2-1/2-inches wide, made of 2 layers of crepe kraft paper weighing not less than 30 lbs. per ream, cemented together with asphalt. Tree wrap shall be removed at 12 months after installation of plant material.

L. Twine: Two-ply jute material.

M. Soil Separator: Rot resistant polypropylene filter fabric, water permeable, and unaffected by freezing and thawing.

- N. Drainage Tile: ASTM F405 corrugated polyethylene drainage tubing, perforated.
- O. Drainage Fill: AASHTO M43 #6 (3/8-inch to 3/4-inch) clean uniformly graded stone or gravel.

PART 3 EXECUTION

3.01 INSPECTION

- A. Examine proposed planting areas and conditions of installation. Do not start planting work until unsatisfactory conditions are corrected.
- B. (Not Used)

3.02 CARE OF TREES TO REMAIN

- A. Minor fills of 6-inches or less: Fill with topsoil; hand grade to required finish grade elevation.
- B. Moderate fills of 12-inches or less: Place layer of 3/4-inch to 1-1/2-inch stone or gravel on grade. Provide aggregate depth 1/2 of fill height, minimum of 3-inches. Cover drainage fill with polypropylene filter fabric or 1" thickness straw choke. Fill remaining depth with loose topsoil; hand grade to required finish grade elevations.
- C. Deep fills over 12-inches: Place layer of 3/4-inch to 1-1/2-inch stone or gravel on grade. Extend drainage fill to within 2-inch of required finish grade. Cover drainage fill with polypropylene filter fabric or 1-inch thickness straw choke. Fill remaining depth with loose topsoil; hand grade to required finish grade elevation. Provide tile drainage system and vents as indicated.
- D. Deep fills over 18-inches: Place 4-inch depth of 1-inch to 2-inches stone or gravel fill on grade, extending three (3) feet beyond the outer branch drip line around tree branch perimeter. Cover drainage fill with polypropylene filter fabric or 1-inch thickness straw choke. Place 1-inch to 2-inches stone or gravel fill around tree trunk, extending to within 2-inches of required finish grade elevation. Fill remaining depth with loose topsoil; hand grade to required finish grade elevation. Do not place earth fill in contact with tree trunk, maintain 18-inches diameter of drainage fill exposed at finish grade.

3.03 PREPARATION

- A. Time of Planting:

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1. Evergreen Material: Plant evergreen materials between September 1 and November 1 or in spring before new growth begins. If project requirements require planting at other times, plants shall be sprayed with anti-desiccant prior to planting operations.
 2. Deciduous Material: Plant deciduous materials in a dormant condition. If deciduous trees are planted in-leaf, they shall be sprayed with an anti-desiccant prior to planting operation.
 3. Planting times other than those indicated shall be acceptable to the Engineer.
- B. Planting shall be performed only by experienced workmen familiar with planting procedures under the supervision of a qualified supervisor.
- C. Locate plants as indicated or as approved in the field after staking by the Contractor. If obstructions are encountered that are not shown on the drawings, do not proceed with planting operations until alternate plant locations have been selected.
- D. Excavate circular plant pits with vertical sides, except for plants specifically indicated to be planted in beds. Provide shrub pits at least 12-inches greater than the diameter of the root system and 24-inches greater for trees. Depth of pit shall accommodate the root system. Provide undisturbed tamped down topsoil to hold root ball at nursery grade as shown on the drawings. Remove excavated materials from the site.
- E. Provide pre-mixed planting mixture for use around the balls and roots of the plants consisting of planting topsoil and 1/2 lb. plant fertilizer Type "A" for each cu. yd. of mixture.
- F. Provide pre-mixed ground cover bed planting mixture consisting of 3 parts planting topsoil to 1 part peat moss and 1/2 lb. plant fertilizer Type "A" per cu. yd. Provide beds a minimum of 12-inches deep. If slopes are greater than 4 to 1 increase depth to 18-inches.
- G. Provide pre-mixed planting mixture for use around the balls and roots of ericaceous plants consisting of 2 part planting topsoil to 1 part sphagnum peat moss and 1/2 lb. plant fertilizer Type "B" per cu. yd. of mixture.

3.04 INSTALLATION

- A. Set plant material in the planting pit to proper grade and alignment. Set plants upright, plumb, and faced to give the best appearance or relationship to each other or adjacent structure. Set plant material 2-inches to 3-inches above the finish grade. No filling will be permitted around trunks or stems. Backfill the pit with planting mixture. Do not use frozen or muddy mixtures for backfilling. Form a ring of soil around the edge of each planting pit to retain water.

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- B. After balled and burlapped plants are set, muddle planting soil mixture around bases of balls and fill all voids. Remove all burlap, ropes, and wires from the tops of balls of trees and remove entirely from all other plant material.
- C. Space ground cover plants in accordance with indicated dimensions. Adjust spacing as necessary to evenly fill planting bed with indicated quantity of plants. Plant to within 12-inches of the trunks of trees and shrubs within planting bed and to within 6-inches of edge of bed.
- D. Drain tile: The Contractor shall provide drainage tiles if he encounters standing water in planting pits or conditions warrant. Install drainage tile with perforations down and closed joints, firmly bedded in minimum 4-inch layer of granular fill material. Provide full bearing for each pipe section. Provide continuous slope in the direction of flow.
 - 1. Provide collars and couplings for all in-line joints and elbows for all corners and changes in direction.
 - 2. Provide unperforated run out pipe. Extend drainage tile to out fall indicated and make connection.
 - 3. Obtain required inspections and perform testing before backfilling. Remove obstructions, replace damaged components, and retest system as required. Provide a satisfactory free flowing drainage tile system.
 - 4. Place drainage fill over drain piping after satisfactory testing and acceptance. Compact drainage fill layers not exceeding 6" in loose depth. Exercise care to avoid damage or displacement of installed piping.
 - a. Completely cover drain lines to width of at least 6-inches each side of pipe and above top of pipe to within 18-inches of finish grade.
 - b. Provide soil separator over drainage fill prior to topsoil fill. Overlap a minimum of 6-inches.
 - 5. Install topsoil fill over compacted drainage fill. Compact topsoil fill in layers not exceeding 6-inches in loose depth. Extend topsoil fill to indicated finish or existing grade elevations.
- E. Mulching:
 - 1. Mulch tree and shrub planting pits and shrub beds with required mulching material 3-inches deep immediately after planting. Thoroughly water mulched areas. After watering, rake mulch to provide a uniform finished surface.
 - 2. Mulch ground cover beds with mulch 2-inches deep immediately after planting.

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F. Wrapping, Guying and Staking:

1. Inspect trees for injury to trunks, evidence of insect infestation, and improper pruning before wrapping.
2. Wrap trunks of all trees spirally from bottom to top with specified tree wrap and secure in place.
 - a. Overlap 1/2 the width of the tree wrap strip and cover the trunk from the ground to the height of the second branch.
 - b. Secure tree wrap in place with twine wound spirally downward in opposite direction, tied around the tree in at least 3 places in addition to the top and bottom. Wrapping and twine to be removed 12 months after installation of plant material.
3. Staking/Guying:
 - a. Stake/guy all trees immediately after lawn seeding or sodding operations and prior to acceptance. When high winds or other conditions which may affect tree survival or appearance occur, the Engineer may require immediate staking/guying.
 - b. Stake deciduous trees under 3-inches in caliper. Stake evergreen trees under 8-foot tall.
 - c. Guy deciduous trees over 3-inches in caliper. Guy evergreen trees over 8-foot tall.
4. All work shall be acceptable to the Engineer.

G. Pruning:

1. Prune branches of deciduous stock, after planting, to balance the loss of roots and preserve the natural character appropriate to the particular plant requirements. In general, remove 1/4 to 1/3 of the leaf bearing buds, proportion shall in all cases be acceptable to the Engineer. Remove or cut back broken, damaged, and unsymmetrical growth of new wood.
2. Multiple leader plants: Preserve the leader which will best promote the symmetry of the plant. Cut branches flush with the trunk or main branch, at a point beyond a lateral shoot or bud at a distance of not less than 1/2 the diameter of the supporting branch. Make cut on an angle.
3. Prune evergreens only to remove broken or damaged branches.

H. Care of Existing Trees:

1. Selectively prune existing trees in designated areas, under Engineer's direction. Remove sucker shoots, dead, rubbing, and damaged branching.

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2. Fertilize designated existing trees with 2 to 3 lbs. of Type "A" plant fertilizer per inch of trunk diameter, for trees less than 6-inches in diameter and 3 to 5 lbs. for trees greater than 6-inches in diameter.
 - a. Fertilize in early spring before growth begins or in late October.
 - b. Fertilize at 2-feet to 3-feet on center in a triangular pattern to a depth of 18-inches within the dripline.
 - c. Injection or drilling fertilization methods, when used, shall be acceptable subject to Engineer's approval.
 3. Water existing trees every 2 weeks until acceptance. Water thoroughly with a fine mist sprinkler head soaker hose or hose at a low flow rate over the entire drip line area as required to allow water to penetrate to a depth of 12-inches to 18-inches.
- I. Tree Relocation:
1. Transplant trees designated for relocation to locations shown on the drawings. Prune, dig, ball and burlap, move and plant in accordance with specified tree planting requirements.

3.05 MAINTENANCE

- A. Maintain plantings until completion and acceptance of the entire project.
- B. Maintenance shall include pruning, cultivating, weeding, watering, and application of appropriate insecticides and fungicides necessary to maintain plants free of insects and disease.
1. Re-set settled plants to proper grade and position. Restore planting saucer and adjacent material and remove dead material.
 2. Tighten and repair guy wires and stakes as required.
 3. Remove tree wrapping and twine 12 months after installation of plant material.
 4. Correct defective work as soon as possible after deficiencies become apparent and weather and season permit.
 5. Water trees, plants, and ground cover beds within the first 24 hours of initial planting, and not less than twice per week until final acceptance.

3.06 ACCEPTANCE

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- A. Inspection to determine acceptance of planted areas will be made by the Engineer, upon Contractor's request. Provide notification at least 10 working days before requested inspection date. Planted areas will be accepted provided all requirements, including maintenance, have been complied with and plant materials are alive and in a healthy, vigorous condition.
- B. Upon acceptance, the Owner will assume plant maintenance.

3.07 CLEANING

- A. Perform cleaning during installation of the work and upon completion of the work. Remove from site all excess materials, soils, debris, and equipment. Repair damage resulting from planting operations.
- B. (Not Used)

+++ END OF SECTION 02900 +++

**SECTION 02920
SITE RESTORATION**

PART 1 GENERAL

1.01 SCOPE

- A. The Contractor shall provide all, labor, materials, equipment and incidentals required for all site restoration and related operations necessary shown on the Drawings or specified in these Specifications.
- B. Restoration activities shall be sufficient to facilitate final site grading, surface restoration, underground piping, structural concreting for buildings and foundations, and other Work necessary to establish the finished site. The site shall left be free of ruts, clean, and stabilized. Sediment basins shall be cleaned to the bottom elevations of the initial construction.
- B. This section includes disposition of materials and structures encountered in the Work, all cleanup and any other similar, incidental, or appurtenant operations which may be necessary to properly complete the Work.

1.02 SUBMITTALS

- A. Submittals shall be made in accordance with the requirements of the General Conditions of the Contract Documents. In addition, the following specific information shall be provided:
 - 1. The Contractor shall submit certificates of inspection as required by government authorities. The Contractor shall submit other data substantiating that materials comply with specified requirements.
 - 2. The Contractor shall submit instructions recommending procedures to be established by the City for maintenance of site restoration work for one (1) full year.

B. (Not Used)

1.03 QUALITY ASSURANCE (Not Used)

1.04 SAFETY REQUIREMENTS

- A. Hazards Control:
 - 1. The Contractor shall store volatile wastes in covered metal containers, and remove from the site of the Work daily.

2. The Contractor shall prevent accumulation of wastes that create hazardous conditions.
 3. The Contractor shall provide adequate ventilation during use of volatile or noxious substances.
- B. The Contractor shall conduct cleaning and disposal operations in compliance with local ordinances and environmental laws and regulations.
1. The Contractor shall not burn or bury rubbish and waste materials on the site of the Work without prior written permission from the Engineer.
 2. The Contractor shall not dispose of volatile wastes such as mineral spirits, oil, or fuel in open drainage ditches or storm or sanitary drains.

1.05 DELIVERY (Not Used)

PART 2 PRODUCTS

(NOT USED)

PART 3 EXECUTION

3.01 DISPOSITION OF MATERIALS AND STRUCTURES ENCOUNTERED IN THE WORK

- A. Existing materials or structures that may be encountered (within the lines, grades, or trenching sections established for completion of the Work), if unsuitable or unacceptable to the Engineer for use in the Work, and for which the disposition is not otherwise specified, shall either be disposed of by the Contractor or shall remain the property of the City as further provided in this section.
- B. At the option of the City, any existing materials or structures of "value" encountered in the Work shall remain the property of the City. The term "value" shall be defined by the City.
- C. Any existing materials or structures encountered in the Work, and determined not to be of "value" by the City, shall be disposed of by the Contractor, in an approved manner.

3.02 JOB CONDITIONS

- A. The Contractor shall determine the locations of underground utilities and perform Work in a manner which will avoid possible damage. The Contractor shall hand excavate, as required. The Contractor shall maintain grade stakes set by others until removal is mutually agreed upon by parties concerned.

- B. All bare earth areas within the limit of work shall be grassed, mulched, or covered with other plant material as shown on the Drawings.
- C. On a continuous basis, the Contractor shall maintain the site of the Work free from accumulations of waste, debris, and rubbish caused by his operations.
- D. At completion of the Work, the Contractor shall remove waste materials, rubbish, tools, equipment, machinery, and surplus materials, and clean all sight-exposed surfaces. The Contractor shall leave the site of the Work clean and ready for occupancy or use.
- E. The Contractor shall proceed with the complete site restoration work as rapidly as portions of the site of the Work become available, working within seasonal limitations for each kind of site restoration work required. The Contractor will not be allowed to postpone cleanup and seeding or sodding until the end of the Work.
- F. When conditions detrimental to plant growth are encountered, such as rubble fill, adverse drainage conditions, or obstructions, the Contractor shall notify the Engineer before planting.
- G. The Contractor shall install materials during normal planting seasons for each type of site restoration work.
- H. The Contractor may, at his option, employ additional measures (other than those specified) to prevent loss of, or damage to the Work resulting from the effects of wind and/or water. No additional compensation will be made for the employment of such additional measures.

3.03 CLEANUP

- A. During site restoration work, the Contractor shall keep pavements clean and the site of the Work in an orderly condition.
- B. The Contractor shall protect site restoration work and materials from damage due to site restoration operations, operations by other contractors, and trades and trespassers. The Contractor shall maintain protection during installation and maintenance periods. The Contractor shall treat, repair, or replace damaged site restoration work as directed by the Engineer.
- C. Immediately upon completion of any section of the Work and before payment therefore has been made, the Contractor shall remove from the site of the Work all construction equipment, temporary structures, and debris, and shall restore the site of the Work to a condition equal to or better than that which existed prior to construction. Waste materials shall be disposed of at locations satisfactory to the City or affected regulatory agencies.

- D. The Contractor shall not remove barricades and warning and direction signs until directed by the Engineer.
- E. After completion of all Work required by the Contract and before final payment has been made, the Contractor shall make a final cleanup of each separate part of the Work; shall restore all surfaces to a neat and orderly condition; and shall remove all construction equipment, tools, and supplies. Clean out sediment control basins to an elevation one foot below the elevations shown on the Drawings.

3.04 INSPECTION AND ACCEPTANCE

- A. When site restoration work is completed, including maintenance, the Engineer will, upon request, make an inspection to determine acceptability.
- B. Where inspected site restoration work does not comply with the requirements of the Engineer, the Contractor shall replace rejected work and continue specified maintenance until re-inspected by the Engineer and found to be acceptable. The Contractor shall remove rejected plants and materials promptly from the site of the Work.

+++ END OF SECTION 02920 +++

**SECTION 02933
SEEDING AND SODDING**

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. 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. Areas disturbed by borrow activities shall also be seeded according to these Specifications.
- C. The Work shall also include temporary seeding operations to stabilize earthen surfaces during construction or inclement weather and to minimize stream siltation and erosion. Temporary seeding shall be performed at the times and locations as directed by the Engineer.

1.02 SUBMITTALS

- A. Submittals shall be made in accordance with the requirements of the General Conditions of the Contract Documents. In addition, the following information shall be submitted:
 - 1. Prior to seeding operations, 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. 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.
 - 2. Prior to topsoil operations, the Contractor shall obtain representative samples and furnish soil test certificates including textural, pH, and organic ignition analysis from the State University Agricultural Extension Services or other certified testing laboratory.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Wood cellulose fiber mulch shall be manufactured by Weyerhaeuser Company or Conway Corporation.

2.02 MATERIALS AND CONSTRUCTION

A. Topsoil

1. Utilizing designated stockpiles or borrow areas on site, the Contractor shall place a minimum of 6-inches of topsoil over all graded earthen areas and over any other areas to be seeded. Sources of topsoil shall be approved by the Engineer prior to disturbance.
2. 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. 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.
3. 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. Topsoil shall contain not less than 5 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.

B. Seed

1. Seed shall be hulled common Bermuda (Cynodon Dactylon) guaranteed by the dealer to be 98% minimum purity and 90% minimum germination and certified free of giant strain Bermuda.
2. 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.
3. All seed shall be from the last crop available at time of purchase and shall not be moldy, wet or otherwise damaged in transit or storage.
4. Seed shall bear the growers analysis testing to 98 percent for purity and 90 percent for germination. At the discretion of the Engineer, samples of seed may be taken for check against the grower's analysis.
5. Species, rate of seeding, fertilization and other requirements are shown in Table 02933-1 at the end of this Section.

C. Fertilizer and Liming Materials

1. Fertilizer and liming materials shall comply with applicable state, local and

federal laws concerned with their production and use.

2. Commercial fertilizer shall be a ready mixed material and shall be equivalent to the grade or grades specified in Table 02933-1. Container bags shall have the name and address of the manufacturer, the brand name, net weight and chemical composition.
3. Agricultural limestone shall be a pulverized limestone having a calcium carbonate content of not less than 85 percent by weight.
4. Fertilizer shall be a complete fertilizer, the content of which shall meet the following minimum requirements: 10% nitrogen, 10% phosphoric acid, 10% potash, available materials. Fertilizer shall be uniform in composition, dry and free flowing, and shall be delivered to the site in original unopened containers bearing the manufacturer's statement of guarantee.
5. Ammonium Nitrate shall be a standard brand and shall be delivered to the site in original unopened containers. It shall contain not less than 33-1/3% Nitrogen.

D. Mulch Material

1. All mulch materials shall be air dried and reasonably free of noxious weeds and weed seeds or other materials detrimental to plant growth.
2. 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.
3. Straw mulch shall be partially decomposed stalks of wheat, rye, oats or other approved grain crops.
4. Stalks shall be the partially decomposed, shredded residue of corn, cane, sorghum or other approved standing field crops.

E. Mulch Binder

1. 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 non-toxic to plant life and shall be acceptable to the Engineer.
2. Emulsified asphalt binder shall be Grade SS-1, ASTM D977. Cutback asphalt binder shall be Grade RC 70 or RC 250.

- F. Inoculants for Legumes: All leguminous seed shall be inoculated prior to seeding with a standard culture of nitrogen fixing bacteria that is adapted to the particular seed involved.

- G. Water: Water shall be clean, clear water free from any objectionable or harmful chemical qualities or organisms and shall be furnished by the Contractor.
- H. Sod
1. Sod shall be living, growing sod of Bermuda hybrids "Tifway 419" or Tifgreen 328". This includes sod which is dormant during the cold or dry season and capable of renewing growth after the dormant period. All sod shall be obtained from approved sources. The presence of weeds or other noxious growth or any other foreign material which may be detrimental to the proposed planting will be cause of rejection. At least 85% of the plants in the sod shall be composed of the designated variety of Bermuda grass.
 2. The Engineer shall be notified of sources before it is harvested. Approval of such sources shall not be construed as an acceptance of the material. The sod will be subject to inspection while it is being planted and any material which has been permitted to dry out excessively or exposed to extreme heat, or which is not viable, will be rejected.
 3. In the harvesting of the sod, grass more than 3-inches tall shall be mowed to a height of 3-inches, raked and removed before sod cutting begins. The sod shall be cut into square or rectangular sections which may vary in length, but which shall be of uniform width and thickness, and shall have at least ½-inch of soil adhering firmly to the roots. Care shall be exercised at all times to retain the soil on the roots of the sod during the process of cutting, transporting and planting. Sod shall be transplanted within 24 hours from the time it is harvested. All sod stored shall be kept moist, shall be protected from exposure to the air and sun and from freezing, and shall not be stored for more than 10 days. Sod shall be cut and moved only when the soil moisture conditions are such that favorable results can be expected.

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 Engineer.
- 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,

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stones, lime, 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 Engineer, 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 Engineer.
- 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 liming, 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. Not 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 2-inches with a weighted disc, tiller, pulvimixer or other equipment, until the surface is smooth and in a condition acceptable to the Engineer.
- C. If the prepared surface becomes eroded as a result of rain or for any other reason, or becomes crusted before the seed is sown, the surface shall again be cultivated for seeding.
- D. Ground preparation operations shall be performed only when the ground is in a tillable and workable condition, as determined by the Engineer.

3.03 FERTILIZATION AND LIMING

- A. Following seedbed preparation, fertilizer shall be applied to all areas to be seeded so as to achieve the application rates shown in Table 02933-1 at the end of this Section.
- B. Fertilizer shall be spread evenly over the seedbed and shall be lightly harrowed, raked, or otherwise incorporated into the soil for a depth of 1/2-inch.
- C. Fertilizer need not be incorporated in the soil as specified above when mixed with seed in water and applied with power sprayer equipment. The seed shall not remain in water containing fertilizer for more than 30 minutes when a hydraulic seeder is used.
- D. Agricultural limestone shall be thoroughly mixed into the soil according to the rates in

Table 02933-1. The specified rate of application of limestone may be reduced by the Engineer if pH tests indicate this to be desirable. It is the responsibility of the Contractor to obtain such tests and submit the results to the Engineer for adjustment in rates.

- E. It is the responsibility of the Contractor to make one application of a maintenance fertilizer according to the recommendations listed in Table 02933-1.
- F. On the approved grade, spread 20 lbs. per 1,000 sq. ft. of 10-10-10 fertilizer into top 3-inches, hand rake and smooth. The surface shall be brought to finish grade requirements, allowance being made for settlement. Finish grades shall be smooth and free from hollows or other inequalities.
- G. Three weeks after construction of lawns add ammonium nitrate at the rate of 5 lbs. per 1000 sq. ft. of lawn area, and thoroughly water in.

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. Seeding shall be performed during the dates shown in Table 02933-1 unless otherwise approved by the Engineer. Seed mixtures may be sown together provided they are kept in a thoroughly mixed condition during the seeding operation.
- B. Seed shall be uniformly sown by any approved mechanical method suitable for the slope and size of the areas to be seeded, preferably with a broadcast type seeder, windmill hand seeder or approved mechanical power drawn seed drills. Hydro-seeding and hydro-mulching may be used on steep embankments, provided full coverage is obtained. Care shall be taken to adjust the seeder for seedings 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.
- C. Immediately after sowing, the seeds shall be covered and compacted to a depth of 1/8 to 3/8-inch by a cultipacker or suitable roller.
- D. Leguminous seeds shall be inoculated prior to seeding with an approved and compatible nitrogen-fixing inoculant in accordance with the manufacturer's mixing instructions.
- E. Italian rye grass (*Lolium Multiflorum*) shall be evenly seeded with a mechanical spreader at the rate of 5 lbs. per 1000 sq. ft. of area, lightly rake, suitably compact and thoroughly water. Before planting the permanent lawn, the rye shall be thoroughly scarified in a manner to incorporate it into the top three inches of the ground.

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- F. The planting of bermuda grass shall be done only within the season extending from April 15 to August 1.

3.05 MULCHING

- A. All seeded areas shall be uniformly mulched in a continuous blanket immediately after seeding. The mulch shall be applied so as to permit some sunlight to penetrate and the air to circulate and at the same time shade the ground, reduce erosion and conserve soil moisture. Approximately 25 percent of the ground shall be visible through the mulch blanket.
- B. One of the following mulches shall be spread evenly over the seeded areas at the following application rates:

Wood Cellulose Fiber	1,400 pounds/acre
Straw	4,000 pounds/acre
Stalks	4,000 pounds/acre

- C. These rates may be adjusted at the discretion of the Engineer at no additional cost to the Owner, depending on the texture and condition of the mulch material and the characteristics of the seeded area.
- D. The Contractor shall cover structures, poles, fence and appurtenances if the mulch binder is applied in such a way that it would come in contact with or discolor the structures.
- E. Mulch and binder shall be applied by suitable blowing equipment at closely controlled application rates in a manner acceptable to the Engineer.

3.06 WATERING

- A. The Contractor shall be responsible for maintaining the proper moisture content of the soil to insure adequate plant growth until a satisfactory stand is obtained. If necessary, watering shall be performed to maintain adequate water content in the soil.
- B. Watering shall be accomplished by hoses, tank truck or sprinklers in such a way to prevent erosion, excessive runoff and overwatered 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

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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 the Contractor's own expense. Seeding work shall be repeated on defective areas until a satisfactory uniform stand is accomplished. Damage resulting from erosion, gulleys, washouts or other causes shall be repaired by filling with topsoil, compacting and repeating the seeding work at the Contractor's expense.
- C. Contractor's guarantee of one (1) year shall also cover a fully rooted stand of grass.

TABLE 02933-1

SEEDING REQUIREMENTS

Area	Sowing Season	Species	Seed	Rates per 1,000 Square Feet		
				Fertilizer	Limestone	Maintenance**
Flat to rolling terrain with slopes less than 3:1	3/1 to 4/15	Rebel II Turf-Type Tall Fescue	6-8 lbs.	30 lbs. 6-12-12	200 lbs.	10 lbs. 10-10-10
	9/1 to 11/15	Rebel II Turf-Type Tall Fescue	6-8 lbs.	30 lbs. 6-12-12	200 lbs.	15 lbs. 10-10-10
Embankments with slopes greater than 3:1	3/1 to 6/1	Crownvetch* Kentucky 31 Fescue Weeping Lovegrass	1 lb. 2 lbs. 1/4 lb.	30 lbs. 6-12-12	200 lbs.	10 lbs. 0-20-20
	8/1 to 11/1	Crownvetch* Kentucky 31 Fescue Annual Ryegrass	1 lb. 2 lb. 2 lb.	30 lbs. 6-12-12	200 lbs.	10 lbs. 0-20-20

* Requires inoculation

** Maintenance fertilizer shall be applied in early spring following initial establishment of cover

+++ END OF SECTION 02933 +++

**SECTION 03100
CONCRETE FORMWORK**

PART 1 - GENERAL

1.01 SCOPE

A. Furnish and install the concrete formwork as required by the concrete outlines shown and indicated on the Drawings and specified in this Section. The use of stay in place forms is expressly prohibited.

B. Coordination:

1. Notify other contractors or subcontractors in advance of the trades of the formwork to provide the other trades with sufficient time for the installation of items included in their contracts that must be installed with the formwork.

C. Form Design:

1. Formwork shall comply with ANSI A10.9 and OSHA Construction Standards, Part 1926, Subpart Q, Concrete, Concrete Forms, and Shoring. In addition, the form designs shall meet the requirements of ACI 347.

1.02 SUBMITTALS

A. Submit for approval copies of manufacturer's data and installation instructions for proprietary materials, including form coatings and releasing agents, manufactured form systems, ties and accessories.

B. Do not provide submittals for the structural design of forms.

1.03 QUALITY ASSURANCE

A. Design and construct forms to withstand stresses due to weight of fresh concrete, vibration during consolidation and loads of equipment and workmen. Comply with ACI 318.

B. Allowable Tolerances:

1. Construct formwork to provide completed concrete surfaces complying with tolerances specified in ACI 347.

2. Maximum acceptable deflection is 1/8" in 5'-0" on all flat surfaces (ACI 347 Class A Finish).
- C. Notify the Engineer a minimum of 48 hours before closure of forms that would hinder the subsequent inspection to enable the Engineer to inspect the work.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. On delivery to jobsite, place materials in area protected from weather.
- B. Store materials above ground on framework or blocking. Cover wood for forms with protective waterproof covering. Provide for adequate air circulation or ventilation.
- C. Handle materials to prevent damage.

PART 2 - PRODUCTS

2.01 FORM MATERIALS

- A. Forms for Exposed Finish Concrete: (Smooth Finish)
1. Unless otherwise shown or specified, construct formwork for concrete surfaces exposed to view in the finished structure, with plywood, metal, metal-framed plywood-faced or other panel type materials acceptable to Engineer, to provide continuous, straight, smooth as-cast surfaces.
 2. Furnish in largest practical sizes to minimize number of joints and to conform to joint system shown or specified. Provide form material with sufficient thickness to withstand pressure of newly placed concrete without bow or deflection.
- B. Forms for Unexposed Finish Concrete: (Rough Finish)
1. Form concrete surfaces that will be unexposed in the finished structure with plywood, lumber, metal, or other acceptable material. Provide lumber that is dressed on at least 2 edges and 1 side.
- C. Forms for tunnel and shaft linings shall be steel: Refer to Section 02425.

D. Form Ties:

1. Provide factory-fabricated, removable or snap off metal form ties designed to resist lateral pressure of fresh concrete on forms, to prevent form deflection, and to prevent spalling of concrete surfaces upon removal. Materials used for tying Forms will be subject to approval of the Engineer.
2. Unless otherwise shown, provide ties so that portion remaining within concrete after removal of exterior parts is at least 1 1/2 inches from the outer concrete surface. Unless otherwise shown, provide form ties that will leave a hole no larger than 1-inch diameter in the concrete surface.
3. Ties for exterior walls and walls subject to hydrostatic pressure shall have water stops that are integral with the tie, preferably a solid washer at mid-point of the tie.
4. Provide wood or plastic cones for ties, where concrete is exposed in the finished structure.

E. Forms Coatings:

1. Provide commercial formulation form-coating compounds that will not bond with, stain, nor adversely affect concrete surfaces and will not impair subsequent treatment of concrete surfaces requiring bond or adhesion, nor impede the wetting of surfaces to be cured with water or curing compounds.

PART 3 - EXECUTION

3.01 DESIGN OF FORMWORK

A. Formwork shall be in accordance with ACI 347 and as follows:

1. Design, erect, support, brace and maintain formwork so that it shall safely support vertical, lateral, static and dynamic loads that might be applied, until such loads can be supported by the concrete structure. Carry vertical and lateral loads to ground by formwork system or in-place construction that has attained adequate strength for this purpose. Construct formwork so that concrete members and structures are of correct size, shape, alignment, elevation and position.
2. Design forms and falsework to include full allowance for all of live loads, dead loads, weight of moving equipment operated on formwork, concrete mix, height of concrete drop, vibrator frequency, ambient temperature, foundation pressures, stresses, lateral stability, and other factors pertinent to safety of structure during construction.

3. Forms shall conform to shape, lines and dimensions of members indicated and shall be sufficiently rigid and tight to prevent leakage of mortar. Forms shall be properly braced or tied together so as to maintain position and shape. Construct forms so that they can be removed readily without hammering or prying against the concrete. Forms shall be carefully made and accurately placed to obtain correct shape and lines.
4. Joints shall be butted tight. Arrangements of panels shall be orderly and symmetrical, and use of small pieces shall be avoided. Forms shall be chamfered 1-inch for external comers of concrete, including tops of walls, which will be exposed to view in the finished work.
5. Provide adequate formwork in its entirety. Forms shall safely support loads they will sustain and shall maintain their dimensional and surface correctness to produce members required by the Drawings. Form ties shall be spaced close enough to avoid bulges and variations in the required cross-sectional dimensions shown on the Drawings for the members being cast.
6. Box out for chases, recesses or other openings required in the completed work.
7. Install all the items (sleeves, inserts, hangers, anchors, etc.) to be supported by the formwork as required by the work.
8. Install pipe sleeves, wall pipes and wall sleeves, as shown or specified, for all piping penetrating walls and slabs. The use of block-outs in walls is prohibited.
9. Provide a sufficient number of cleanout doors at the base of walls and columns to facilitate cleaning and the application of grout to the base of walls.
10. The use of reinforcing steel, partially embedded in concrete, as toe pins or form spacers is prohibited.
11. Any proposed formwork requiring temporary support using permanent structure walls and slabs shall require analysis and design conducted by the Contractor. Plans and calculations shall be submitted to the Engineer for information only prior to installation of the formwork. The stability and structural integrity of all permanent structural elements shall remain the responsibility of the Contractor until the entire structure is complete, in-place, and accepted.

B. Forms for Exposed Concrete:

1. Do not use metal cover plates for patching holes or defects in forms.
2. Provide sharp, clean comers at intersecting planes, without visible edges of offsets. Provide back joints with extra beams or girts to maintain true, square intersections.

3. Use extra beams walers and bracing to prevent bowing of forms between beams and to avoid bowed appearance in concrete. Do not use narrow strips of form material that will produce bow.
4. Assemble forms so they may be readily removed without damage to exposed concrete surfaces.
5. Form molding shapes, recessed and projections with smooth-finish materials, and install in forms with sealed joints to prevent displacement.
6. Chamfer exposed comers and edges.

C. Comer Treatment:

1. Form exposed comers of beams, walls, bases and columns to produce smooth, solid, unbroken lines, except as otherwise shown. Except as specified below for re-entrant or internal comers, exposed comers shall be chamfered.
2. Form chamfers with $\frac{3}{4}$ by $\frac{3}{4}$ strips, unless otherwise shown, accurately formed and surfaced to produce uniformly straight lines and tight edge joints. Extend terminal edges to required limit and miter chamfer strips at changes in direction.
3. Re-entrant or internal comers and unexposed comers may be formed square.

D. Joints:

1. See Specification Section 03250 and Drawings for treatment of joints. Locate as shown and specified.

E. Cleaning and Tightening:

1. Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt or other debris just before concrete is to be placed. Re-tighten forms immediately after concrete placement as required to eliminate mortar leaks.

3.02 FORM COATINGS

- A. Coat form contact surfaces with a non-staining no petroleum form coating compound before reinforcement is placed. Do not allow excess form coating material to accumulate in the forms or to come into contact with surfaces, which will be bonded to fresh concrete. Apply in compliance with manufacturer's instructions.
- B. Volatile organic compound emissions of form releasing agents shall not exceed 2.09 pounds per gallon or that as acceptable in the State, County, or District of their intended use, whichever is more stringent.

- C. Coat steel forms with a non-staining, rust-preventative form oil or otherwise protect against rusting. Rust-stained steel formwork is not acceptable.
 - 1. Form releasing agents must not impair subsequent treatment of concrete surfaces that depend upon bond or adhesion nor impede the wetting of surfaces to be cured with water or curing compounds.

3.03 INSTALLATION OF EMBEDDED ITEMS

A. General:

- 1. Set and build into the formwork, anchorage devices and other embedded items, shown specified or required by other Section. Refer to paragraph 1.01 herein for the requirements of coordination. Use necessary setting drawings, diagrams, instructions and directions.
- 2. All embeds should be supported, plumbed and carefully taped or covered to prohibit the infiltration of concrete during the pour.
- 3. Coat any aluminum or reactive metal inserts, with non-reactive coating to isolate the metal surfaces.
- 4. Concrete cover for pipes, conduits, and fittings shall not be less than 2 inches for concrete exposed to earth, contained liquids, or weather, nor $\frac{3}{4}$ inches for concrete not exposed to contained liquids, weather, or in contact with ground.

B. Edge Forms and Screed Strips for Slabs and Sidewalks:

- 1. Set edge forms or bulkheads and intermediate screed strips for slabs and sidewalks to obtain required elevations and contours in the finished slab surface. Provide and secure units to support screeds.
- 2. The screeds may not be tack welded to the rebar embeds, or structural steel.

3.04 FIELD QUALITY CONTROL

- A. Before concrete placement, the Engineer shall inspect all formwork. No concrete shall be poured without Engineer approval.
- B. Before concrete placement, Subcontractor shall check the formwork, including lines, ties, tie cone, and form coatings. Subcontractor shall make corrections and adjustments to ensure proper size and location of concrete members and stability of forming systems.

- C. During concrete placement Subcontractor shall check formwork and related supports to ensure that forms are not displaced and that completed Work shall be within specified tolerances.
- D. If Subcontractor finds that forms are unsatisfactory in any way, either before or during placing of concrete, placement of concrete shall be postponed or stopped until the defects have been corrected, and reviewed by the Engineer.

3.05 REMOVAL OF FORMS

- A. Remove forms and falsework in a manner that will prevent damage to the concrete and not impair the safety of the structure.
- B. Do not use pinch bars or similar tools to pry against concrete surfaces.
- C. Do not remove forms until concrete has aged as follows:
 - 1. Elevated slabs and beams: 7 days minimum.
 - 2. Grade beams, columns, walls, construction and expansion joint bulkheads and other vertical surfaces: 24 hours minimum.
- D. Elevated slabs and beams shall have attained at least 70 percent of the specified 28day strength before form removal. Concrete shall also have sufficient strength to safely support its own weight and construction loads. Determine concrete strength for form removal in conformance with ACI301.
- E. Reshore elevated concrete elements immediately upon form removal. Shoring shall remain in place until the concrete has attained the specified 28 day design strength.
- F. Maintain shoring of elevated concrete elements which support subsequent construction when the subsequent construction loads exceed the design live load of the elements

3.06 REUSE OF FORMS

- A. Clean and repair surfaces of forms to be re-used in the Work. Split, frayed, delaminated or otherwise damaged form facing material will not be acceptable. Apply new form coating compound material to concrete contact surfaces as specified for new formwork.
 - 1. Plywood surfaced forms must have smooth clean faces for re-use, and may not have excessive knots or tie hole plugs. They may not be used more than (3) times without an Engineer's inspection and approval.

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2. Metal surfaced forms must have a smooth even surface without plate patches.

+++ END OF SECTION 03100 +++

SECTION 03200
CONCRETE REINFORCEMENT AND DOWELLING

PART 1 - GENERAL

1.01 SCOPE

- A. Furnish and install the concrete reinforcement as shown and indicated on the Drawings and specified in this Section, complete in place.
- B. Provide and set reinforcement and accessories for electrical work as indicated and specified under electrical work.
- C. Provide reinforcing bar dowels to be embedded into concrete elements at top and bottom of CMU walls as indicated and specified. Furnish wall reinforcement for concrete masonry walls for installation.

1.02 SUBMITTALS

A. Shop Drawings

- 1. All shop drawings shall be of the same size. Reproductions of the Drawings for use as shop drawings are not permitted. Shop drawings shall include placing drawings, bending details, and bar lists with bar marks. All details and notes appearing on the Drawings, giving information for the placing of reinforcing steel, shall be shown on the shop drawings. Shop drawings will not be reviewed without such information.
 - 2. Wall reinforcing shall be shown in elevation.
 - 3. Show location and size of all penetrations greater than 6-inches in diameter or across the opening with the corresponding added reinforcing around the penetrations.
 - 4. Location and arrangement of accessories shall be clearly indicated.
 - 5. All shop drawings shall be checked by the fabricator and Subcontractor before being submitted to the Engineer.
 - 6. Reproduction of the Contract Drawings shall not be used for shop drawings.
 - 7. Review of shop drawings is for bar size, spacing, details and general compliance with the Contract Drawings only. Material quantities, fit, verification of job conditions and coordination with other trades are the responsibility of the General Contractor.
 - 8. Do not begin fabrication of materials prior to review of shop drawings.
- B. Mill tests of reinforcing steel shall be submitted prior to use for each 15 tons or less shipped to the site. Tests shall be conducted in conformance with ASTM A615, and methods prescribed herein.

1. Cost of mill tests shall be borne by Subcontractor.
2. Three copies of each test report stating whether the material meets the requirements of the ASTM specifications shall be submitted to the Engineer.
3. Certified copies of the mill tests may be considered evidence of compliance provided such tests are regularly conducted by the reinforcement supplier by experienced, competent personnel using adequate testing equipment. In case of doubt as to the adequacy or accuracy of the mill tests, the Engineer may require the Subcontractor to furnish, at no additional cost to the Owner, test results from an independent testing laboratory acceptable to the Engineer on mill samples or delivered steel reinforcement.

1.03 QUALITY ASSURANCE

- A. The Contractor shall examine the substrate and the conditions under which concrete reinforcement is to be placed, and notify the Engineer in writing of unsatisfactory conditions. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the Engineer.
- B. Minimum Concrete Cover for Reinforcement: Comply with ACI 350, except as shown on Drawings
- C. Splices other than lap splices shall not be used except where permitted in writing by the Engineer.
- D. Field bending of reinforcement is prohibited unless reinforcement is indicated or specified to be field bent.

1.04 DELIVERY, STORAGE AND HANDLING

- A. Deliver concrete reinforcement materials to the site bundled, tagged and marked. Use metal tags indicating bar size, length, and other information corresponding to markings shown on placement diagrams. Reinforcement which arrives on the jobsite which is not tagged shall be rejected by the Engineer and removed at the Contractor's expense.
- B. Store concrete reinforcement material at the site to prevent damage and accumulation of dirt or excessive rust. Store on heavy wood blocking so that no part of it will come in contact with the ground.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Reinforcing Bars and Dowelling shall conform to ASTM A 615, Grade 60.
- B. Mechanical Reinforcing Bar Splice Couplers indicated in the construction drawings shall be integrally forged, with parallel threaded splice bars conforming to ASTM A 615, Grade 60. The Mechanical Splice Coupler shall develop in tension or compression at least 125% the specified Reinforcing Bar yield strength.
- C. Steel Wire: Shall conform to ASTM A82.
- D. Welded Smooth Wire Fabric: Shall conform to ASTM A185:
 - 1. Furnish in flat sheets, not rolls.
- E. Supports for Reinforcement: Bar supports coming into contact with forms shall be CRSI Class 1 plastic protected or Class 2 stainless steel protected and shall be located in accordance with CRSI MSP-1 and placed in accordance with CRSI PRE. Precast concrete block supports shall be provided for reinforcing in concrete cast against grade.

2.02 FABRICATION

- A. General: Fabricate reinforcing bars to conform to required shapes and dimensions, with fabrication tolerances complying with CRSI "Manual of Standard Practice" and ACI minimums. In case of fabricating errors, do not re-bend, retemper, heat, deform or straighten reinforcement.
- B. Unacceptable Materials: Reinforcement with any of the defects listed below will not be permitted in the Work:
 - 1. Bar lengths, bends, and other dimensions exceeding specified fabrication tolerances.
 - 2. Bends or kinks not shown on approved. Shop Drawings.
 - 3. Bars with reduced cross-section due to excessive rusting or other cause.
 - 4. Surface contamination that would affect the bond i.e. grease, dirt, paint, rust etc.
 - 5. Heat deformed or torched bars.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Comply with the applicable recommendations of specified codes and standards, and CRSI "Placing Reinforcing Bars" and ACI requirements for details and methods of reinforcement placement and supports.
- B. Clean reinforcement to remove loose rust and mill scale, earth, ice, and other materials, which reduce or destroy bond with concrete.
- C. Position, support, and secure reinforcement and dowelling against displacement during formwork construction or concrete placement and grouting operations. Locate and support reinforcing by metal chairs, runners, bolsters, spacers and hangers, as required. No wood blocks allowed for rebar support. Do not tack weld crossing reinforcing bars.
 - 1. Place reinforcement to obtain the minimum concrete coverages as shown and as specified in ACI 350 at the Pump Station and Tunnel Shaft Transition Box structures. ACI 318 may be used at all other structures. Arrange, space, and securely tie bars and bar supports together with 16 gauge wire to hold reinforcement accurately in position during concrete placement operations. Set wire ties so that twisted ends are directed away from exposed concrete surfaces.
 - 2. Reinforcing steel shall not be secured to forms with wire, nails or other ferrous metal. Metal supports subject to corrosion shall not touch formed or exposed concrete surfaces.
- D. Install welded wire fabric in as long lengths as practical. Lap adjoining pieces at least one full mesh and lace splices with 16 gauge wire and tie. Offset laps of adjoining sheet widths to prevent continuous laps in either direction.
- E. Provide sufficient numbers of supports of strength required to carry reinforcement without sagging. Do not place reinforcing bars more than 2 inches beyond the last leg of any continuous bar support. Do not use supports as bases for runways for concrete conveying equipment and similar construction loads.
- F. Splices: Provide standard reinforcement splices by lapping ends, placing bars in contact, and tying tightly with wire. Comply with requirements shown for minimum lap of spliced bars. The use of Mechanical Reinforcing Bar Splice Couplers may be used at locations indicated in the construction plans. Any additional locations where Mechanical Splice Couplers are being proposed shall be submitted to the Engineer for approval.
- G. Existing concrete, which is shown to remain but is removed in error or must be removed to install new Work, and then to be reinstalled is to be reinforced to the extent as required and approved by the Engineer. This work will be performed with no additional compensation to the Subcontractor.

- H. Do not straighten or rebend reinforcing.
- I. Reinforcement Around Openings: Place an equivalent area of steel around the pipe or openings and extend on each side sufficiently to develop bond in each bar. See the Details on the Drawings for bar extension length each side of openings. Where welded wire fabric is used, provides extra reinforcing using fabric or deformed bars.
- J. Welded Reinforcement: Welding is not permitted.

3.02 INSPECTION OF REINFORCEMENT

- A. After the rebar, appliance, anchors and embedments have been installed and checked, the Subcontractor shall review all aspects of the pending concrete pour and initial those items on its pour card. Subcontractor shall notify the Engineer no less than 24 hours prior to the pour, so that the Engineer may check the area to be poured. No concrete shall be placed until this is complete.
- B. Concrete shall not be placed until the reinforcing steel is inspected and permission for placing concrete is granted by the Engineer. All concrete placed in violation of this provision will be rejected. Rejected concrete shall be removed and replaced at no cost to the City.

+++ END OF SECTION 03200 +++

**SECTION 03250
CONCRETE JOINTS**

PART 1 - GENERAL

1.01 SCOPE

- A. Contractor shall furnish all labor, materials, equipment and incidentals required to provide concrete joints as shown and specified.
- B. The types of concrete joints required include the following:
 - a. Construction joints.
 - b. Expansion joints and fillers.
 - c. Waterstops.
- C. General: All joints subject to hydrostatic pressure shall be provided with continuous waterstop.
- D. Related Work Specified Elsewhere:
 - 1. Section 03100, Concrete Formwork.
 - 2. Section 03200, Concrete Reinforcement and Dowelling
 - 3. Section 03300, Cast-In-Place Concrete.
 - 4. Section 07900, Caulking and Sealants.

1.02 SUBMITTALS

- A. Submittals shall be made in accordance with the requirements of the General Conditions of the Contract Documents. In addition, the following specific information shall be provided:
 - 1. Product data for all materials stating the location where product is to be used.
 - 2. Certification that materials meet the specifications.
 - 3. Manufacturer's application and installation instructions.
 - 4. Samples of water stops, concrete roughener, joint fillers, caulk and bonding agent if requested by the Engineer.

1.03 QUALITY ASSURANCE

- A. Reference Standards: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified:
 - 1. ACI 301, Specifications for Structural Concrete for Buildings, Chapter 6, Joints and Embedded Items.
 - 2. ACI 350, Environmental Engineering concrete structures, Chapter 2.8, Joints.
 - 3. ASTM D 1752, Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction.
- B. All manufactured items shall be installed in accordance with manufacturer's instructions.
- C. Construction and expansion joints shall not be added or relocated without the approval of the

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Engineer.

PART 2 - PRODUCTS

2.01 JOINT SEALER

- A. Materials shall be two component, polyurethane meeting ASTM-C-920 and FED SPEC TT-S-00227E specifications. Materials shall have $\pm 50\%$ movement.
- B. Manufacturer and Product shall be:
 - 1. Horizontal Joint - Sikaflex 2C Self Leveling by Sika Corp or equal.
 - 2. Vertical Joint - Sikaflex 2C Non-Sag by Sika Corp or equal.

2.02 CONSTRUCTION JOINTS

- A. Bonding Agent - Shall meet ASTM C 881 with a bond strength of 1500 psi minimum. Agent shall be capable of spraying in inaccessible locations, if necessary.
 - 1. Manufacturer and Product shall be:
 - a. Sika Armatic 110 by Sika Corp.
 - b. Sikadur 32 Hi-Mod by Sika Corp.
 - c. Or equal.

2.03 JOINT FILLER

- A. Expansion Joint Material: Type I, preformed sponge neoprene expansion joint filler conforming to AASHTO Designation M-153.

2.04 WATERSTOPS

- A. Waterstop shall be PVC (Polyvinylchloride) meeting ASTM D-638 test method for tensile strength of 2020 psi and ultimate elongation of 370.
 - 1. Construction joints:
 - a. Serrated with center bulb, 3/8" thick by 6" minimum width, Greanstreak #706 or equal.
 - b. Preformed plastic adhesive waterstop, Synko-Flex Products or equal. Use only where shown on Drawings.
 - 2. Expansion Joints: Serrated with center bulb, 3/8" thick by 9" minimum width, Greanstreak #738 or equal.

PART 3 - EXECUTION

3.01 CONSTRUCTION JOINTS

- A. General:

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1. Comply with ACI 301, Chapter 6, and ACI 350, Chapter 2.8.3 and as specified below.
2. Provide waterstops in construction joints as shown and as specified in this Section.
3. All joints between new and existing concrete to comply with Article 3.01 of this Section.

B. Installation:

1. Brush blast new and existing concrete surfaces at joint and surrounding area. Dry, oil-free air to be used for blasting operation. Blasting to be sufficient to remove laitance and solid contaminants, open up surface voids, bugholes, air pockets and other subsurface irregularities but not expose underlying aggregate. The abrasive shall be dry and clean and will pass through a 16 mesh screen. After blast cleaning is completed, residual abrasive dust and loose particles are to be removed from the surface by vacuuming or by compressed air. Blasting operation is to be repeated if requested by the Engineer at no additional compensation to the Contractor.
2. Install waterstop and bonding agent per manufacturer recommendations and this Section. Spray on epoxy bonding agent in inaccessible areas per manufacturer's recommendations.
3. Place a 6-inch grout charge of similar proportions to the cement in the concrete, over the damp, clean horizontal contact surface of the old concrete. Place fresh-concrete before the grout has attained its initial set. Grout shall be ordinary cement-sand grout as specified in Section 03600.
4. When concrete has been placed and the form removed, wash loosened material off with high pressure water spray to obtain roughened surface subject to approval by Engineer, prior to rub finish.
5. Cure concrete sufficiently prior to placement of joint filler and epoxy coating to obtain optimum bond as per manufacturer's recommendations.
6. Apply approved epoxy coating per. Section 09900.
7. Install appliances per drawings and specifications.

3.02 WATERSTOPS

A. General:

1. Comply with ACI 301, Chapter 6, Section 3.01 B and as specified below. All joints shall be made in accordance with manufacturer's instructions.
2. Obtain Engineer's approval for waterstop locations not shown.

B. Polyvinyl Chloride Waterstop:

1. Tie waterstop to reinforcement so that it is securely and rigidly supported in the proper position during concrete placement to insure their proper positioning. Puncturing waterstop with tire wire to secure it to reinforcement is prohibited.

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2. Waterstops shall be fused using equipment as supplied by or recommended by the manufacturer. Heat welded at all splice points.
3. Provide sufficient bed of epoxy grout, after sandblasting, cleaning roughening and priming the surface, so as to fill all voids including the "V" at the split.
4. Install split-bulb PVC waterstop onto the non-shrink, non-metallic grout bed. Mount waterstop to wall using two (2) 1/4" x 2" type 316 stainless steel strips on either side of the waterstop anchored with 1/2" diameter type 316 stainless steel anchor bolts on 12" centers.
5. Fill all voids between the waterstop and the concrete with approved epoxy grout with no additional compensation to the Contractor if injection method is used.
6. Obtain final Engineer's approval of the waterstop installation prior to placing concrete.

+++ END OF SECTION 03250 +++

**SECTION 03251
CONCRETE ACCESSORIES**

PART 1 - GENERAL

1.01 SCOPE

- A. The work covered by Section includes, but is not necessarily limited to, furnishing and installing all concrete accessories as indicated on the Drawings, herein specified, and as necessary for the progress and complete performance of this work.

1.02 SUBMITTALS

- A. The waterstop manufacturer shall submit documented test results demonstrating that the waterstop will not permit water leakage when subjected to pressure and joint movement.

1.03 QUALITY ASSURANCE

- A. The waterstop manufacturer shall demonstrate five years (minimum) continuous, successful experience in production of waterstops.

1.04 STORAGE AND PROTECTION

- A. Store waterstops under tarps to protect from oil, dirt, water, and sunlight.

1.05 QUALITY CONTROL

- A. Contractor shall establish and maintain records sufficient to furnish evidence of quality of materials, equipment, storage, and workmanship.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Waterstops for construction joints shall be Wirestop Waterstop Type No. FR-6380 manufactured by Paul Murphey Plastics Company, Rossville, Michigan; Vinylex Waterstop Type R6-38T manufactured by Vinylex Corporation, Knoxville, Tennessee; or Greenstreak Waterstop Stop 679 manufactured by Greenstreak, St. Louis, Missouri.
- B. Expanding waterstops for construction joints shall be Hydrotite Waterstop Profile CJ -0725 manufactured by Greenstreak, St. Louis, Missouri or equal.

2.02 MATERIALS AND CONSTRUCTION

A. Waterstops:

1. Reference Section 03250, Concrete Joints

B. Dovetail Slots:

1. No. 22 gauge, galvanized steel, 1-inch wide back.
2. Crimped anchors shall be furnished by other trades whose work abuts concrete.

C. Inserts for General Trades:

1. Malleable iron, strength as required.
2. Include bolts, nuts, and washers.

2.03 OTHER MATERIALS

- ### **A.**
- All other materials not specifically described, but required for a complete and proper installation of concrete accessories, shall be as selected by the Contractor subject to the approval of the Engineer.

PART 3 - EXECUTION

3.01 INSTALLATION

- ### **A. General:**
- Install concrete accessories as indicated on the Drawings, specified in various other Sections and as necessary for the proper and complete performance of this work.

B. Waterstops:

1. Waterstops shall be installed in all construction joints in walls and slabs which are to hold water and also where shown on the Drawings. The waterstop shall extend the entire length of the joint and all splices shall be installed and tested in accordance with the manufacturer's recommendations. Place waterstop to form a continuous watertight diaphragm in joints.
2. Waterstops for all joints shall be continuous around all corners and intersections. For PVC waterstops, provide factory formed corners and intersections where angle intersections occur, and only straight splices shall be made in the field. Splices shall be made in accordance with the manufacturer's recommendations and shall be subject to the approval of the

Engineer. Maintain 2-in. [50 mm] minimum clearance between waterstop and reinforcement and embedded items.

3. No holes will be permitted in waterstops.
4. Waterstops shall be securely fastened to formwork or reinforcing steel every 12-inch or less on both edges as required to concrete placement.
5. Expanding waterstops shall be spliced using cyanoacrylate adhesive (super glue) and a band-aid seal of hydrophilic polyurethane sealant.
6. Cut coil ends of expanding waterstops square (or at proper angle for mitered comers) with shears or sharp blade to fit splices together without overlaps.
7. Joinery between PVC and expanding waterstops shall be sealed using hydrophilic polyurethane sealant.
8. Provide concrete surface preparation that is consistent with the manufacturer's recommendations for expanding waterstops. Coordinate this preparation with other joint preparation shown on the drawings.
9. Install the expanding waterstop in accordance with the manufacturer's recommendations.
10. See also requirements in Section 03250, Concrete Joints

+++ END OF SECTION 03251 +++

**SECTION 03420
STRUCTURAL PRECAST CONCRETE**

PART 1 - GENERAL

1.01 DESCRIPTION

This Section specifies all labor, materials, equipment, and services necessary to provide the structural precast concrete members indicated or specified.

1.02 QUALITY ASSURANCE

- A. References: This Section references the following documents. They are a part of this Section insofar as specified and modified herein. In case of conflict between the requirements of this Section and the listed documents, the requirements of this Section shall prevail. Use the latest editions of these documents.

Reference	Title
ACI Standard 318	Building Code Requirements for Reinforced Concrete
ASTM A416	Specification for Uncoated Seven-Wire Stress-Relieved Strand for Precast Concrete
ASTM A320	Specification for Alloy-Steel Bolting Materials for Low Temperature
ASTM D2240	Tests for Rubber Property-Durometer Hardness
ASTM D412	Tests for Rubber Properties in Tension
ASTM C33	Specification for Concrete Aggregates

- B. Performance and Design Requirements: Cast and erect members shall conform to tolerances of PCI Standard MNL 16 latest edition except as noted.
- C. Testing: Testing shall be in general conformance with testing provisions in Prestressed Concrete Institute "Manual for Quality Control for Plants and Production of Precast and Prestressed Concrete Product," MNL-116.
- D. Manufacturer Qualifications: The precast concrete manufacturing plant shall be certified by the Prestressing Concrete Institute, Plant Certification Program, prior to start of production.
- a. Group C, Category C1 - Precast Concrete Products (no prestressed reinforcement), Category C4 - Prestressed Deflected Strand Structural Members.
- E. Installer Qualifications: A precast concrete erector qualified and designated by PCI's Certificate of Compliance, to erect Category S2 - Complex Structural Systems.

1.03 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design precast structural concrete, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated. The qualified professional engineer, licensed in the state where the project is located, shall be responsible for the design of the complete structural system, including the design of all precast components, connections and lateral-load resisting system.
- B. Structural Performance: Precast structural concrete units and connections shall withstand design loads indicated within limits and under conditions indicated.
- C. Structural Performance: Provide precast structural concrete units and connections capable of withstanding the following design loads within limits and under conditions indicated:
 - 1. Dead Loads: As specified on the Contract Drawings.
 - 2. Concrete Topping Load: As specified on the Contract Drawings.
 - 3. Live Loads: As specified on the Contract Drawings.
 - 4. Snow Loads: As specified on the Contract Drawings.
 - 5. Seismic Loads: As specified on the Contract Drawings.
 - 6. Wind Loads: As specified on the Contract Drawings.
 - 7. Design precast structural concrete framing system and connections to maintain clearances at openings, to allow for fabrication and construction tolerances, to accommodate live-load deflection, shrinkage and creep of primary building structure, and other building movements. Maintain precast structural concrete deflections within limits of ACI 318.
 - a. Thermal Movements: Allow for in-plane thermal movements resulting from annual ambient temperature changes of minus 18 to plus 120 deg F.
 - 8. Fire-Resistance Rating: Select material and minimum thicknesses to provide indicated fire rating.

1.04 SUBMITTALS

- A. Submittals shall be made in accordance with the General Conditions. In addition, the following specific information shall be provided:
 - 1. Product Data: For each type of product indicated
 - 2. Design Mixtures: For each precast concrete mixture. Include compressive strength and water absorption tests.
 - 3. Shop Drawings: Include member locations, plans, elevations, dimensions, shapes and sections, openings, support conditions, and types of reinforcement, including special reinforcement. Detail fabrication and installation of precast structural concrete units.

- a. Submit shop drawings electronically in PDF format via email for review the Structural Engineer-of-Record. The Structural Engineer-of-Record will review the shop drawings and forward stamped electronic documents to the contractor through the Architect via email. The contractor shall be responsible for transmitting the reviewed set to the fabricator for corrections. The printing of shop drawings as required for review is considered a reimbursable expense and will be billed at cost.
 - b. Only complete shop drawings submittals will be reviewed. Shop drawings not in compliance with the Submittal portion of this document will be rejected. Time required by Wallace Engineering Structural Consultants, Inc. to review shop drawing submittals a second or third time will be billed to the General Contractor at Wallace Engineering Structural Consultants, Inc. hourly rates.
 - c. Indicate joints, reveals, and extent and location of each surface finish.
 - d. Indicate separate face and backup mixture locations and thicknesses.
 - e. Indicate welded connections by AWS standard symbols. Show size, length, and type of each weld.
 - f. Detail loose and cast-in hardware, lifting and erection inserts, connections, and joints.
 - g. Indicate locations, tolerances, and details of anchorage devices to be embedded in or attached to structure or other construction.
 - h. Include and locate openings larger than 10 inches.
 - i. Indicate location of each precast structural concrete unit by same identification mark placed on panel.
 - j. Indicate relationship of precast structural concrete units to adjacent materials.
 - k. Indicate locations and details of brick units, including corner units and special shapes, and joint treatment.
 - l. Indicate locations and details of stone facings, anchors, and joint widths.
 - m. Indicate estimated camber for precast floor slabs with concrete toppings.
 - n. Indicate shim sizes and grouting sequence.
 - o. Design Modifications: If design modifications are proposed to meet performance requirements and field conditions, submit design calculations and Shop Drawings. Do not adversely affect the appearance, durability, or strength of units when modifying details or materials and maintain the general design concept.
4. Erection Drawings:
- a. Erection drawings shall consist of the following.
 - 1) Plans and elevations locating and defining all material furnished by manufacturer
 - 2) Sections and details showing connections, cast in items and their relation to the structure
 - 3) Description of all loose, cast in and field hardware.

- 4) Field installed anchor location drawings.
- 5) Erection sequences and handling requirements

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Portland Cement: Portland cement shall be ASTM C150, *Type II* and conform to Section 03300.
- B. Admixtures: Admixtures shall conform to Section 03300.
- C. Aggregates: Aggregates shall conform to Section 03300.
- D. Water: Water shall conform to Section 03300.
- E. Reinforcing Steel: Reinforcing steel shall conform to Section 03200.
- F. Shapes, Plates, Anchors and Inserts: Steel shapes, plates, anchors and inserts shall be from material conforming to ASTM A36. Finish shall be manufacturer's standard shop primer or hot dip galvanized if exposed to earth or weather.
- G. Grout:
 1. Cement grout shall consist of one-part cement to three parts water with sufficient water for workability.
 2. Nonshrink grout shall conform to Section 03600.
- H. Bearing Pads: Neoprene bearing pads shall conform to requirements of ASTM D2240 and D412, Grade 2 Durometer 60 or higher.
- I. Welding Studs: Welding studs shall conform to AWS D1.1.

2.02 CONCRETE ADMIXTURES

- A. Concrete shall have a minimum 28-day strength of 7,000 psi.

2.03 MANUFACTURE

- A. Manufacturing Procedures: Manufacturing tolerances shall comply with PCI MNL-116.
- B. Finishes:
 1. Standard Underside: Resulting from casting against approved forms using good industry practice in cleaning of forms, design of concrete mix, placing, and curing. Small surface holes caused by air bubbles, normal color variations, normal form joint marks, and

- minor chips and spalls shall be tolerated, but no major or unsightly imperfections, honeycomb, or other defects shall be permitted.
2. Standard Top: Results of vibrating screed and additional hand finishing at projection. Normal color variations, minor indentations, minor chips and spalls shall be permitted. No major imperfections, honeycomb, or defects shall be permitted.
- C. Patching: Patching shall be acceptable providing the structural integrity of the product and the appearance are not impaired.
 - D. Fastenings: Manufacturer shall cast in inserts, bolts, and plates as required for the Project.

PART 3 - EXECUTION

3.01 ERECTION

- A. Examine supporting structural frame or foundation and conditions for compliance with requirements for installation tolerances, bearing surface tolerances, and other conditions affecting performance of the Work. Proceed with installation only after unsatisfactory conditions have been corrected.
- B. All members shall be erected in workmanlike manner, using only competent experienced workmen. Erect precast structural concrete units level, plumb, square, and in alignment without exceeding the noncumulative erection tolerances of PCI MNL 135.
- C. All connections shall be made in accordance with the Contract Drawings and the approved shop drawings.
- D. Subcontractor shall furnish, erect, and remove all temporary elements required for shoring or bracing of members in place until permanently attached.
- E. Members shall be leveled to a tolerance of plus or minus 1/4 inch.
- F. All welding shall be performed using only certified welders (certification approved during the preceding 12-month period) in accordance with the Contract Documents and the approved shop drawings.
- G. Subcontractor shall take all necessary precautions to protect members from damage after installation. Remove all wedges, spacers, or other setting appliances which are likely to cause straining from joints as soon as practical. Repair or replace any members which do not comply with Contract Documents or approved shop drawings.
- H. Install neoprene bearing pads of sizes indicated as detailed necessary for erection

of members. No shims allowed under slab edge at bearing.

3.02 REPAIRS

- A. Repair precast structural concrete units if permitted by Architect.
 - 1. Repairs may be permitted if structural adequacy, serviceability, durability, and appearance of units have not been impaired.
- B. Mix patching materials and repair units so cured patches blend with color, texture, and uniformity of adjacent exposed surfaces and show no apparent line of demarcation between original and repaired work, when viewed in typical daylight illumination from a distance of 20 feet.
- C. Prepare and repair damaged galvanized coatings with galvanizing repair paint according to ASTM A 780/A 780M.
- D. Wire brush, clean, and paint damaged prime-painted components with same type of shop primer.
- E. Remove and replace damaged precast structural concrete units that cannot be repaired or when repairs do not comply with requirements as determined by Architect.

+++ END OF SECTION 03420 +++

**SECTION 03600
GROUT**

PART 1 - GENERAL

1.01 SCOPE

- A. The work covered under this Section includes furnishing all labor, materials, equipment, and incidentals required to provide grout as shown and specified.
- B. The types of grout include the following:
 - 1. Non-shrink, epoxy type.
 - 2. Non-shrink, non-metallic type.
 - 3. Ordinary cement-sand.
 - 4. Refer to Section 03300 for pressure grouting applications.
- C. Related Work Specified Elsewhere:
 - 1. Section 03200, Concrete Reinforcement and Dowelling.
 - 2. Section 03300, Cast-In-Place Concrete.

1.02 SUBMITTALS

- A. Submittals shall be made in accordance with the requirements of the General Conditions of the Contract Documents. In addition, the following specific information shall be provided:
 - 1. Copies of manufacturer's specifications and installation instructions for all proprietary materials.
 - 2. Reports and Certificates:
 - a. For proprietary materials, submit copies of reports on quality control tests.
 - b. For nonproprietary materials, submit certification that materials meet specification requirements.

1.03 QUALITY ASSURANCE

- A. Reference Standards: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.
 - 1. ASTM C 150, Portland Cement.
 - 2. ASTM C 109, Compressive Strength of Hydraulic Cement Mortars (using 2-in. or 50 mm. Cube Specimens).
 - 3. ASTM C 191, Time of Setting of Hydraulic Cement by Vicat Needle.
 - 4. CRD-C 588, Specifications for Non-Shrink Grout.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Delivery of Materials: Grout materials from manufacturers shall be delivered in unopened

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containers and shall bear intact manufacturer's labels.

- B. Storage of Materials: Grout materials shall be stored in a dry shelter and shall be protected from moisture.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Non-metallic, cartridge style, 100 percent solids, high strength epoxy grout.
 - 1. Product and Manufacturer: Speed Bond #1 as manufactured by Prime Resins Inc.
 - 2. Or Equal.
- B. Non-Shrink, Non-Metallic Grout:
 - 1. Pre-mixed non-staining cementitious grout requiring only the addition of water at the jobsite meeting ASTM C-827 and CRD C-621.
 - 2. Product and Manufacturer:
 - a. Sikagrout 212 by Sika Corp.
 - b. Masterflow 713 by Master Builders Company.
 - c. Non-Ferrous Non-Shrink Grout by the Burke Company.
 - d. Non-Shrink, Non-Metalic Grout as manufactured by W. R.Meadows.
 - e. Or Equal.
- C. Ordinary Cement-Sand Grout:
 - 1. Except where otherwise specified use 1 part cement to 3 parts sand complying with the following:
 - a. Cement: ASTM C 150, Type II.
 - b. Sand: ASTM C 33.
 - 2. For water repelling and shrinkage reducing requirements use admixtures.
 - a. Product and Manufacturer:
 - 1. Integral Waterpeller by The Euclid Chemical Company.
 - 2. Omicron, Type OM by Master Builders Company.
 - 3. Hydrocide Powder by Sonneborn-Contech.
 - 4. Or Equal.
 - 3. For use at horizontal waterstops only.
- D. Water:
 - 1. Use clean, fresh, potable water free from injurious amounts of oils, acids, alkalies or organic matter.
- E. Epoxy Resin Adhesive:
 - 1. Two part mix 1:1
 - 2. Manufacturer: Sika Corp - Sikadur 32, Hi-Mod (Horizontal joints), Sikadur 31 Hi-Modgel (Vertical joints) or equal.

PART 3 - EXECUTION

3.01 INSTALLATION

A. General:

1. Place grout as shown and in accordance with manufacturer's instructions. If manufacturer's instructions conflict with the Specifications do not proceed until Engineer provides clarification.
2. Drypacking will not be permitted unless approved by the Engineer.
3. Manufacturers of proprietary products shall make available upon 72 hours notification the services of a qualified, full time employee to aid in assuring proper use of the product under job conditions.
4. Placing grout shall conform to temperature and weather limitations in Section 03300.
5. Surface to be grouted is to be adequately cured, cleaned dampened and roughened per manufacturer recommendations to insure adequate bonding.

B. Pipe Railings:

1. After posts have been properly inserted into the holes or sleeves, fill the annular space between posts and sleeve with the non-shrink, non-metallic grout. Bevel grout at juncture with post so that moisture flows away from post.
2. Do not grout railing designated as "removable sections".

C. Grout for Dowelling and Anchor Bolts:

1. Grout shall be introduced at the bottom of the drill holes using a caulking tube or other injection means. The hole shall be blown out or pumped dry prior to the introduction of grout into the hole. Care shall be taken to adequately fill the hole with grout before the dowel or anchor rod is inserted, to insure complete contact with the anchor for its full length.
2. A plug shall be placed in the top of the hole to hold the bars securely until the grout sets. Special care shall be taken to insure against any movement of the bars which have been placed.
3. Epoxy resin Adhesive may be used in accordance with manufacturer's recommended application.

D. Grouting for Waterstops:

1. Grout for PVC waterstops to be the non-shrink, non-metallic type. Refer to Section 03251 for installation procedures.
2. Grout from Redi-mix plant conforming to applicable requirements of Section 03300 may be substituted at no additional compensation to the contractor.

E. Grouting for Weir and Slide Gates:

1. Provide minimum of 1" thickness of non-shrink, non-metallic grout under frames. Gates to be coated with an approved epoxy coating per Section 09900 prior to installing and grouting.

F. Grouting for Bearing Plates and Equipment:

1. Use non-shrink, non-metallic grout for setting bearing plates and equipment. Provide a minimum grout thickness of 1".

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G. Patchwork at Demolition Areas:

1. Furnish and install non-shrink, non-metallic grout for dry packing as required to patch all mechanical, electrical and miscellaneous penetrations which are either designated to be patched or are the result of abandoned, removed or relocated material and equipment. Prepare surface and place grout as recommended by manufacturer and as specified. Finish grout off flush with existing surface.
2. Reinforce with approved wire mesh and use approved structural concrete for penetrations larger than 1/2 square feet. Conform to requirements of Sections 03100, 03200 and 03300.

+++ END OF SECTION 03600 +++

SECTION 05510

METAL STAIRS

PART 1 GENERAL

1.01 RELATED SPECIFICATION SECTIONS:

- A. Section 01000 – GENERAL REQUIREMENTS

1.02 SECTION INCLUDES

- A. Steel stair frame of structural sections, with open risers.
- B. Open grate stair treads and landings.
- C. Integral balusters and hand railing.

1.03 REFERENCES

- A. ANSI A117.1 - Buildings and Facilities - Providing Accessibility and Usability For Physically Handicapped People.
- B. ASTM A36 - Structural Steel.
- C. ASTM/ANSI A202.1 - Metal Bar Grating Manual for Steel and Aluminum Gratings and Stair Treads.
- D. ASTM A283 - Carbon Steel Plates, Shapes, and Bars.
- E. AWS A2.0 - Standard Welding Symbols.
- F. AWS D1.1 - Structural Welding Code.
- G. SSPC - Steel Structures Painting Council.

1.04 DESIGN REQUIREMENTS

- A. Delegated Design: Design metal stairs, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Structural Performance of Stairs: Metal stairs shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
 - 1. Uniform Live Load: 100-lb/sq. ft.
 - 2. Concentrated Live Load: 300 lb applied on an area of 4 sq. in.
 - 3. Uniform and concentrated loads need not be assumed to act concurrently.
 - 4. Stair Framing: Capable of withstanding stresses resulting from railing loads in addition to loads specified above.
 - 5. Limit deflection of treads, platforms, and framing members to L/240 for total loads and L/360 for live loads or 1/4 inch, whichever is less.

- C. Structural Performance of Railings: Railings shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated.
 - 1. Handrails and Top Rails of Guards:
 - a. Uniform live load of 50 lb/ft applied in any direction.
 - b. Concentrated live load of 200 lb applied in any direction.
 - c. Uniform and concentrated loads need not be assumed to act concurrently.
 - 2. Infill of Guards:
 - a. Concentrated live load of 50 lb applied horizontally on an area of 1 sq. ft.
 - b. Infill load and other loads need not be assumed to act concurrently.
- D. Seismic Performance: Metal stairs shall withstand the effects of earthquake motions determined according to the International Building Code.
 - 1. Component Importance Factor is 1.5.

1.05 SUBMITTALS

- A. Submit under provisions of Section 01300.
- B. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include plans, elevations, sections, details, size and thickness of members, and attachments to other work. Indicate size of fabricated section intended to be delivered.
 - 1. Submit shop drawings and calculation electronically in PDF format via email for review by the Structural Engineer-of-Record. The Structural Engineer-of-Record will review the shop drawings and forward stamped electronic documents to the contractor through the Architect via email. The contractor shall be responsible for transmitting the reviewed set to the fabricator for corrections. The printing of shop drawings as required for review is considered a reimbursable expense and will be billed cost.
 - 2. Reproduction of Contract Drawings shall not be used for shop drawings.
- C. Indicate welded connections using standard AWS A2.0 welding symbols. Indicate net weld lengths.
- D. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, include analysis data and design calculations for the stairs and railings prepared by and signed and sealed by the qualified professional engineer responsible for their preparation and licensed in the state where the project is located. Calculations shall clearly define loads, stair geometry, steel strength, concrete strength and connection design for each stair.
- E. See note 2 on S-001 for Deferred Submittals

1.06 QUALIFICATIONS

- A. Prepare shop Drawings under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State of Georgia.

- B. Welders' Certificates: Submit under provisions of Section 01300, certifying welders employed on the Work, verifying AWS qualification within the previous 12 months.
- C. See note 2 on S-001 for Deferred Submittals

1.07 FIELD MEASUREMENTS

- A. Verify that field measurements are as indicated on Drawings.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Steel Sections: ASTM A36.
- B. Plates: ASTM A283.
- C. Pipe: ASTM A53, Grade B or Schedule 40 or 60.
- D. Gratings: ANSI A202.1, Type C.
- E. Bolts, Nuts, and Washers: ASTM A32S.
- F. Exposed Mechanical Fastenings: Flush countersunk screws or bolts, consistent with design of stair structure.
- G. Welding Materials: AWS D1.1; type required for materials being welded.
- H. Shop and Touch-Up Primer: SSPC Is, Type 1, red oxide.

2.02 FABRICATION - GENERAL

- A. Fit and shop assemble in largest practical sections, for delivery to site.
- B. Fabricate components with joints tightly fitted and secured.
- C. Continuously seal jointed pieces by continuous welds.
- D. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.
- E. Exposed Mechanical Fastenings: Flush countersunk screws or bolts, unobtrusively located, consistent with design of component, except where specifically noted otherwise.
- F. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

- G. Accurately form components required for anchorage of stairs and landings and railings to each other and to building structure.

2.03 FABRICATION - OPEN GRATING STAIRS

- A. Fabricate treads 1.75-inch-thick in accordance with ANSI A202.1 of welded steel bars, welded, bolted to supports; prime paint finish.
- B. Form stringers with rolled steel channels prime paint finish.
- C. Form balusters with 1.5-inch diameter steel sections, welded to stringers; prime paint finish.

2.04 FINISHES

- A. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.
- B. Do not prime surfaces in direct contact with concrete or where field welding is required.
- C. Prime paint items with one coat.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive work.
- B. Beginning of installation means erector accepts existing conditions.

3.02 PREPARATION

- A. Clean and strip primed steel items to bare metal where site welding is required.

3.03 INSTALLATION

- A. Install items plumb and level, accurately fitted, free from distortion or defects.
- B. Provide anchors, plates and angles required for connecting stairs to structure.
- C. Allow for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.
- D. Field weld components indicated on Drawings. Perform field welding in accordance with AWS D1.1.
- E. Field bolt and weld to match shop bolting and welding. Conceal bolts and screws whenever possible.
- F. Mechanically fasten joints butted tight, flush, and hairline. Grind welds smooth and flush.

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- G. Obtain Contracting Officer's approval prior to site cutting or making adjustments not scheduled.
- H. After erection, prime welds, abrasions, and surfaces not shop primed, except surfaces to be in contact with concrete.

3.04 ERECTION TOLERANCES

- A. Maximum Variation from Plumb: 1/4 inch.
- B. Maximum Offset from True Alignment: 1/4 inch.

+++END OF SECTION+++

**SECTION 07100
WATERPROOFING AND MOISTUREPROOFING**

PART 1 - GENERAL

1 SCOPE

- A. This section specifies waterproofing and moisture proofing of concrete surfaces and below grade masonry surfaces.

PART 2 - PRODUCTS

1 MATERIALS

- A. Waterproofing and Moistureproofing Coatings: Waterproofing and moistureproofing coating shall be PVC lining where shown on the Drawings or epoxy resin. Acceptable epoxy resin products are Tnemec Series 69, Ameron Amercoat 351, and Porter 7600 Series Magna Coat. Each of these is a polyamidoamine epoxy.
- B. Waterproofing Membrane:
 - 1. Membrane: Waterproofing membrane shall be Bituthene as manufactured by W.R. Grace and Company, Jiffy Seal as manufactured by Protecto Wrap Co., or equal. Volclay Panels or Bentonize bentonite system are acceptable alternates, except where membrane is required between concrete slabs or where there is concrete over waterproofing membrane.
 - 2. Protective Board: Protective board shall be 1/2-inch asphalt impregnated celotex insulation board.
- A. Moistureproofing Underlay:
 - 1. Plastic Membrane: Plastic reinforced membrane for moistureproofing underlay shall be a reinforced film with a thickness of 15 mils.
 - 2. Pressure Sensitive Tape: Pressure sensitive tape shall be 2-inch wide polyethylene tape.

PART 3 - EXECUTION

1. CONSTRUCTION

A. Waterproofing Coating:

1. Location: Waterproofing coating shall be applied to the water side of walls and bottoms of channels or tanks which are common with rooms, tunnels or galleries to be occupied by equipment, piping, conduit, or personnel.
2. Surface Preparation: New concrete to be waterproofed shall have aged at least 28 days and allowed to dry to a moisture content recommended by the coating manufacturer. Loose concrete and laitance shall be removed from new concrete surfaces by abrasive blasting. Voids and cracks shall be repaired as specified in Section 03300, CAST-IN-PLACE CONCRETE.
3. Application: Two or more coats at manufacturer's recommended dry film thickness. Total dry film thickness shall be minimum 16 mils, final coat shall be black. Drying time between coats shall be as recommended by the coating manufacturer.

B. Moistureproofing Coating:

1. Location: Moistureproofing coating shall be applied to the earth side of concrete or masonry walls which are below grade and are common with rooms, tunnels, or galleries to be occupied by equipment, piping, or personnel. Moistureproofing coating is not required for walls to be provided with waterproofing membrane or for walls which are poured directly against an excavated surface.
2. Surface Preparation: Preparation of concrete shall conform to Paragraph Surface Preparation. Masonry surfaces shall be allowed to age for at least 28 days. Holes or other joint defects shall be filled with mortar and repointed. Loose or splattered mortar shall be removed by scraping and chipping. Masonry surfaces shall be cleaned with clear water by washing and scrubbing. Muriatic acid shall not be used. After cleaning, masonry surfaces shall be sealed or filled with sealer or block filler compatible with the specified primer. Sealer or filler shall dry a minimum of 48 hours prior to application for prime coat.
3. Application: One or more coats shall be applied at the manufacturer's recommended dry film thickness. The number of finish coats shall be sufficient to produce a total dry film thickness of at least 16 mils. Drying time between coats shall be as recommended by the coating manufacturer.

C. Waterproofing Membrane:

1. Location: Waterproofing membrane shall be applied to surfaces as specified.

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2. Surface Preparation: Concrete surfaces to receive waterproofing membrane shall be clean, dry, and free of voids, spalled areas, loose aggregate, and sharp protrusions, with no coarse aggregate visible.
3. Application: Waterproofing membrane shall be applied in accordance with the manufacturer's recommendations. Surfaces shall be clean and primed prior to application of the membrane. The manufacturer's representative shall be present during initial application to certify that the Contractor's procedures comply with manufacturer's specifications. Pipes or conduits entering structures shall be watertight. The protective board shall be placed directly against the membrane prior to backfilling. Where the membrane is turned up from the base of the walls, at angles in walls, and at any other place where the membrane may be subjected to unusual strain, strips consisting of two additional plies of membrane shall be applied.

D. Moistureproofing Underlay:

1. Location: Unless otherwise specified, moistureproofing underlay shall be provided under concrete floors or floating slabs-on-grade including those deposited on drain rock.
2. Surface Preparation: Backfilled surfaces to receive moistureproofing underlay shall be leveled off and smoothed over to minimize contact with sharp edges.
3. Application: At joints, moistureproofing membrane shall be lapped 12 inches and sealed with pressure sensitive tape. Where pipes and conduits pass through the membrane, they shall be wrapped tightly with separate sheets of membrane which shall then be sealed with tape to the main membrane. Reinforcing steel or wire mesh shall be supported by chairs with flat bases to protect the membrane.

+++ END OF SECTION 07100 +++

**SECTION 07115
SELF-ADHESIVE SHEET WATERPROOFING**

PART 1 - GENERAL

1.01 SCOPE

- A. Section Includes:
1. Substrate preparation.
 2. Primer.
 3. Waterproofing membrane.
 4. Edge and penetration detailing material.
 5. Protection board.

1.02 SUBMITTALS

- A. Submittals shall be made in accordance with the requirements of the General Conditions of the Contract Documents. In addition, the following specific information shall be provided:
1. Manufacturer's technical product data, installation instructions, recommendations for use of each product required.
 2. 12-inch square samples of membrane material.
 3. 6-inch square samples of protection board.

1.03 QUALITY ASSURANCE

- A. Reference Standards. Comply with all Federal and State laws or ordinances, as well as all applicable codes, standards, regulations and/or regulatory agency requirements including the partial listing below:
1. ASTM C 144-93, Standard Specification for Aggregate for Masonry Mortar; 1993.
 2. ASTM C 150-92 -- Standard Specification for Portland Cement; 1992.
 3. ASTM D 146-90 -- Standard Test Methods for Sampling and Testing Bitumen-Saturated Felts and Woven Fabrics for Roofing and Waterproofing; 1990.
 4. ASTM D 412-92 -- Standard Test Methods for Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers-Tension; 1992.
 5. ASTM E 154-88 -- Standard Test Methods for Water Vapor Retarders Used in Contact with Earth under Concrete Slabs, on Walls, or as Ground Cover; 1988.

1.04 QUALITY STANDARDS

- A. The waterproofing system shall be furnished by a single manufacturer who shall assume sole responsibility for providing a complete, operating system designed for long life with a minimum of required maintenance meeting the requirements

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specified herein and as shown on the Drawings.

- B. **Manufacturer Qualifications:** A company that has produced waterproof membrane and accessories of the type included in this section for at least 5 years.
- C. **Installer Qualifications:** A company approved by the membrane manufacturer and which has completed at least 20 previous installations of membranes similar to the type required.
- D. **Manufacturer shall provide written certification that the systems provided under this Specification have been designed in accordance with these specifications and are a suitable application for these service conditions.**
- E. **Manufacturer's offering products that comply with these specifications include:**
 - 1. Mirafi Division/The Nicolon Corporation.
 - 2. Polyguard Products, Inc.
 - 3. Polyken Technologies Division/The Kendall Company.
 - 4. Progress Unlimited, Inc.
 - 5. Protecto Wrap Company.
 - 6. Royston Laboratories Division/Chase Corporation.
 - 7. W. R. Grace & Company.
 - 8. W. R. Meadows, Inc.
 - 9. Or equal.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to project site in manufacturer's original, unopened containers.
- B. Store materials in dry, well ventilated space.
- C. Protect membrane materials from prolonged sunlight exposure.

1.06 SITE CONDITIONS

- A. Comply with manufacturer's recommendations regarding weather conditions before and during installation, condition of substrate to receive waterproofing, and protection of installed waterproofing system.
 - 1. Do not install membrane or primer during wet weather or when temperature is below 25 degrees F.
- B. Do not leave membrane exposed to sunlight.

1.07 WARRANTY

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- A. Provide a warranty against defective equipment and workmanship in accordance with the requirements of the General Conditions of the Contract Documents.
- B. Special Project Warranty: Submit a written warranty signed by manufacturer and installer, guaranteeing to correct failures in product and workmanship which occur within period indicated, without reducing or otherwise limiting any other rights to correction which the City may have under the Contract Documents. Failure is defined to include faulty workmanship, or product failure which contributes to failure of watertight condition.
 - 1. Warranty period duration: 10 years, starting at date of substantial completion.

PART 2 - PRODUCTS

2.01 SELF-ADHESIVE SHEET WATERPROOFING MEMBRANE

- A. Standard Membrane: Self-adhesive, unreinforced, polyester-reinforced, or fiberglass-reinforced rubberized asphalt core bonded to 4-mil-thick polyethylene or polyester film. Packaged in rolls with disposable release paper.
 - 1. Nominal thickness: 0.060 inch (60 mils) minimum.
 - 2. Width: 36 or 48 inches, nominal.
 - 3. Tensile strength (ASTM D 412, modified): 250 psi minimum.
 - 4. Elongation (ASTM D 412, modified): 250 percent minimum.
 - 5. Pliability (ASTM D 146; 1-inch mandrel, 180 degree bend, minus 25 degrees F): No cracks.
 - 6. Puncture resistance (ASTM E 154): 40 pounds, minimum.
 - 7. Peel resistance: 5 pounds per inch, minimum.
- B. Provide specially formulated low-temperature membrane if application temperatures below 40 degrees F are likely; otherwise provide manufacturer's standard membrane.

2.02 INSTALLATION ACCESSORIES

- A. Primer: Fast-drying, solvent-based rubber material, made by manufacturer of membrane, specifically intended for use with membrane.
 - 1. High solids content, with low volatile organic compound emissions.
 - 2. Provide special primer formulation for application at temperatures below 40

degrees F.

- B. Detailing Mastic: Solvent-based rubberized asphalt mastic, made by manufacturer of membrane for sealing of edges and penetrations.
- C. Latex-Modified Mortar: Proprietary; premixed and bagged, or site-mixed as follows:
 - 1. Latex (acrylic) admixture: Proprietary non-reemulsifiable acrylic liquid compound, specifically manufactured to improve cohesion, tensile strength, and adhesive properties of portland cement mortars and concrete.
 - 2. Sand: Clean, sharp masonry sand; ASTM C 144.
 - 3. Cement: ASTM C 150, Type I.
 - 4. Mix: 2-1/2 parts sand (by volume), 1 part cement, 50/50 mix of water and latex admixture to provide workability.

2.03 PROTECTION BOARD

- A. Asphalt/Mineral Fiberboard: Semi-rigid sheets of fiberglass or mineral-reinforced asphaltic core, pressure-laminated between two asphalt-saturated fibrous liners.
- B. Protection Board Adhesive: Rubber-based solvent type recommended by membrane manufacturer.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces are smooth, sound, clean, and dry and that elements which will penetrate waterproofing have been completed and are rigidly installed.

3.02 PREPARATION

- A. Remove honeycomb, aggregate pockets, fins, ridges, and projecting rough areas.
- B. Fill cracks, holes, depressions, and irregularities with latex patching mortar, sealant, or detailing mastic as recommended by membrane manufacturer.
- C. Apply one coat of primer at the rate of 200 to 300 square feet per gallon and allow to dry.
- D. Form fillets (cants) at inside corners and around projecting elements using latex patching mortar or detailing mastic and install 10- to 12-inch-wide strip of membrane

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material.

- E. Outside Corners: Apply 10- to 20-inch-wide strip of membrane material centered on corner.

3.03 MEMBRANE INSTALLATION

- A. Place and adhere membrane over entire area to receive waterproofing. Lap seams a minimum of 2-1/2 inches and seal using a hand-held steel roller. Heat-weld end laps if recommended by manufacturer.
- B. Slit and flatten fishmouths and blisters. Cover damaged area with patch of membrane material extending a minimum of 6 inches beyond damaged area in all directions.
- C. Apply detailing mastic at membrane edges and at penetrations. Detailing mastic may be omitted where membrane terminates in a reglet.

3.04 PROTECTION COURSE

- A. Install protection board over membrane as soon as practicable after membrane installation to avoid damage to membrane from sunlight and subsequent operations.

3.05 INSPECTION

- A. Do not cover membrane before it has been observed by the Engineer.

3.06 PROTECTION AND CLEANING

- A. Protect completed membrane installation from damage until project completion.
- B. Do not permit traffic on exposed membrane.
- C. Clean spillage and soiling from adjacent surfaces, using cleaning agents and procedures recommended by the manufacturer of the surface.

+++ END OF SECTION 07115 +++

**SECTION 07190
VAPOR BARRIER**

PART 1 - GENERAL

1.01 SCOPE

- A. The Contractor shall furnish all materials, labor, equipment, and incidentals required to perform all vapor barrier work and related work necessary for the proper completion of the project as required by the Drawings and as specified herein.

1.02 RELATED WORK

- A. Related Work Specified Elsewhere:
 - 1. Section 03300, CAST-IN-PLACE CONCRETE.

1.03 SUBMITTALS

- A. Submit to the Architect/Engineer as provided in the General Conditions for shop drawings, detailed information on materials proposed and installation methods.

PART 2 - PRODUCTS

2.01 MOISTURE BARRIER (UNDER CONCRETE SLABS)

- A. Where so indicated on the Drawings, provide a moisture barrier consisting of pre-molded, membrane meeting the standard of ASTM E-96, Method B, 1980 and ASTM D781, 1968, ASTM D1228, 1964.
- B. Manufacturers:
 - 1. Stego Wrap Vapor Barrier (15-mil)
 - 2. Or equal.

2.02 OTHER MATERIALS

- A. Provide other materials, not specifically described but, required for a complete and proper installation, as selected by the Contractor subject to the approval of the Engineer.

PART 3 - EXECUTION

3.01 SURFACE PREPARATION

- A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

3.02 INSTALLATION

- A. Install vapor barrier under concrete slabs-on-grade, sealing all lap joints, around all protrusions, and at slab edges.
- B. Vapor barrier to extend continually from the top of footing or to be sealed to the foundation wall, or to extend to the outside edge of a monolithic slab or patio.
- C. Vapor barrier should be installed with all seams lapped at least 12 inches, taped and sealed with plastic roof cement, or other flexible air tight seal as approved by the Engineer.
- D. All punctures in vapor barrier to be repaired with same material, lapped at least 12 inches, taped and sealed.
- E. Field fabricate a sealing boot around all utility entries and other penetrations and seal boot airtight to vapor barrier and conduit.

+++ END OF SECTION 07190 +++

**SECTION 07210
BUILDING INSULATION**

PART 1 - GENERAL

1.01 SCOPE

A. Work described in this Section includes furnishing all labor, materials, equipment, tools and incidentals required for a complete installation of all building insulation. All insulation shall be installed in accordance with these Specifications, the manufacturer's recommendations and as shown on the Drawings.

B. Related Work Specified Elsewhere:

1. Section 03300: Cast-in-Place Concrete
2. Section 07150: Dampproofing
3. Section 07270: Firestopping

1.02 REFERENCES

A. Standards of the following as referenced:

1. American Society for Testing and Materials (ASTM).
2. Federal Specifications (Fed. Spec.).
3. The Society of the Plastics Industry, Inc. (SPI).
4. Underwriters Laboratories, Inc. (UL).

1.03 DEFINITIONS

A. Terms:

1. Rigid Closed Cell Polyisocyanurate

1.04 SUBMITTALS

A. Submittals shall be made in accordance with the requirements of the General Conditions of the Contract Documents. In addition, the following specific information shall be provided:

1. Product data and installation instructions for each type insulation and installation.
2. Certificates indicating materials supplied or installed are asbestos free.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Storage and handling:

1. Store materials under cover, off ground: protect from moisture.

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2. Remove wet, damaged, or deteriorated materials.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Roof Deck and Wall Cavity insulation:

1. Acceptable manufacturers, subject to compliance with specified requirements:
 - a. Certain Teed Corporation.
 - b. Knauf Fiber Glass.
 - c. John Manville Sales Company.
 - d. Owens Corning Fiberglas Corp.
2. Characteristics:
 - a. Type: Rigid polyisocyanurate insulation board.
 - b. Facing:
 - 1) Foil Faced for Wall and Fiberglass reinforce Face for roof insulation.
 - c. "R" value: R-11.4 min, vertical cavity-wall installations; 2 layers of R-30 min. horizontal roof installations.

PART 3 - EXECUTION

3.01 INSTALLATION

- ##### A. General: Comply with manufacturer's product data for each type installation. Cut insulation around obstructions and protrusions. Remove projections interfering with installation.

+++ END OF SECTION 07210 +++

**SECTION 07700
ROOF ACCESSORIES**

PART 1 GENERAL

1.01 SCOPE

- A. Work described in this Section includes furnishing all labor, materials, equipment, tools and incidentals required for a complete installation of all roof accessories. All equipment shall be installed, adjusted and tested in accordance with these Specifications, the manufacturer's recommendations and as shown on the Drawings.
- B. Contract drawings show only functional features and some of the required external connections. They do not show all components required for a complete installation nor exact dimensions particular to any manufacturer's equipment. Contractor shall supply all parts, devices and equipment necessary to meet the requirements of the Contract Documents and shall make all dimensional adjustments particular to the equipment being furnished. All costs associated with such changes and adjustments shall be considered as being included in the price bid for the Work shown and specified.

1.02 SUBMITTALS

- A. Submittals shall be made in accordance with the requirements of the General Conditions. In addition, the following specific information shall be provided:
 - 1. Product Data: Submit manufacturer's technical product data, rough-in diagrams, details, installation instructions and general product recommendations.

1.03 QUALITY ASSURANCE

- A. Reference Standards. Comply with all Federal and State laws or ordinances, as well as all applicable codes, standards, regulations and/or regulatory agency requirements including the partial listing below:
 - 1. ASTM A167, Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet and Strip
 - 2. ASTM A653/A653M, Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
 - 3. ASTM A526/A526M Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Commercial Quality
 - 4. ASTM B209, Specification for Aluminum and Aluminum-Alloy Sheet and Plate

5. ASTM B370, Specification for Copper Sheet and Strip for Building Construction
6. ASTM D2822, Specification for Asphalt Roof Cement
7. ASTM D4586, Specification for Asphalt Roof Cement, Asbestos-Free

1.04 QUALITY STANDARDS

- A. The roof accessories shall be furnished by a single manufacturer who shall assume sole responsibility for providing a complete, operating system designed for long life with a minimum of required maintenance meeting the requirements specified herein and as shown on the Drawings.
- B. Manufacturer shall provide written certification that the equipment provided under this Specification has been amply designed and is a suitable application for these service conditions.

1.05 WARRANTY

- A. Provide a warranty against defective equipment and workmanship in accordance with the requirements of the General Conditions of the Contract Documents.

PART 2 - PRODUCTS

2.01 GENERAL PRODUCT REQUIREMENTS

- A. Provide manufacturer's standard units, modified as necessary to comply with requirements. Shop fabricate each unit to greatest extent possible.

2.02 MATERIALS, FOR ROOF CURBS

- A. None.

2.03 PREFABRICATED ROOF HATCHES

- A. None.

2.04 PREFABRICATED PIPE BOOT

- A. None.

2.05 COMBINED ROOF DRAIN AND SECONDARY OVERFLOW SYSTEM

- A. MIFAB Series R1154-M-13-SPEC-U combined roof drain and secondary overflow system, consisting of a one piece lacquered cast iron roof drain body

with integral sump receiver, no hub outlet, cast iron waterproofing membrane clamp rings with integral gravel stops, one 2-1/2" (64) high integral cast iron overflow standpipe and two self-locking metal dome strainers with a free area of 43 square inches each. Or approved equal.

2.06 ROOF DRAIN FOR INSULATED ROOF DECK

A. MIFAB Series R1104-EU-13 lacquered cast iron roof drain with anchor flange, cast iron waterproofing membrane clamp ring with integral gravel stop, adjustable cast iron extension flange, underdeck clamp, no hub outlet, and standard self-locking galvanized dome strainer with a free area of 43 square inches. Or approved equal.

2.07 SECONDARY OVERFLOW ROOF DRAIN FOR INSULATED ROOF DECK

A. MIFAB Series R1104-EU-13-W lacquered cast iron roof drain with anchor flange, cast iron waterproofing membrane clamp ring with integral gravel stop, adjustable cast iron extension flange, underdeck clamp, no hub outlet, standard self-locking galvanized dome strainer with a free area of 43 square inches, and an adjustable water dam to be set at 2.5" above the primary roof drain level. Or approved equal.

2.08 OVERFLOW DRAIN NOZZLE

A. Jay R. Smith Mfg. Co. Downspout Nozzle 1770T-BS-NB, sized as indicated on the plumbing drawings, used as a parapet overflow where a concealed leader discharges rainwater to the roof and ground. The wall flange covers rough opening and serves as anchor. Provide bird-screen; finish to be nickel bronze. Or approved equal.

2.07 ROOFING UNDERLAYMENT

A. GCP Applied Tech Ice and Water Shield HT, or approved equal.

PART 3 - EXECUTION

3.01 INSTALLATION OF ROOF CURBS AND ROOF ACCESS HATCHES

- A. General: Comply with manufacturer's instructions and recommendations. Coordinate with installation of roof deck and other substrates to receive accessory units, and with vapor barriers, roof insulation, roofing and flashing as required to ensure that each element of the work performs properly, and that combined elements are waterproof and weathertight. Anchor units securely to supporting structural substrates, adequate to withstand lateral and thermal stresses as well as inward and outward loading pressures. Except as otherwise indicated install roof accessory items in accordance with construction details of "NRCA Roofing and Water-proofing Manual."
- B. Isolation: Where metal surfaces of units are to be installed in contact with noncompatible metal or corrosive substrates, including wood, apply bituminous

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coating on concealed metal surfaces, or provide other permanent separation.

- C. Flange Seals: Except as otherwise indicated, set flanges of accessory units in a thick bed of roofing cement to form a seal.
- D. Cap Flashing: Where cap flashing is required as component of accessory, install to provide adequate waterproofing overlap with roofing or roof flashing (as counter flashing). Seal watertight with thick bead of mastic sealant.
- E. Operational Units: Test operate units with operable components. Clean and lubricate joints and hardware. Adjust for proper operation.
- F. Install pipe boot flashing as shown and as recommended by manufacturer.

3.02 CLEANING AND PROTECTION

- A. Clean exposed metal and plastic surfaces in accordance with manufacturer's instructions. Touch up damaged metal coatings.

+++ END OF SECTION 07700 +++

**SECTION 07900
CAULKING AND SEALANTS**

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. The Contractor shall furnish all materials, labor, equipment, and incidentals required to perform all caulking, and related work necessary for the proper completion of the project as required by the Drawings and as specified herein.
- B. Contract drawings show only functional features and some of the required external connections. They do not show all components required for a complete installation nor exact dimensions particular to any manufacturer's equipment. Contractor shall supply all parts, devices and equipment necessary to meet the requirements of the Contract Documents and shall make all dimensional adjustments particular to the equipment being furnished. All costs associated with such changes and adjustments shall be considered as being included in the price bid for the Work shown and specified.

1.02 APPLICATION SCHEDULE

- A. Caulk all exterior wall joints between frames in openings and adjacent materials, between masonry and cast in place concrete, expansion and control joints and all other joints shown on the Drawings or required for the completion of the work.
- B. Caulk all interior joints between frames and masonry, at tops of masonry walls, between masonry and structural concrete and control joints, exterior window and door frames and all other joints shown on the drawings or required for the completion of the work.
- C. Joints of similar nature to those indicated shall be sealed with same sealer, whether indicated on Drawings to be sealed or not.

1.03 SUBMITTALS

- A. Submit to the Engineer as provided in the General Conditions for shop drawings, detailed information on materials proposed and installation methods.
- B. Product Data: Manufacturer's technical data for each joint sealer product required, including instructions for joint preparation and joint sealer application.
- C. Samples for Color Selection: Manufacturer's standard bead samples consisting of strips of actual products showing full range of colors available, for each product exposed to view.
- D. Samples for Color Verification: Samples of each type and color of joint sealer required. Install joint sealer samples in 1/2 inch wide joints formed between two 6 inch long strips of material matching the appearance of exposed surfaces adjacent to joint sealers in the

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Work.

1.04 QUALITY ASSURANCE

A. Applicable standards: Standards of the following, as referenced herein:

1. ASTM C 920-98 Standard Specification for Elastomeric Joint Sealants, 1998.

B. Preinstallation Meeting: The contractor shall arrange a meeting with installer, sealer manufacturers' representatives, and other trades whose work affects installation of sealers at project site to review procedures and time schedule proposed for installation of sealers which is coordinated with other related work.

1.05 WARRANTY

A. Provide a warranty against defective equipment and workmanship in accordance with the requirements of the General Conditions of the Contract Documents.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to project site in original unopened containers or bundles with labels showing manufacturer, product name and designation, color, expiration period for use, pot life, curing time, and mixing instructions for multicomponent materials.

B. Store and handle materials to prevent their deterioration or damage due to moisture, temperature changes, contaminants, or other causes.

1.07 PROJECT CONDITIONS

A. Environmental Conditions: Do not proceed with installation of sealers under the following conditions:

1. When ambient and substrate temperature conditions are outside the limits permitted by sealer manufacturer or below 40 degrees F (4.4 degrees C).
2. When substrates are wet due to rain, frost, condensation, or other causes.

B. Joint Dimension Conditions: Do not proceed with installation of sealers when joint dimensions are less than recommended by joint sealer manufacturer for application indicated.

PART 2 - PRODUCTS

2.01 CAULKING

A. Caulking Compound: One component, synthetic rubber base sealant, soft curing, nonstaining, conforming to F.S. TT-S-00230 and Thiokol's Building Trade Performance Specifications for Type 1 Class B sealants. Colors shall be selected by the Engineer.

Acceptable Manufacturer

- a. Dow Corning Corporation;
 - b. GE Advanced Materials
 - c. Pecora Corporation
 - d. Sika Corporation
 - e. Tremco Incorporated; Spectrem
- B. Primer: As recommended by caulking compound manufacturer.
- C. Back-up Material: Closed cell foam polyethylene, or similar non-bituminous material as recommended by manufacturer of caulking compound and completely compatible with selected compound.

PART 3 - EXECUTION

3.01 SURFACE PREPARATION AND INSTALLATION

- A. Remove dirt, grease, mortar droppings and other foreign matter from substrate.
- B. Require installer to inspect joints indicated to receive joint sealers for compliance with requirements for joint configuration, installation tolerances and other conditions affecting joint sealer performance. Do not allow joint sealer work to proceed until unsatisfactory conditions have been corrected.

3.02 CAULKING

- A. Surface Preparation: Clean metal surfaces free of grease, oil, wax lacquer, and other foreign residue by wiping with a clean cloth moistened with a suitable solvent. Scape or brush masonry surfaces clean. Apply appropriate primer to contact surfaces.
- B. Joint Preparation: Joints to be caulked having a depth in excess of 3/8-inch shall be packed with back-up material. Round back-up material shall be sized to require 20 percent to 50 percent compression upon insertion. In joints not of sufficient depth to allow packing, install polyethylene bond-breaking tape at back of joint. Avoid lengthwise stretching of back-up material. Cut all corners, avoid wrapping around corners.
- C. Application: Apply compound with pressure flow gun with nozzle of proper size and shape to suit width of joint, promptly after mixing and with sufficient pressure to fill joint. Apply as a continuous operation horizontally in one direction, and vertically from bottom to top, except joints having excessive widths where compound might sag, the joints shall be built up with successive beads. Finish joints smooth and slightly coved.

3.03 PROTECTION AND CLEANING

- A. Protect joint sealers during and after curing period from contact with contaminating substances or from damage resulting from construction operations or other causes so that they are without deterioration or damage at time of substantial completion. If, despite

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such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealers immediately and reseal joints with new materials to produce joint sealer installations with repaired areas indistinguishable from original work.

- B. Clean off excess sealants or sealant smears adjacent to joints as work progresses by methods and with cleaning materials approved by manufacturers of joint sealers and of products in which joints occur.

+++ END OF SECTION 07900 +++

**SECTION 08305
ACCESS HATCHES**

PART 1 GENERAL

1.01 SCOPE

- A. The Contractor shall furnish all labor, materials, equipment and incidentals required and install all access hatches as shown on the Drawings and specified herein.
- B. (Not Used)

1.02 SUBMITTALS

- A. Submittals shall be made in accordance with the requirements of the General Conditions of the Contract Documents. In addition, the following specific information shall be submitted:
 - 1. Manufacturer's data on all materials listed in Part 2 of this Section.
 - 2. Detail drawings showing sizes of members, method of assembly, anchorage, and connection to other members shall be submitted to the Engineer for review before fabrication.
 - 3. Certification that submitted hatches meet specified load ratings.
 - 4. Executed copy of manufacturer's standard warranty.
- B. (Not Used)

1.03 QUALITY ASSURANCE

- A. Reference Standards: The Contractor shall comply with the applicable provisions and recommendations of the latest editions of the following standards, except as otherwise shown on the Drawings or specified herein.
 - 1. ASTM A36 – Standard Specification for Carbon Structural Steel
 - 2. ASTM A48 – Standard Specification for Grey Iron Castings
 - 3. ASTM A53 – Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless

4. ASTM A123 – Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
5. ASTM A153 – Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
6. ASTM A167 – Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet and Strip
7. ASTM A276 – Standard Specification for Stainless Steel Bars and Shapes
8. ASTM A307 – Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength
9. AWS Specifications for Arc Welding

B. (Not Used)

1.04 COORDINATION

- A. The work of this Section shall be completely coordinated with the work of other Sections.
- B. Verify at the site both the dimensions and work of other trades adjoining items of work in this Section before fabrication and installation of items herein specified.
- C. Furnish to the pertinent trades all items included under this Section that are to be built into the work of other Sections.

1.05 FIELD MEASUREMENTS

- A. Field measurements shall be taken at the site to verify or supplement indicated dimensions and to insure proper fitting of all items.
- B. (Not Used)

1.06 PRODUCT HANDLING

- A. Protection: Use all means necessary to protect the materials of this section, before during and after installation and to protect the work and materials of all other trades.
- B. Delivery and storage: Deliver materials to the jobsite, and store in a safe dry place with all labels intact and legible at the time of installation.

- C. Replacement: In the event of damage, immediately make all repairs and replacements necessary to the approval of the Engineer and at no additional cost to the Owner.

1.07 WARRANTY

- A. Provide a warranty against defective equipment and workmanship in accordance with the requirements of the General Conditions of the Contract Documents.
- B. (Not Used)

PART 2 PRODUCTS

2.01 HATCH SCHEDULE

Location	Quantity	Size	Description	Load Rating	Model
Tunnel Drop Structure	2	2'-6" x 4'	Single Leaf Aluminum Access Hatch	300 psf	Bilco J-6AL or equal
Meter Vault	1	8'x2'6"	Service Stair Aluminum Access Hatch	300 psf	Bilco L-50 or equal
Meter Vault	1	8'x2'6"	Service Stair Aluminum Access Hatch	300 psf	Bilco L-50 or equal

2.02 SINGLE LEAF ALUMINUM ACCESS HATCHES

- A. Size: 30"W x 48"L.
- B. Material: Cover and frame are 1/4" (6 mm) aluminum
- C. Cover: Diamond-pattern tread plate reinforced for 300 psf (1464 kg/m²) live load.
- D. Frame: Extruded aluminum channel frame with bend down anchor tabs around the perimeter. A 1-1/2" (38mm) drain coupling is welded under the frame for a pipe connection to a dry well or disposal system
- E. Hinges: Heavy forged Type 316 stainless steel hinges with 1/4" (6 mm) type 316 stainless steel hinge pins.
- F. Latch: Type 316 stainless steel slam lock with fixed interior handle and removable exterior turn/lift handle. Latch release is protected by a flush, gasketed, removable screw plug

- G. Lift Assistance: Compression spring operators enclosed in telescopic tubes. Automatic hold-open arm with release handle automatically locks cover(s) in the open position.
- H. Finish: Mill Finish aluminum with a bituminous coating applied to the exterior of the frame.
- I. Hardware: Type 316 stainless steel throughout

2.03 SERVICE STAIR ALUMINUM ACCESS HATCHES

- A. Furnish and install where indicated on plans service stair aluminum access hatches, size width: 30" x length: 96". Length denotes hinge side. The roof hatch shall be single leaf. The roof hatch shall be pre-assembled from the manufacturer.
- B. Performance characteristics:
 - 1. Cover shall be reinforced to support a minimum live load of 40 psf with a maximum deflection of 1/150th of the span or 20 psf wind uplift.
 - 2. Operation of the cover shall be smooth and easy with controlled operation throughout the entire arc of opening and closing.
 - 3. Operation of the cover shall not be affected by temperature.
 - 4. Entire hatch shall be weathertight with fully welded corner joints on cover and curb.
- C. Cover: Shall be 11 gauge aluminum with a 3" (76mm) beaded flange with formed reinforcing members. Cover shall have a heavy extruded EPDM rubber gasket that is bonded to the cover interior to assure a continuous seal when compressed to the top surface of the curb.
- D. Cover insulation: Shall be fiberglass of 1" thickness, fully covered and protected by a 18 gauge aluminum liner.
- E. Curb: Shall be 12" in height and shall be 11 gauge aluminum. The curb shall be formed with a 3-1/2" flange with 7/16" holes provided for securing to the roof deck. The curb shall be equipped with an integral metal capflashing of the same gauge and material as the curb, fully welded at the corners, that features the Bil-Clip® flashing system, including stamped tabs, 6" on center, to be bent inward to hold single ply roofing membrane securely in place.
- F. Curb insulation: Shall be rigid, high-density fiberboard of 1" (25mm) thickness on outside of curb.
- G. Lifting mechanisms: Manufacturer shall provide compression spring operators enclosed in telescopic tubes to provide, smooth, easy, and controlled cover operation throughout the entire arc of opening and closing. The upper tube shall be the outer

tube to prevent accumulation of moisture, grit, and debris inside the lower tube assembly. The lower tube shall interlock with a flanged support shoe welded to the curb assembly.

H. Hardware

1. Heavy pintle hinges shall be provided.
2. Cover shall be equipped with an enclosed two point spring latch with interior and exterior turn handles.
3. Roof hatch shall be equipped with interior and exterior padlock hasps.
4. The latch strike shall be a stamped component bolted to the curb assembly.
5. Cover shall automatically lock in the open position with a rigid hold open arm equipped with a 1" (25mm) diameter red vinyl grip handle to permit easy release for closing.
6. Compression spring tubes shall be an anti-corrosive composite material and all other hardware shall be zinc plated and chromate sealed. Use Type 316 Stainless Steel Hardware.
7. Cover hardware shall be bolted into heavy gauge channel reinforcing welded to the underside of the cover and concealed within the insulation space.
8. Finishes: Factory finish shall be mill finish aluminum.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install all items furnished except items to be imbedded in concrete which shall be installed under Division 3. Items to be attached to concrete or masonry after such work is completed shall be installed in accordance with the details shown and in accordance with manufacturer's instructions and approved shop drawings. All dimensions shall be verified at the site before fabrication is started.
- B. Where aluminum contacts a dissimilar metal, apply a heavy brush coat of zinc- chromate primer followed by two coats of aluminum metal and masonry paint to dissimilar metal.
- C. Where aluminum contacts concrete, apply a heavy coat of approved alkali resistant paint to the concrete.

+++ END OF SECTION 08305 +++

**SECTION 08710
FINISH HARDWARE**

PART 1 - GENERAL

1.01 SCOPE

- A. Work described in this Section includes furnishing all labor, materials, equipment, tools and incidentals required for a complete installation of all finish hardware including door butts, hinges and closures. All equipment shall be installed, adjusted, tested and placed in operation in accordance with these Specifications, the manufacturer's recommendations and as shown on the Drawings.
- B. Contract drawings show only functional features and some of the required external connections. They do not show all components required for a complete installation nor exact dimensions particular to any manufacturer's equipment. Contractor shall supply all parts, devices and equipment necessary to meet the requirements of the Contract Documents and shall make all dimensional adjustments particular to the equipment being furnished. All costs associated with such changes and adjustments shall be considered as being included in the price bid for the Work shown and specified.
- C. Related Work Specified Elsewhere:
 - Section 08110, Steel Doors and Frames
 - Section 08331, Overhead Rolling Doors
 - Section 08210, Wood Doors

1.02 QUALITY ASSURANCE

- A. Provide hardware in compliance with the local building code requirements. Also comply with NFPA101 Life Safety Code and ANSI A117.1 where applicable.
- B. Provide hardware for fire rated openings in accordance with NFPA80, Fire Doors and Windows and NFPA105 Smoke and Draft Control Door Assemblies.
- C. Provide the services of a finish hardware supplier who has been furnishing hardware in the project's vicinity for a period of not less than two (2) years and is an experienced hardware consultant (AHC). The consultant shall be available during the course of the work to the Engineer and Contractor.

1.03 SUBMITTALS

- A. Submittals shall be made in accordance with the requirements of the General Conditions of the Contract Documents. In addition, the following specific information shall be provided:

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1. Complete schedule of hardware. Using the format of this specification, indicate type, number location, and finish of each item. Include manufacturers name and model description, fastening devices, and complete keying schedule. Reference architect's door designation. Submit five (5) copies.
2. Cross-reference between door number and hardware headings.
3. When requested submit physical samples of each item of hardware showing manufacturers name, model, and finish.
4. Furnish templates and approved schedule to each related manufacturer of equipment which require same for the fabrication of their material.

1.04 DELIVERY STORAGE AND HANDLING

- A. Deliver finish hardware to project site in manufacturers protective packaging. All items are to be marked to indicate door opening number, hardware schedule number, or other identifying marks.
- B. Store hardware in secure lock-up area that is dry and lighted.

1.05 WARRANTY

- A. Warrant door closers against failure due to defective materials and workmanship for a period of five (5) years beginning at date of substantial completion. Closers judged defective during this period shall be replaced or repaired at no cost to the owner.
- B. All other warranties and bonds are to be in accordance with the General Conditions of the Contract Documents.

PART 2 - PRODUCTS

2.01 FINISH

- A. Finish, unless otherwise indicated, shall be US26D, satin chrome.
- B. Door closers shall be spray-painted for finish to match adjacent hardware.

2.02 KEYING

- A. All new cylinders shall be keyed to a new Master Key System.
- B. Provide the following number of keys:
 1. Three Change Keys per lock.

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2. Six Master Keys.

2.03 HINGES

A. Acceptable manufacturers:

1. H. Soss
2. Stanley
3. Hager

B. Hinges shall be the types, materials, sizes, and finishes indicated in Finish Hardware Schedule.

1. Provide 4-1/2 inch x 4-1/2 inch size on doors up to 3'0" wide. Provide 5-inch x 4-1/2 inch on doors over 3'0" wide. Provide 1-1/2 pair on doors up to 7'6" and one additional hinge for each 2'6" of door thereafter. All exterior outswing doors shall have N.R.P. feature. Provide hinge types as listed in hardware sets.

2.04 LOCKSETS AND LATCHES

A. Acceptable Manufacturers:

1. Schlage Lock Company
2. Sargent & Company
3. Corbin Div. of Emhart
4. Russwin Div. of Emhart
5. Best Lock Company
6. Or equal.

B. Acceptable lockset series and design:

1. L9000 Series - 06B Design
2. 18-8100 Series - LNL Design
3. 9500 Series - 977L4 Design
4. 5000 Series - L4 Newport Design
5. 35H Series - 14G Design
6. Or equal.

C. Cylinders shall be mortise, six pin type complete with cam and tail piece for exit devices.

2.05 SURFACE MOUNTED DOOR CLOSERS

A. Acceptable manufacturers and product:

1. Rixson-Firemark, Inc.; 2020 Series x SNB
2. LCN
3. Or equal.

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- B. All surface closers shall be of one manufacturer. The closers shall be nonhanded and nonsized. They will be hydraulically controlled and full rack and pinion operation. They shall have cast iron bodies and will have adjustments for backcheck, general speed, and latch speed.
- C. Provide mounting plates as required, hex nuts and bolts for application to hollow metal doors, and thru bolts for application to wood doors.

2.06 STOPS AND MISCELLANEOUS

- A. Acceptable manufacturers:
 - 1. Quality Hardware
 - 2. H. B. Ives Co.
 - 3. Baldwin Hardware Corp.
 - 4. Or equal.
- B. Types as indicated in Hardware Schedule.

2.07 BOLTS

- A. Acceptable manufacturers:
 - 1. Quality Hardware
 - 2. H. B. Ives Co.
 - 3. Baldwin Hardware Corp.
 - 4. Or equal.
- B. Flush bolts shall be 1" x 6-3/4" brass, rectangular front, per lengths indicated, with 3/4" throw. Furnish bottom strike and top strike plate.
- C. Bolts and accessories for use on fire-rated doors shall be Underwriters' Laboratories listed.

2.08 FLAT GOODS

- A. Acceptable manufacturers:
 - 1. Quality Hardware Company
 - 2. Baldwin Hardware Corp.
 - 3. H. B. Ives Co.
 - 4. Accurate
 - 5. Or equal.

2.09 THRESHOLDS AND WEATHERSTRIP

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A. Acceptable manufacturer:

1. Reese
2. Pemko
3. National Guard
4. Or equal.

2.10 WEATHERSTRIPPING: HEAD, JAMBS AND SILL

- A. Acceptable manufacturers shall include National Guard Products, Inc., Pemko Mfg. Company, Zero Weatherstripping Company, Inc., Hager or equal.
- B. The types are as indicated on the hardware Schedule.

2.11 SILENCERS

- A. Silencers shall be rubber, self-lipping, cream color. Provide three silencers for single doors and 2 silencers for pairs of doors.

PART 3 - EXECUTION

3.01 PRELIMINARY

- A. Receive, store in temporary bins, and be responsible for all finish hardware. Tag, index, and file all keys temporarily during construction.
- B. Check all hardware upon arrival on job site against approved Finish Hardware Schedule. Function of hardware shall be examined against the job site conditions and interferences. If exceptions in these regards are found, notify Architect at once and retain subject hardware in its original packing carton. Adjustment and/or substitutions shall be made only as authorized by the Engineer.

3.02 INSTALLATION

- A. Install hardware to doors as listed in the door schedule. Comply with "Recommended Locations for Builders Hardware for Custom Steel Doors and Frames", as published by The Door and Hardware Institute, except for height locations below. Application shall be by skilled workmen, who work with proper equipment, shall be in accord with manufacturer's instructions, fit to work of others accurately, applied securely, and adjusted properly. Hardware let into work of others shall be neatly done from template and shall fit perfectly. Exercise care not to injure work of others.

Locksets and latchsets: Centered 40" A.F.F.
Deadlocks: Centered 60" A.F.F.
Push Plates: Centered 48" A.F.F.
Pulls: Centered 48" A.F.F.

- B. Install finish hardware to template. Cut and fit substrate to avoid substrate damage or

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weakening. Cover cut-outs with hardware item. Mortise work to correct location and size without gouging, splintering, or causing irregularities in exposed finished work.

- C. Where cutting and fitting is required on substrates to be painted or similarly finished, install, fit, and adjust hardware prior to finishing, and then remove and place in original packaging. Reinstall hardware after finishing operation is completed.
- D. Attach thresholds with flathead screws in expansion shields spaced at 24" o.c. maximum and symmetrical with the center of door opening.
- E. Attach door closers to door, whether wood or metal, with hex nut and bolt assemblies. Where closers have stop function, install closer to stop the door before striking obstructions.
- F. All locksets, specialty locks and cylinders shall be installed so as to be made operable via insertion of their keys held with cut edges up, smooth edges down.
- G. Install push/pull sets so as to conceal all back mounted "pull" handle attachments from view on the "push" side of doors.

3.03 CLEANING AND ADJUSTING

- A. At time of hardware installation, adjust each hardware item to perform function intended. Lubricate moving parts with lubricant acceptable to hardware manufacturer.
- B. Prior to "Date of Substantial Completion", readjust and relubricate hardware. Repair or replace defective materials. Clean hardware as recommended by manufacturer to remove dust and stains.

3.04 FASTENINGS

- A. All exposed screws shall be Phillips head, finished to match item and sized to suit job requirements.
- B. Surface applied items such as closers and overhead holders shall be applied with hex nut and bolt assemblies.

3.05 OPERATION AND ADJUSTMENT

- A. After installation, all templates, instruction sheets, installation details, and special tools shall be turned over to the Engineer at Final Acceptance of the building.
- B. After Final Acceptance, the hardware supplier shall be available to instruct Owner's designated personnel in the proper adjustment and maintenance of hardware and finishes.

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 3.06 COORDINATION

- A. Fully coordinate finish hardware installation with other specified systems which relate to installation and ultimate coordinated function intended for a complete operating system.

3.07 HARDWARE SCHEDULE

1. Electrical Building - Hardware Schedule. See – Architectural drawings – A 6 – 101
Door 101-B
Door 101-C
Door 102
Door 103

	Set NO. 1	Doors		
3 PR	Butts	4-1/2 x 4-1/2	626	Hager
1	Latchset	37HON3G626		Best
1	Closer	404QH	Al	LCN
1	Dome Stop	331Es	ALUM	Quality
3	Silencers			
	Set NO. 2	Door		
3 PR	Butts	4-1/2 x 4-1/2	626	Hager
1	Electronic Lockset	Fail Safe		Adam Rite
1	Closure	404QH	Al	LCN

Hardware Sets: - Each Door

Set 3	Doors	Front Entrance		
3 PR	Butts	BB850 x 5" 612		Hager
1	Lockset	35H7FWW14G612SH		Best
1	Closer	4041 CUSH 13 DEL PARALLEL ARM		LCN
1	Threshold	896 BR		Nat Guard
1	Stop	431 ES 612		Quality
1 Set	Weatherstrip	S 182		Accurate
3	Silencers	1337-B		Quality

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Set 4	Doors		
	Butts	BB850 x 4/12" 612	
3 PR	Lockset	35H7G14G12SH	
1	Closer	4040 13	
1	Threshold	890 DKB	
1	Stop	431 ES 612 332 Riser	
1	Weatherstrip	S 812	
1 set			
Set 5	Doors	Gazebo	
	Butts	BB850 x 4 1/2" 612	
3 PR	Lockset	35H7G14G612SH	
1	Closer	4040 13	
1	Threshold	890 DKB	
1	Stop	431 ES 612	
1	Weatherstrip	S182	
1 Set			

+++ END OF SECTION 08710 +++

**SECTION 09900
PAINTING**

PART 1 - GENERAL

1.01 SCOPE

- A. This Section of the Specifications includes, but is not necessarily limited to, standards for cleaning and painting structures and equipment described in the Drawings and Specifications. Furnish all materials, equipment, and labor necessary to complete the Work.
- B. Section includes:
 - 1. Surface preparation to receive finishes.
 - 2. Priming and backpriming interior and exterior finish carpentry.
 - 3. Painting, staining, or otherwise finishing of all surfaces.
 - 4. Finishing millwork.
- C. Related Work Specified Elsewhere
 - 1. Section 04400, Masonry.
 - 2. Section 05120, Structural Steel.
 - 3. Section 05500, Miscellaneous Metal.
 - 4. Section 05530, Steel Grating.
 - 5. Section 15050, Basic Mechanical Materials and Methods.

1.02 SUBSTITUTIONS

- A. To the maximum extent possible, similar coatings shall be the products of one manufacturer. Guidelines for determination of acceptability of product substitutions are given in Instructions to Bidders. Contractors intending to furnish substitute materials or equipment are cautioned to read and comply strictly with these guidelines.

1.03 SUBMITTALS

- A. All submittals and storage and protection provisions shall be in accordance with the requirements of the General Conditions, and the following.
 - 1. Product data:
 - a. Submit complete list of products for use; indicate compliance with:
 - 1) Mercury-free composition limits.
 - 2) VOC limits, when mixed and thinned.
 - 3) Indicate lead content.
 - b. Indicate manufacturer, brand name, quality, and type paint for each surface to be finished; correlate to specified item if from other manufacturer than specified item. Refer to the attached sample Paint Submittal Schedule for required

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submittal format.

- c. Include specified manufacturer's data sheets for reference to submitted manufacturer's data sheets.
 - d. Manufacturer's Safety Data Sheets (MSDS) for materials.
 - e. Intent of Contractor to use products specified does not relieve him from responsibility of submitting product line.
2. Samples:
- a. Color samples: Submit two sets of color samples from paint manufacturers proposed for use for color selections by Engineer.
 - b. Brush-outs:
 - 1) Prepare actual brush-outs for each color paint, stain, or finish following final color schedule issuance.
 - 2) Submit brush-outs in duplicate: minimum size, 120 sq. in.
 - 3) Apply products in number of coats specified for actual Work.
 - 4) Provide following substrates for brush-outs:
 - a) Concrete unit masonry: Paint one face to simulate concrete and masonry.
 - b) Hardboard to simulate drywall, lumber, board products, and metals for paint finish.
 - c) Actual species and grade of wood specified for transparent finish.
3. Quality control submittals:
- a. Certificates:
 - 1) Indicate interior paints and stains are mercury-free.
 - 2) Indicate lead content. Lead content in excess of 0.06% by weight of nonvolatile content calculated as lead metal is prohibited.
 - 3) Indicate compliance with applicable VOC limits when mixed and thinned.

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1.04 PROJECT MEETING

- A. Prior to ordering any of the materials covered under this Section, the Contractor, Engineer, painting subcontractor, and paint manufacturer's representative shall attend a progress meeting in accordance with the General Conditions and review the Work to be performed under this Section.

1.05 PAINTING REQUIREMENTS

- A. Finish paint all exposed surfaces except anodized or lacquered aluminum, fiberglass reinforced plastic, stainless steel and copper surfaces. Items to be left unfinished or to receive other types of finishes are specifically shown on the Drawings or specified.
 1. Unpainted Products: Full field cleaning and priming will be performed in accordance with specification requirements for unpainted products. Maintain adequate equipment on the site to assure proper cleaning.
 2. Shop Primed Products:
 - a. Manufactured products may be shop cleaned and primed. Shop cleaning must equal or exceed cleaning specified in the Painting Schedule. Clean as specified and reprime all abrasions, weld splatter, excessive weathering, and other defects in the shop prime coating.
 - b. Manufacturers furnishing shop primed products shall certify that cleaning was performed in accordance with specification requirements and that the specified primer was used.
 - c. Fully field clean and prime any shop primed products which the Engineer determines that were not cleaned in accordance with the Specifications prior to priming, that the wrong primer was applied, that the primer was applied improperly, or has excessively weathered, or the product is otherwise unacceptable.
 3. Finish Painted Products:

Certain products such as electrical control panels and similar items may, with the approval of the Engineer, be furnished finish painted. Properly protect these products throughout the project to maintain a bright and new appearance. If the finish surfaces are defaced, weathered, or not of the selected color, repaint as necessary in accordance with the paint system manufacturer's written recommendations.
 4. Hardware:

Remove all electrical plates, surface hardware, fittings and fastenings prior to painting operations. These items are to be carefully stored, cleaned and replaced upon completion of Work in each area. Do not use solvent to clean hardware that may remove permanent lacquer finish.

1.06 SEQUENCING AND SCHEDULING

- A. Schedule and coordinate this Work with other trades; proceeding until other Work and job conditions are proper to achieve satisfactory results is prohibited.
- B. Examine specification sections for various other trades; be thoroughly familiar with Work required in other sections regarding painting.

PART 2 - PRODUCTS

2.01 MATERIAL SCHEDULE

- A. Material schedules list pretreatment coats, wash coats, seal coats, prime coats, intermediate coats, finish coats and cover coats that comprise a complete and compatible system of surface protection for the particular substrate. Maintain the unity of these systems, making sure all coats applied to any surface are from the same system and same manufacturer. Verify with the manufacturer the compatibility of the materials used.

2.02 APPLICATION DATA

- A. All applicable data currently published by the paint manufacturer relating to surface preparation, coverages, film thickness, application technique, drying and overcoating times is included by reference as a part of this Section. It will be the responsibility of the Contractor to obtain and fully understand the appropriate data sheets for the coatings specified.

2.03 MATERIALS

- A. Paints shall be factory mixed and delivered to the job in unbroken original packages bearing the manufacturer's name and brand designation and shall be applied in strict accordance with the manufacturer's printed specifications. Two-component coatings shall be mixed in accordance with manufacturer's instructions. All two-component coatings, once mixed, shall be applied within the pot-life recommended by the manufacturer.
- B. Unless otherwise specified, paints shall be of the best grade. All thinners, driers, varnish, etc., shall be of the best grade and shall be furnished by the coating manufacturer for use with the specified paints.
- C. Paint thinners and tints: Products of same manufacturer as paints or approved by paint manufacturer for use with paint.
- D. Shellac, turpentine, patching compounds, and similar materials required for execution of Work: Pure, best quality products.
- E. All paints, finishes, stains, primers, shellacs, sealants and coatings shall comply with the

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requirement of LEED 2009 IEQ Credit 4.2: Low-Emitting Materials - Paintings and Coatings.

2.04 COLORS

- A. The Architect/Engineer will select the colors to be used on the various portions of the Work. Provide color cards for the coatings proposed. Where more than one coat of paint is required, job tint the paint for each undercoat off-shade to show complete coverage.
- B. Paint inside of ductwork flat black for entire area visible through ceiling openings. Paint underside of ductwork and other above ceiling items flat black for entire area visible through ceiling openings.
- C. Paint exposed pipes and ductwork same as adjacent ceiling surfaces, unless noted otherwise.
- D. Review Finish Schedule for color selections that may have already been made by the Architect/Engineer.

PART 3 - EXECUTION

3.01 GENERAL

- A. Adequately protect other surfaces from paint and damage. Furnish sufficient drop cloths, shields and protective equipment to prevent spray or droppings from fouling surfaces not being painted. Repair damage as a result of inadequate or unsuitable protection.
- B. Protection: Cover finished Work of other trades, surfaces not being painted concurrently, and prefinished items.
- C. Application of materials in spaces where dust is being generated is prohibited.

3.02 PRODUCT HANDLING

- A. Delivery
 - 1. Deliver materials in original, sealed containers of the manufacturer with labels legible and intact.
 - 2. Each container shall be clearly marked or labeled to show paint identification, paint type and color, date of manufacture, batch number, analysis or contents, identification of all toxic substances, and special instructions.
- B. Storage
 - 1. Store only acceptable project materials on the project site.

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2. Store material in a suitable location and in such a manner as to comply with all safety requirements including any applicable federal, state and local rules and requirements. Storage shall also be in accordance with the instructions of the paint manufacturer and the requirements of the insurance underwriters.
3. Restrict storage area to paint materials and related equipment.
4. Place any materials which may constitute a fire hazard in closed metal containers and remove daily from the project site.
5. Maintain neat, clean conditions in storage area; remove used rags from work areas at end of each day's work; store rags in closed containers.
6. Close containers at end of each day's Work. Leave no materials open.
7. Safety precautions:
 - a. Provide temporary fire protection equipment in materials storage area. Mark fire protection equipment location for quick access.
 - b. Prohibit smoking in storage area; post signs in visible location adjacent to and within storage area.

3.03 ENVIRONMENTAL CONDITIONS

- A. Environmental conditions which affect coating application include, but are not necessarily limited to, ambient air temperature, surface temperature, humidity, dew point and environmental cleanliness. Comply with the manufacturer's recommendations regarding environmental conditions under which coatings may be applied.

3.04 SURFACE PREPARATION

- A. General: All surfaces shall be thoroughly clean, dry, and free from oil, grease or dust. All fabricated metal products shall have all weld flux and weld spatter removed and sharp peaks in weld ground smooth. The Engineer will inspect the surface preparation prior to the application of coatings. If the preparation is found to be satisfactory, a written order will be given to proceed with coatings.
- B. Lumber, plywood, and veneered surfaces:
 1. Apply shellac, maximum four lb. cut to knots, pitch, and resinous sapwood prior to application of first paint coat.
 2. Surfaces to be painted: Fill nail holes, cracks, joints, and defects with spackling compound. Apply after first coat of paint.
 3. Sand surfaces smooth, except where rough-sawn surfaces are indicated. Dust to

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remove debris.

4. Treat mildewed surfaces with solution of one quart hypochlorite bleach, one tablespoon laundry detergent, and three quarts water. Rinse and allow to dry prior to painting.
5. Previously painted surfaces: Remove dirt, debris, and chalking by washing with detergent and water or low pressure cold water spray. Dull glossy surfaces by light sanding. Remove loose paint and blisters by scraping and sanding.

C. Gypsum board:

1. Fill narrow, shallow cracks and small holes with patching plaster or non-shrinking spackling compound. Allow to dry; sand smooth without raising gypsum board paper nap.
2. Wall surfaces designated to receive semi-gloss or gloss finish: Roll apply batter consistency mixture of gypsum board joint compound and water to surfaces; remove immediately with wide broadknife, without leaving ridges or gouges in finished surface. Allow to dry prior to prime coat application, Or;
Apply U.S. Gypsum Company, Sheetrock First Coat at 300-500 SF per gallon in accord with manufacturer's installation instructions. Allow to dry prior to prime coat application.

D. Ferrous Metals: Standards for the surface preparation of ferrous metals required in the Material Schedules are the standards of the Steel Structures Painting Council (SSPC, SP-1 through SP-10). Inspection of these surfaces will be evaluated by field comparison with visual comparator panels. These panels shall be securely wrapped in clear plastic and sealed to protect them from deterioration and marring.

E. Galvanized metal: Wash with xylol to remove grease, oil, and contaminants; wipe dry with dry cloth.

F. Aluminum: Sand to remove oxides. Wash with xylol to remove grease, oil, and contaminants; wipe dry with dry cloth.

G. Cast-In-Place Concrete Surfaces :

1. No Coatings Required.

3.05 APPLICATION

A. Conditions: No paint shall be applied upon damp or frosty surfaces, or in wet or foggy weather. No paint shall be applied in temperatures below 40⁰ F. or when freezing (32⁰ F.) is predicted within 24 hours of application, or under temperature or humidity conditions not recommended by the manufacturer.

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- B. Surface Preparation: After specified surface preparation, all surfaces shall be brushed free of dust or foreign matter. Surfaces shall be completely dry before any paint is applied.
1. Apply materials only when moisture content of surfaces is within manufacturer's recommended range.
- C. Application: Paint shall be evenly spread in the proper thickness so that there shall be no drops, runs or sagging of the coating. Where runs and drops do occur, they shall be removed and the surface re-coated to the satisfaction of the Engineer. Sufficient time, as directed by the manufacturer, shall be allowed for the paint to dry before the application of succeeding coats.
1. Apply materials in accord with manufacturer's approved product data to achieve specified DFT.
 2. Apply materials using clean brushes, rollers, or spray equipment. Limit paint spraying only to those materials recommended by manufacturer to be sprayed with no loss of performance, durability, or color.
 3. Apply materials at rate not exceeding manufacturer's recommendations for surface being coated, less ten percent for losses.
 4. Sand and dust between coats to remove defects visible from 5' - 0" distance. Tint primer and intermediate coats slightly to provide slight contrast.
 5. Finish coats: Smooth, free of brush marks, streaks, laps or pile-up of paint, skips, or missed areas.
 6. Make coating edges adjoining other materials or colors sharp and clean without overlapping.
 7. Primer coats may be omitted for surfaces specified to receive factory applied primer if finish coats are compatible with primer. Substitute bond coat recommended by paint manufacturer for specified primer coat if finish coats are not compatible.
 8. Refinish entire partition surface where portion of finish on gypsum board partition is damaged or unacceptable.
 9. Back prime exterior and interior finish carpentry and millwork with material specified for prime coat without runs on face; finish cut edges just prior to installation.
 10. Seal interior doors' tops and bottoms of with prime coat only; side edges same as faces.

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11. Finish exterior door edges same as exterior faces.
- D. Protection of Work Area: Use drop cloths or other suitable means to protect other surfaces of the structure or equipment in place. Upon completion of the Work, remove all paint spots from surfaces as directed by the Engineer.
 - E. Inspection: The Engineer will inspect each coat prior to the application of subsequent coats. If the work is found to be satisfactory, a written order will be given to proceed. Application of additional coats until completed coat has been inspected is prohibited. Only inspected coats of paint will be counted in determining the number of coats applied.
 - F. Defective Work: Remove and replace, at the direction of the Engineer, any painting work found to be defective or applied under adverse conditions.

3.08 PAINTING SCHEDULE

- A. Paint construction on roof top; include mechanical and electrical equipment except as indicated below.
 1. None.
- A. Surfaces not requiring painting or coating:
 1. Face brick.
 2. Cast-in-place concrete and Precast concrete.
 3. EIFS.
 4. Prefinished surfaces and items.
 5. Concealed ductwork, conduit, and piping.
 6. Fume hood exhaust fan enclosures on roof.
 7. Solvent Room exhaust fan on roof.
 8. HPLC room exhaust fans on roof.
- C. The Painting Schedule summarizes the painting systems to be applied to the various surfaces.

SAMPLE PAINT SUBMITTAL SCHEDULE

System	Specification	Item	Surface Prep	Primer	Finish & Touch Up	Color
A	SS 3300-2.05	Epoxy Floor Sealer	Blastrac or Muriatic Etch	76 Series, 4-6.0 mils	2 Coats of 76 Series, 4-6.0 mils	Gray

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B	SS 3300-2.06	Tnemec 61 Submitted	SSPC-7	Self Priming	2 Coats of Tnemec 61,4-6.0 mils per coat	Gray
C	SS 4400	Masonry Paint	SSPC 2 or 3 Pressure Washing to Remove Loose Concrete & Dirt	Block Fil 46-W-8,1 Coat	2 Coats of Valspar 76 Series at 4-6.0 mils per coat	Gray
D	SS 5500	Misc. Metals	SSPC 6 for Non-Immersion	Tnemec 90-97	2 Coats of 89 Series for Non-Immersion at 4-6.0 mils	Warm Gray M3759
E	SS 5500	Misc. Metals	SSPC 10 of Immersion	Not Required	2 Coats of 78 Series for Immersion at 4-6.0 mils	Gray
F	SS 5500	Roof Hatch	Mill Finish Aluminum	Not Required	Not Required	Not Required
F	SS 8331	Door Slats	Mill Finish Aluminum	Not Required	Not Required	Not Required
System	Specification	Item	Surface Prep	Primer	Finish & Touch Up	Color
D	SS 15000	Dip Pipe	SSPC 6 for Non-Immersion	Tnemec 90-97	2 Coats of 89 Series for Non-Immersion at 4-6.0 mils	Buff D4608
E	SS 15000	Dip Pipe	SSPC 10 for Immersion	Not Required	2 Coats of 78 Series for Immersion	Gray

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					at 4-6.0 mils	
I	SS 15060	Plastic Pipe	Lightly Sand	Not Required	2 Coats of 89 Series, 4-6.0 mils per coat	Warm Gray M3759
I	SS 15060	Valves & Operator	Lightly Sand	Not Required	2 Coats of 89 Series, 4-6.0 mils per coat	OSHA Orange
I	SS 15060	Pumps & Drives	Lightly Sand	Not Required	2 Coats of 89 Series, 4-6.0 mils per coat	Vale Green P2402
I	SS 15060	Unit Heaters & Ventilator Operators	Lightly Sand	Not Required	2 Coats of 89 Series, 4-6.0 mils per coat	Light Gray F42 ANSI 70

PAINTING SCHEDULE

Surfaces	Substrate Materials	Paint Material/Schedule
Millwork Interiors	Wood	110
All Wood Surfaces, Except Millwork Interiors	Wood	Transparent Finish -112
Ceilings	Gypsum Board	122
Walls	Gypsum Board	Latex Low Luster Enamel - 121
	M.R. Gypsum Board	Latex Low Luster Epoxy - 122
	CMU Block	131

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Interior Structural Steel	Galvanized Metal	140*
	Ferrous Metal	140
All Other Listed Metal Surfaces, Except Dumpsters	Galvanized Metal	141
	Ferrous Metal	141
Dumpsters, Exterior Surface	Ferrous Metal	240
Dumpsters, Interior Surface	Ferrous Metal	241
PVC Roof Drain Piping	Polyvinylchloride	150

* Galvanized metal shall not be painted unless called for on the Finish Schedule.

MATERIAL SCHEDULE 110

TYPE: POLYURETHANE

USE: MILLWORK INTERIORS

SURFACE PREPARATION: PER SECTION 3.05.B

GLIDDEN

FIRST COAT: ULTRA-HIDE QUICK-DRYING SANDING SEALER NO. 5035 -1.1 MILS*

SECOND COAT: WOODMASTER CLEAR POLYURETHANE SATIN SHEEN NO. 82 - 1.3 MILS*

*MINIMUM DRY FILM THICKNESS

NOTES:

1. IF MINIMUM TOTAL DRY FILM THICKNESS OF 2.4 MILS IS NOT ACHIEVED IN THE NUMBER OF COATS SPECIFIED, ADDITIONAL COATS SHALL BE APPLIED AT NO ADDITIONAL COST TO THE OWNER.
2. PRODUCTS OF THE FOLLOWING MANUFACTURERS SIMILAR IN TYPE, COLOR, SOLIDS AND QUALITY TO THE PRODUCTS SPECIFIED ABOVE ARE ACCEPTABLE FOR USE, SUBJECT TO APPROVAL OF PRODUCT LIST AND SAMPLES:
 - a. Benjamin Moore Company
 - b. Devoe and Reynolds Company, Inc.
 - c. Pratt and Lambert, Inc.

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- d. PPG Industries, Inc.
- e. Sherwin-Williams Company

MATERIAL SCHEDULE 112

TYPE: POLYURETHANE

USE: TRANSPARENT FINISH ON WOOD

SURFACE PREPARATION: PER SECTION 3.05.B

GLIDDEN

FIRST COAT: WOODMASTER OIL WOOD STAIN, NO. 1600 SERIES

SECOND COAT: ULTRA-HIDE QUICK-DRYING SANDING SEALER NO. 5035 - 1.1 MILS*

THIRD COAT: WOODMASTER CLEAR POLYURETHANE GLOSS NO. 81 - 1.3 MILS*

FOURTH COAT: WOODMASTER CLEAR POLYURETHANE SATIN SHEEN NO. 82 -1.3 MILS*

* MINIMUM DRY FILM THICKNESS

NOTES:

1. IF MINIMUM TOTAL DRY FILM THICKNESS OF 3.7 MILS IS NOT ACHIEVED IN THE NUMBER OF COATS SPECIFIED, ADDITIONAL COATS SHALL BE APPLIED AT NO ADDITIONAL COST TO THE OWNER.

2. PRODUCTS OF THE FOLLOWING MANUFACTURERS SIMILAR IN TYPE, COLOR, SOLIDS AND QUALITY TO THE PRODUCTS SPECIFIED ABOVE ARE ACCEPTABLE FOR USE, SUBJECT TO APPROVAL OF PRODUCT LIST AND SAMPLES:

- a. Benjamin Moore Company
- b. Devoe and Reynolds Company, Inc.
- c. Pratt and Lambert, Inc.
- d. PPG Industries, Inc.
- e. Sherwin-Williams Company

MATERIAL SCHEDULE 121

TYPE: LOW LUSTER LATEX ENAMEL

USE: GYPSUM BOARD, AS SPECIFIED OR INDICATED ON DRAWINGS.

SURFACE PREPARATION: PER SECTION 3.05.C.

GLIDDEN

FIRST COAT: SPRED ULTRA EGGSHELL LATEX WALL & TRIM PAINT NO. 4100
SERIES - 1.6 MILS*

SECOND COAT: SPRED ULTRA EGGSHELL LATEX WALL & TRIM PAINT NO.
4100 SERIES - 1.6 MILS*

* MINIMUM DRY FILM THICKNESS

NOTES:

1. IF MINIMUM TOTAL DRY FILM THICKNESS OF 3.2 MILS IS NOT ACHIEVED IN
THE NUMBER OF COATS SPECIFIED, ADDITIONAL COATS SHALL BE
APPLIED AT NO ADDITIONAL COST TO OWNER.

2. PRODUCTS OF THE FOLLOWING MANUFACTURERS SIMILAR IN TYPE,
COLOR, SOLIDS AND QUALITY TO THE PRODUCTS SPECIFIED ABOVE ARE
ACCEPTABLE FOR USE, SUBJECT TO APPROVAL OF PRODUCT LISTS AND
SAMPLES:

- a. Benjamin Moore Company.
- b. Devoe and Reynolds Company, Inc.
- c. Pratt and Lambert Inc.
- d. PPG Industries Inc.
- e. Sherwin-Williams Company.

MATERIAL SCHEDULE 122

TYPE: EPOXY

USE: WATERPROOF OR M.R. GYPSUM BOARD, AS SPECIFIED ON DRAWINGS

SURFACE PREPARATION: PER SECTION 3.05.C

SHERWIN-WILLIAMS

FIRST COAT: PROMAR 200 ZERO LATEX - 1.5 MILS*

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SECOND COAT: PRE-CATALYZED WATERBASED EPOXY EGGSHELL SHEEN – 2 MILS*

THIRD COAT: PRE-CATALYZED WATERBASED EPOXY EGGSHELL SHEEN – 2 MILS*

* MINIMUM DRY FILM THICKNESS

NOTES:

1. IF MINIMUM TOTAL DRY FILM THICKNESS OF 5.5 MILS IS NOT ACHIEVED IN THE NUMBER OF COATS SPECIFIED, ADDITIONAL COATS SHALL BE APPLIED AT NO ADDITIONAL COST TO THE OWNER.

2. PRODUCTS OF THE FOLLOWING MANUFACTURERS SIMILAR IN TYPE, COLOR, SOLIDS AND QUALITY TO THE PRODUCTS SPECIFIED ABOVE ARE ACCEPTABLE FOR USE, SUBJECT TO APPROVAL OF PRODUCT LISTS AND SAMPLES:

- a. Benjamin Moore Company.
- b. Devoe and Reynolds Company, Inc.
- c. Pratt and Lambert Inc.
- d. PPG Industries Inc.
- e. Glidden.

MATERIAL SCHEDULE 131

TYPE: EPOXY

USE: INTERIOR CMU MASONRY

SURFACE PREPARATION: CC-I

SHERWIN WILLIAMS

FIRST COAT: HEAVY DUTY BLOCK FILLER – 10.0 MILS DRY*

SECOND COAT: MACROPOXY 646-100 FC - 4.0 MILS DRY *

THIRD COAT: MACROPOXY 646-100 FC- 4.0 MILS DRY *

* MINIMUM DRY FILM THICKNESS

KOPPERS

FIRST COAT: AND MASONRY FILLER

SECOND COAT: HI-GARD EPOXY - 4.0 MILS DRY

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THIRD COAT: HI-GARD EPOXY - 4.0 MILS DRY

* MINIMUM 8.0 MILS DRY FOR SECOND AND THIRD COAT

NOTES:

1. IF MINIMUM 18.0 MIL THICKNESS IS NOT ACHIEVED IN NUMBER OF COATS SHOWN, ADDITIONAL COATS WILL BE APPLIED AT NO ADDITIONAL EXPENSE TO CITY.
2. PRODUCTS OF THE FOLLOWING MANUFACTURERS SIMILAR IN TYPE, COLOR, SOLIDS AND QUALITY TO THE PRODUCTS SPECIFIED ABOVE ARE ACCEPTABLE FOR USE, SUBJECT TO APPROVAL OF PRODUCT LIST AND SAMPLES:
 - a. Tnemec.

MATERIAL SCHEDULE 140

TYPE: EPOXY

USE: FERROUS METAL SURFACES AND STRUCTURAL STEEL LOCATED INSIDE A BUILDING WHICH ARE NOT SUBMERGED OR LOCATED ABOVE A LIQUID. NOT FOR USE WITH PROCESS EQUIPMENT.

SURFACE PREPARATION: SSPC SP-6

SHERWIN-WILLIAMS

PRIMER: KEM-KROMIK UNIVERSAL METAL PRIMER- 3.3 MILS*

FIRST COAT: MACROPOXY 646-100 FC - 4.0 MILS*

SECOND COAT: ACROLON 100 URETHANE - 3.0 MILS*

* MINIMUM DRY FILM THICKNESS

NOTES:

1. IF MINIMUM TOTAL DRY FILM THICKNESS OF 10.3 MILS IS NOT ACHIEVED IN THE NUMBER OF COATS SPECIFIED, ADDITIONAL COATS SHALL BE APPLIED AT NO ADDITIONAL COST TO THE OWNER.
2. PRODUCTS OF THE FOLLOWING MANUFACTURERS SIMILAR IN TYPE, COLOR, SOLIDS AND QUALITY TO THE PRODUCTS SPECIFIED ABOVE ARE

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ACCEPTABLE FOR USE, SUBJECT TO APPROVAL OF PRODUCT LIST AND SAMPLES:

- a. Koppers.
- b. Tnemec.

MATERIAL SCHEDULE 141

TYPE: HIGH BUILD EPOXY

USE: PROVIDE THE FOLLOWING COATING SYSTEM FOR FERROUS METAL SURFACES ON ALL MECHANICAL EQUIPMENT AND ACCESSORIES INCLUDING BUT NOT LIMITED TO: PUMPS, VALVING AND OTHER PROCESS EQUIPMENT AND EXTERIOR STRUCTURAL STEEL AND EXPOSED STEEL PIPE.

SURFACE PREPARATION: SSPC-SP10 NEAR WHITE BLAST-IMMERSION SERVICE

SHERWIN-WILLIAMS

PRIMER: ZINC CLAD III - 3.0 MILS*

FIRST COAT: MACROPOXY 646-100 FC - 4.0 MILS*

SECOND COAT: ACROLON 100 URETHANE - 3.0 MILS*

* MINIMUM DRY FILM THICKNESS

NOTES:

1. IF MINIMUM TOTAL DRY FILM THICKNESS OF 10.0 MILS IS NOT ACHIEVED IN THE NUMBER OF COATS SPECIFIED, ADDITIONAL COATS SHALL BE APPLIED AT NO ADDITIONAL COST TO THE OWNER.
2. PRODUCTS OF THE FOLLOWING MANUFACTURERS SIMILAR IN TYPE, COLOR, SOLIDS AND QUALITY TO THE PRODUCTS SPECIFIED ABOVE ARE ACCEPTABLE FOR USE, SUBJECT TO APPROVAL OF PRODUCT LIST AND SAMPLES:
 - a. Koppers.
 - b. Tnemec.

MATERIAL SCHEDULE 150

TYPE: ACRYLIC LATEX

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USE: ALL PVC SURFACES TO BE PAINTED, AS SPECIFIED OR SHOWN ON DRAWINGS.

SURFACE PREPARATION: CLEAN AND DRY.

GLIDDEN

FIRST COAT: GLID-GUARD LIFEMASTER NO. 6900 SERIES - 2.0 MILS*

SECOND COAT: GLID-GUARD LIFEMASTER NO. 6900 SERIES - 2.0 MILS*

* MINIMUM DRY FILM THICKNESS

NOTES:

1. IF MINIMUM TOTAL DRY FILM THICKNESS OF 4.0 MILS IS NOT ACHIEVED IN THE NUMBER OF COATS SPECIFIED, ADDITIONAL COATS SHALL BE APPLIED AT NO COST TO THE OWNER.
2. PRODUCTS OF THE FOLLOWING MANUFACTURERS SIMILAR IN TYPE, COLOR, SOLIDS AND QUALITY TO THE PRODUCTS SPECIFIED ABOVE ARE ACCEPTABLE FOR USE, SUBJECT TO APPROVAL OF PRODUCT LIST AND SAMPLES:
 - a. Benjamin Moore Company.
 - b. Devoe and Reynolds Company, Inc.
 - c. Pratt and Lambert Inc.
 - d. PPG Industries Inc.
 - e. Sherwin-Williams.

MATERIAL SCHEDULE 240

TYPE: ALIPHATIC POLYURETHANE

USE: EXTERIOR OF SLUDGE HOPPER AND DUMPSTER

SURFACE PREPARATION: SP-6

SHERWIN-WILLIAMS

PRIMER: ZINC CLAD III - 3.0 MILS*

FIRST COAT: MACROPOXY 646-100 FC - 4.0 MILS*

SECOND COAT: ACROLON 100 URETHANE - 3.0 MILS*

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* MINIMUM DRY FILM THICKNESS

NOTES:

1. IF MINIMUM TOTAL DRY FILM THICKNESS OF 10.0 MILS IS NOT ACHIEVED IN THE NUMBER OF COATS SPECIFIED, ADDITIONAL COATS SHALL BE APPLIED AT NO ADDITIONAL COST TO THE OWNER.
2. PRODUCTS OF THE FOLLOWING MANUFACTURERS SIMILAR IN TYPE, COLOR, SOLIDS AND QUALITY TO THE PRODUCTS SPECIFIED ABOVE ARE ACCEPTABLE FOR USE, SUBJECT TO APPROVAL OF PRODUCT LIST AND SAMPLES:
 - a. Koppers.
 - b. Tnemec
 - c. Valspar.

MATERIAL SCHEDULE 241

TYPE: HIGH BUILD EPOXY

USE: PROVIDE THE FOLLOWING COATING SYSTEM FOR FERROUS METAL SURFACES ON ALL MECHANICAL EQUIPMENT AND ACCESSORIES INCLUDING BUT NOT LIMITED TO: PUMPS, VALVING AND OTHER PROCESS EQUIPMENT AND EXTERIOR STRUCTURAL STEEL AND EXPOSED STEEL PIPE.

SURFACE PREPARATION: SSPC-SP10 NEAR WHITE BLAST-IMMERSION SERVICE

SHERWIN-WILLIAMS

PRIMER: ZINC CLAD III - 3.0 MILS*

FIRST COAT: MACROPOXY 646-100 FC - 4.0 MILS*

SECOND COAT: ACROLON 100 URETHANE - 3.0 MILS*

* MINIMUM DRY FILM THICKNESS

NOTES:

1. IF MINIMUM TOTAL DRY FILM THICKNESS OF 10.0 MILS IS NOT ACHIEVED IN THE NUMBER OF COATS SPECIFIED, ADDITIONAL COATS SHALL BE APPLIED AT NO ADDITIONAL COST TO THE OWNER.

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2. PRODUCTS OF THE FOLLOWING MANUFACTURERS SIMILAR IN TYPE, COLOR, SOLIDS AND QUALITY TO THE PRODUCTS SPECIFIED ABOVE ARE ACCEPTABLE FOR USE, SUBJECT TO APPROVAL OF PRODUCT LIST AND SAMPLES:

- a. Koppers.
- b. Tnemec.

PIPE AND EQUIPMENT COLORS

STENCIL WORDING	SYMBOL	COLOR	LETTERS & ARROW
Raw Water		SW6366- BLUEBLOOD	YES AND DIRECTION OF FLOW
Potable Water		SW6366- BLUEBLOOD	YES AND DIRECTION OF FLOW
Non-Potable Water	W3	SW6366- BLUEBLOOD	YES AND DIRECTION OF FLOW
Compressed Air		SW4084- SAFETY YELLOW	YES
Air Vacuum	ARV		YES
Vent	V		YES

+++ END OF SECTION 09900 +++

**SECTION 10440
IDENTIFYING DEVICES**

PART 1 - GENERAL

1.01 DESCRIPTION

- A. The Contractor shall furnish all the materials for and shall properly erect and install all identifying devices at the locations shown and as indicated on the Drawings, and as specified herein.
- B. This shall include all identification signs and warning signs, including supports, fastening devices, and accessories, and all labor, materials, tools, and appurtenances required to complete the Work.
- C. It is the intent of this Specification that the installation shall be complete in all respects and ready for use. The Contractor shall be responsible for all incidental details and for any special construction necessary to complete the work in an acceptable manner.
- D. Related Work Specified Elsewhere:
 - 1. Section 10520, Fire Extinguishers.
 - 2. Section 15440, Emergency Shower and Eyewash Fixtures.
 - 3. Section 15060, Piping and Appurtenances.

1.02 SUBMITTALS:

- A. Product Data: Submit manufacturer's technical data and installation instructions for each type of sign required.
- B. Samples: Submit samples of each sign form and materials showing finished, colors, surface textures and qualities of manufacturer and design of each sign component including graphics.

1.03 QUALITY ASSURANCE:

- A. Uniformity of manufacturer: For each sign form and graphic image process indicated furnish products of single manufacturer.
- B. Quality of signage shall be not less than ASI-SPE construction.

PART 2 - PRODUCTS

2.02 MATERIALS

- A. General: Identifying devices shall be of the type and materials specified for each

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category. Unless otherwise indicated, signs shall be the manufacturer's stock items.

- B. Life Safety Signs: Signs shall be butyrate with red lettering on white background, and conforming to OSHA regulations. Sign denoting fire extinguisher location shall be vinyl with pressure-sensitive adhesive backing.
 - 1. NO SMOKING WITHIN 25 FEET OF THE BUILDING: Located at all entrance doors.
 - 2. FIRE EXTINGUISHER: Located above all extinguishers.
- C. Interior and Directional Signs: Signs shall be ASI/2 type A, constructed of 0.015-inch vinyl laminated to 1/4-inch acrylic backing. Letters shall ASI/2 pressure-sensitive vinyl letters. Signs shall have 1-inch border around perimeter. All signs to be compliant with ADA and COA standards. Colors to be as selected by Architect from standard manufacturer colors.
- D. Exterior Signs: sign shall be 12" x 18" embossed steel with cast iron base and 1-inch diameter pipe standard, 36-inches high, with black enamel finish.
 - 1. NO PARKING: Located as shown on the plans. (White background, red letters).
 - 2. HANDICAPPED PARKING ONLY: Located as shown on the plans. (Blue background, white letters).
 - 3. LOW EMISSIONS VEHICLE PARKING ONLY: Located as shown on the plans. (White background, green letters)

PART 3- EXECUTION

3.01 INSTALLATION:

- A. General: Locate sign units and accessories where shown or directed, using mounting methods of the type described and in compliance with the manufacturer's instructions.
 - 1. Install signs level, plumb and at the height indicated, with sign surfaces free from distortion or other defects in appearance.

3.02 CLEANING AND PROTECTION:

- A. At completion of the installation, clean soiled sign surfaces in accordance with the manufacturer's instructions. Protect units from damage until acceptance by the Engineer.

+++ END OF SECTION 10440 +++

**SECTION 11500
TRANSIT TIME FLOW METERS**

PART 1 – GENERAL

1.01 SCOPE

Contractor to supply all labor, equipment and materials to furnish and install an ultrasonic, transit time metering device as indicated on the Contract Drawings and as specified herein.

1.02 SUBMITTALS

- A. Submittals shall be provided the following items as per Specification 01600:
1. Materials list of a complete installation including meter, transducers, wiring connections, etc.
 2. Dimensioned drawings and schematics of a complete installation.
 3. Manufacturer's catalog data for the meter, transducers, and all other parts to be provided.
 4. Operation and maintenance manual meeting the requirements of Specification 11500.1.04.
 5. Manufacturer's certification of proper installation and inspection report.

1.03 QUALITY ASSURANCE

- A. Manufacturers shall have supplied ultrasonic, transit time meters, similar to the unit specified for this project, that are in satisfactory service for the past two years under similar operating conditions. All equipment hereinafter specified will be considered as components of a single operating unit. The Contractor shall be held fully accountable and responsible for the adequacy and proper operation of each component provided, regardless of original source or manufacturer.
- B. Contractor shall retain a factory-trained manufacturer's field representative with demonstrated ability and experience in installation, testing, and operation of instrumentation and control systems. The manufacturer's representative shall perform the following listed services, as applicable:
1. Supervise installation of equipment.
 2. Test, calibrate and adjust all components of the equipment.
 3. Inspect the completed installation, prepare an inspection report, and certify proper installation.
 4. Instruct Owner's and Contractor's personnel in calibrating, testing, operating and maintaining the equipment as required

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1.04 OPERATIONS AND MAINTENANCE MANUALS

- A. Provide three (3) bound sets of operation and maintenance (O&M) manuals at the time equipment is delivered to the site.
- B. Include in the O&M manual the following types of information on each Control System component and item of equipment:
 - 1. Approved shop drawings.
 - 2. Product information.
 - 3. Installation instructions.
 - 4. Operating procedures.
 - 5. Shut-down procedures.
 - 6. Safety instructions.
 - 7. Calibration instructions.
 - 8. Maintenance and repair instructions.
 - 9. Recommended spare parts list.
 - 10. Special tools list (if any).
 - 11. Name, address and phone number of supplier's local representative.

1.05 PRODUCT DELIVERY AND STORAGE

- A. Package all equipment and materials at the factory to protect each item from damage during shipment and storage.
- B. Protect painted surfaces against impact, abrasion, discoloration and other damage.
- C. Protect equipment and materials stored at the site from the weather, moisture, corrosive liquids and gases, dust and other agents that could cause damage.

PART 2 - PRODUCTS

2.01. Ultrasonic Transit Time Flow Meter

A. Meter Components:

- 1. General: The metering system shall generally consist of a spool piece of same material and size (48") as surrounding piping, ultrasonic transducers, a wall mounted processing and display unit, and all other parts and incidentals required to install a complete and functioning ultrasonic transit time flow meter. The metering system shall meet the following requirements:
 - a. Fluid to be metered: Raw Water
 - b. Fluid temperature: 35° F to 85°F

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- c. Pressure rating: 250 psi
- d. Flow range: See Table 1, Section 11500.3.B
- e. Accuracy: $\pm 0.5\%$

2. Spool Piece: The spool piece shall be provided by the flow meter manufacturer and shall be flanged end spool piece with welded boss assemblies. The spool piece shall be DIP in accordance with Section 02665.

3. Ultrasonic Transducers: The ultrasonic transducers shall mount through radial holes in the spool piece pipe wall. The transducer assembly shall be watertight, rated for 150 psi, 32 deg. F to 120 deg. F and have a sealed acoustic window that allows for transducer replacement while the spool piece is under pressure. Eight transducer assemblies shall be installed in the spool piece to create four chordal ultrasonic paths. Size, type, and location of the transducer installations shall be in accordance with the flow meter manufacturer's recommendations.

4. Wall Mounted Processing and Display Unit: The unit shall consist of power supply, processing units, display, outputs, all necessary software and cabinets to control and process the signals from the transducers. The unit shall have a key pad and display to allow the operator to interface for normal operation and troubleshooting. The display shall show flow rate in million gallons per day (mgd) and system status messages. The unit shall provide a 4 to 20 mA flow signal, and signal alarm set points, contacts, and fault contact for reporting system failures. The unit shall be in a rack suitable for a wall-mounted enclosure as shown on the plans.

5. Miscellaneous Equipment: The Owner shall be provided with all miscellaneous and/or special tools required to perform periodic maintenance of the system, including but not limited to, installing and removing transducer assemblies, all interconnecting cable from the wall mounted processing and display unit to the transducers and junction boxes required for connections at the transducers.

- 6. Manufacturer:
 - a. The wall mounted processing and display unit shall be Model 7700;
 - b. The transducer assemblies shall be Model 8510+;
 - c. Manufacturer shall be ADS Environmental, Inc. or approved equal.

PART 3 – EXECUTION

3.01 Installation

A. The Contractor shall obtain the services of a manufacturer's trained technician to install the metering system and to place the equipment in operation with the proper calibration settings. The manufacturer's trained technician shall provide a minimum of

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two days of on-site training to the Owner's personnel in the installation, use, and maintenance of all aspects of the metering system.

B. The metering system shall be installed in complete compliance with the manufacturer's recommendations.

Table 1: Flow Meter Schedule

Tag ID	Pipe Size, in	Min Flow, mgd	Max Flow, mgd
10-FM-001	48	6.5	65
11-FM-001	48	40	120
11-FM-002	48	40	120

+++END OF SECTION+++

SECTION 13000
INSTRUMENTATION, CONTROL AND MONITORING SYSTEM
GENERAL REQUIREMENTS

PART 1 - GENERAL REQUIREMENTS

1.01 SCOPE

- A. The Instrumentation, Control, and Monitoring System (ICM) consists of new panel work, modification of existing panels, modification to the existing HMI system, field components and system communication links. The ICM should be provided by one of the following System Integrators:

- MR Systems, Inc.
- Southern Flow
- Control Instruments, Inc. (C2i)
- Revere Controls.

or equal meeting the qualifications of paragraph 1.09.

- B. This Section covers the general requirements for furnishing and installing all instrumentation, control and monitoring (ICM) systems complete in every detail for the purposes specified and shall form a part of all other Sections of Division 13 unless otherwise specified. Other Sections of this Division shall supplement this Section as necessary.

1. Work Included

Furnish all tools, equipment, materials, and supplies and perform all labor required to complete the furnishing and installation of, validation, start-up and operational testing of a complete and operable Instrumentation, Control and Monitoring System as indicated on the Drawings and as specified herein.

Provide all the necessary equipment components, interconnections and the services of the manufacturers' engineering representatives for the engineering, implementation, startup, operation, and instruction, to insure that the City receives a completely integrated and operational ICM as herein specified.

2. Work Not Included

Process piping, installation of in-line instrumentation, i.e., final control elements in process pipelines, air compressors, main air supply headers, and miscellaneous mechanical work as specified in other Divisions.

Electrical power distribution and signal wiring specifically included under Division 16, circuit protection devices, power conduit and wiring indicated, local equipment control stations, and miscellaneous electrical requirements as specified in Division 16.

D. System Responsibility

1. Each Section in this Division shall be provided by a competent, qualified company with ten years minimum experience successfully performing similar work of a similar scope. 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 ten years minimum experience successfully performing similar installations. The System shall be integrated using the latest, most modern proven design.
2. The Contractor may subcontract the work under this Division to qualified Suppliers, but 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 this Division and shall assure system uniformity, subsystem compatibility and coordination of all system interfaces, submittals, documentation, testing and training.
4. The Contractor shall determine that all components of each section are completely compatible with other required equipment, including the DCS, and shall function as outlined, and the Contractor shall furnish and install such additional equipment, accessories, etc. as are necessary to meet these objectives at no additional cost to the City.

E. Contract Drawings

1. Information on the Drawings

The following information relative to the work of this Division is indicated on the Contract Drawings.

- a) Location of all primary elements, cabinets, and final control elements.
- b) Instrumentation signal and power conduit runs between control panels and field instruments and devices.
- c) Quantity and sizes of instrumentation conductors and cables are indicated on the drawings, but shall be verified by the Contractor.
- d) Major instrument conduit runs.

1.02 SUBMITTALS

- A. Submittals shall be made in accordance with the requirements of the General Conditions of the Contract Documents. In addition, the following specific information shall be provided:

B. GENERAL

1. Presubmittal Conference

Arrange a conference between the Supplier of each Section, Contractor, and the Engineer within thirty (30) days after award of the Contract for the purpose of informally discussing in detail and verifying the correctness of the Contractor's system engineering methods and equipment and to generally provide a framework for communication and coordination. This conference shall be attended by the Supplier's Engineer, and duly authorized representatives of the Contractor and the Engineer.

2. Draft Submittal

Prepare a draft of the submittal for review. The draft shall include the following, as a minimum:

- a) Listing of major items proposed for this Division. 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 City if the specified item is no longer manufactured.
- b) Shop Drawings. Before proceeding with any manufacturing, submit Shop Drawings for approval 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 all equipment and tag numbers on all panels. Include material specifications lists where applicable. Submit detailed field instrument installation drawings for each instrument.

C. Design Related Submittals

Provide five (5) copies of the following submittals:

1. Catalog Cuts

Catalog information, descriptive literature, wiring diagrams, and shop drawings shall be provided for all devices, whether electrical or mechanical, furnished under this section. 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

Data sheets, specification sheets, and an instrument list shall be provided for all 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., complete part numbers, scales, ranges, service, materials of construction, component location, options, and the individual tag number as noted in the Drawings and Specifications.

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

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 differential pressure flow elements and shall include the actual scaling factors and units used.

4. Panel Construction Drawings

a) Shop Drawings and Catalog Cuts

Provide detailed shop drawings and catalog cuts for all panels, instrument racks, and enclosures. Drawings shall show the location of all front panel and internal sub-panel mounted devices to scale and shall include a panel legend and bill of materials. Layout drawings shall show all major dimensions as well as elevations, in inches from the base up, of all rows of components.

The panel legend shall list and identify all front of panel devices by their assigned tag numbers, all nameplate inscriptions, service legends, and annunciator inscriptions.

The bill of materials shall include all devices including those 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.

5. Panel Wiring Diagrams

Wiring diagrams shall be similar to those diagrams shown in the Contract Drawings, but with the addition of all auxiliary devices such as additional relays, alarms, fuses, lights, etc.

Provide complete terminal identification of all 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.

All external wiring that the electrical contractor must provide and wire shall be shown as a dotted line. Special cables that are provided with the instrument shall be clearly identified.

Panel wiring diagrams shall identify wire numbers and types, terminal numbers, and tag numbers. Wiring diagrams shall show all circuits individually; no common diagrams shall be allowed.

Provide panel power wiring diagrams for all panels. The diagrams shall include all grounding requirements.

6. Interconnecting Wiring Diagrams

Diagrams shall show all component and Termination Cabinet identification numbers and external wire, fiber, and cable numbers. This diagram shall be coordinated with the Electrical Supplier and shall bear his mark showing that this has been done.

7. Loop Diagrams

Provide an individual wiring diagram for each analog loop showing all terminal numbers, the location of the DC power supply, signal polarity, the location of any dropping resistors, surge protection, shielding, grounding, etc. The loop diagrams shall meet the minimum requirements of ISA S5.4 plus the following requirements:

Each loop diagram shall be divided into areas for identification of device locations (e.g. panel face, back-of-panel, field, etc.). 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.

8. Instrument Installation Details

The ICM Supplier 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 components.

D. Test Related Submittals

Provide five (5) copies of the following:

1. Operational Field Acceptance Test Documentation

The ICM Supplier shall submit an example of each type of Instrument Calibration

Sheet and Loop Status Report that will be used for the OAT.

After approval of the examples, the ICM Supplier shall prepare Loop Status Report Sheet(s) for each loop and an Instrument Calibration Sheet for each active I & C element (except simple hand switches, lights, etc). These sheets shall be submitted after the tests are completed.

a) Instrument Calibration Sheets

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:

- Facility identification (Name, location, etc.)
- Loop identification (Name or function)
- Equipment tag and serial numbers.
- Scale Ranges and units.
- Test mode or type of test.
- Input values or settings.
- Expected outputs and tolerances
- Actual readings at 10, 50, and 90 percent of span.
- Explanations or special notes as applicable.
- Date, time, and weather.
- Tester's certification with name and signature.

2. Functional Acceptance Test Documentation

The ICM Supplier shall prepare two types of test procedures and forms as follows.

a) Loop Test Documentation

For functions that can be demonstrated on a loop-by-loop basis, the form shall include:

- 1) Project Name
- 2) Loop number
- 3) Loop description
- 4) Test procedure description, with a space after each specific test to facilitate sign off on completion of each test.
- 5) For each component: tag number, description, manufacturer, and data sheet number.
- 6) Space for sign off and date by the Contractor, the ICM Supplier, and the Engineer.

b) Functional Test Documentation

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:

Specification page and paragraph of function demonstrated

Description of Function

Test procedure description

Space after each specific test to facilitate signoff on completion of each test.

1.03 TESTING

A. Factory Testing

1. Unwitnessed Factory Testing

- a. Prior to the arrival of the Engineer, each panel shall have been completely tested by the manufacturers personnel. Provide report certifying the control panels are operable and meet the Specifications. If upon arrival of the Engineer, the panel(s) tests have not been performed, the Contractor may be liable for back charges for any extra time required by the Engineers services. The necessary panel tests shall be repeated in the presence of the Engineer; the Engineer, shall have the right to check all test observations. The ICM Supplier shall demonstrate, on a spot check basis, that the results of the unwitnessed Factory Tests are accurate. As a minimum, tests shall verify the following:

- 1) Location of interface wires on terminal blocks.
- 2) Function of discrete panel components

2. Witnessed Factory Testing

- a. Inspection and test of materials and equipment may be made by the Engineer (or his representative) at the place of manufacturer prior to shipment, to verify that the completed control panel(s) meets the requirements of the specifications. Shipment shall not be made until receipt of written approval from the Engineer after satisfactory completion of shop tests.
- b. The manufacturer furnishing materials, equipment and labor for the fabrication of the panel(s) shall afford the necessary facilities for such shop inspection and tests. The Contractor shall give the Engineer written notice three (3) weeks prior to the estimated date when the equipment will be ready for the inspection and witnessed shop test.
- c. Sufficient time, ample space and necessary assistance shall be provided by the manufacturer to assure inspection and testing to the satisfaction of the Engineer.
- d. The ICM Supplier shall furnish all power, labor, materials, and properly calibrated instruments required for the shop tests.

- e. The Engineer reserves the right to reject defective materials, poor workmanship and items that do not function in accordance with the requirements of the specifications.
- f. The ICM Supplier shall maintain approved copies of all design and testing related submittals at the site of testing for reference.

B. Operational Field Acceptance Testing

1. Installation Supervision

- a. Furnish the services of authorized factory personnel specially trained and experienced in the installation of the equipment to: (1) supervise the installation in accordance with the approved Instruction Manual; (2) be present when the instruments and equipment are first put into operation; (3) inspect, check, adjust as necessary, and approve the installation; (4) calibrate the instruments, in accordance with the Specifications herein, until all trouble or defects are corrected and the installation and operation are acceptable.

2. Instrument Calibration

- a. Provide the services of factory trained instrumentation technicians, tools and equipment to field calibrate each instrument to its specified accuracy in accordance with the manufacturer's specifications and instructions for calibration. Each instrument shall be calibrated at 10 percent, 50 percent and 90 percent of span using test instruments to simulate inputs and read outputs that are rated to an accuracy of at least 10 times greater than the specified accuracy of the instrument being calibrated.
- b. Provide a list and basic specifications for instruments used for calibration.

3. System Validation

- a. Provide the services of factory trained and field experienced instrumentation engineer(s) to validate each system to verify that each system is operational and performing its intended function within system tolerance. System tolerance is defined as the root-mean-square sum of the system component published specified accuracies from input to output.
- b. Validate each system by simulating inputs at the first element in loop (i.e. sensor) of 10 percent, 50 percent and 90 percent of span, or on/off and verifying other loop devices. During system validation, make provisional settings on levels, alarms, etc. Verify controllers by observing that the final control element moves in the proper direction to correct the process variable as compared to the set point. Verify that all logic sequences operate in accordance with the specifications.
- c. Cause malfunctions to sound alarms or switch to standby to check system

operation. Check all systems thoroughly for correct operation. Test equipment for this function shall be as specified under "Instrument Calibration."

- d. Immediately correct all defects and malfunctions disclosed by tests. Use new parts and materials as required and approved and retest.
 - e. Provide a report certifying completion of validation of each instrument system. This report shall indicate calculated system tolerances, data verifying that the system meets these tolerances, and any provisional settings made to devices. Data sheets shall be similar to those used for calibration.
4. Contractor's Certified Reports
- a. Upon completion of all testing, the Contractor, or his authorized representative, shall submit a certified report for each control panel and associated field instruments certifying that the equipment (1) had been properly installed under his supervision, (2) is in accurate calibration, (3) was placed in operation in his presence, (4) has been checked, inspected, calibrated, and adjusted as necessary, (5) has been operated under maximum power variation conditions and operated satisfactorily, and (6) is fully covered under the terms of the guarantee.

C. Functional Acceptance Testing

1. Upon completion of instrument calibration and system validation, test all systems under actual process conditions in the presence of the Engineer. The intent of this test is to demonstrate and verify the operational interrelationship of the instrumentation systems. This testing shall include, but not be limited to, all specified operational modes, taking process variables to their limits (simulated or process) to verify all alarms, failure interlocks, and operational interlocks between systems and/or mechanical equipment.
2. Testing shall be observed by the Engineer. Notify the Engineer in writing a minimum of 14 days prior to the proposed date for commencing the test. Upon completion of this test the Contractor shall begin or have begun system start-up. Engineer reserves the right to set the schedule.
3. Submit for approval not later than 30 days prior to the functional acceptance test demonstration, a written plan for demonstrating that each system of equipment provided under Division 13 meets the specified operational requirements.
4. The plan shall detail procedures to be used in functional acceptance testing of all systems. The plan shall including a description of test methods and materials utilized for testing each system.
5. Immediately correct defects and malfunctions with approved methods and materials in each case and repeat the testing.
6. Submit three copies of test results and records for all functional acceptance tests.

7. Upon completion of functional acceptance testing, submit certified report, with substantiating data sheets, indicating that total ICM System meets all the functional requirements specified herein. The Engineer will countersign this report and it shall constitute final acceptance of the ICM System.

D. System Commissioning Assistance

1. Provide the services of a factory trained and field experienced instrumentation engineer to assist City's personnel during startup of the system. Purpose of this assistance is to support in making final adjustments of settings on the instrument systems.

E. Final Acceptance

1. Approved completion of the following shall constitute Final Acceptance of the ICM System.
 - a. Certified Functional testing Report countersigned by the Engineer.
 - b. Final Documentation.
 - c. Spares and expendables delivery.
 - d. Training.

1.04 OPERATION & MAINTENANCE MANUALS

- A. Furnish six (6) sets of Instruction Manuals and Part Lists for instrumentation equipment provided under Division 13. Obtain distribution method instructions from the Engineer.

B. Schedule

1. Deliver two (2) copies of 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.

B. Material Content

1. 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. The list may be similar to the Instrument List in the Supplements. All 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:

Instrument, panel, rack or device tag number
Description
Quantity supplied
Reference to component data sheet and/or catalog cut
Component type

b. Component Data Sheets

See 1.02 B.2 specified herein before.

c. Catalog Cuts

See 1.02 B.1 specified herein before.

d. Component O&M Manuals

An O&M manual shall be submitted for all instruments and devices supplied. The O&M manuals shall contain, as a minimum:

Operating procedures
Installation procedures
Maintenance procedures
Troubleshooting procedures
Calibration procedures
Internal device schematics and wiring diagrams
Shut-down procedures
Component parts list
Detailed circuit operational description including programmable controller ladder diagrams.

e. Spare Parts and Expendables List

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:

Panel Fabrication Drawings.
Panel Wiring, Loop, and Interconnection Drawings.

1.05 FINAL "AS-INSTALLED" DOCUMENTATION

A. Reproducible Drawings

1. Contractor shall submit one (1) set of reproducible's of complete schematics, wiring diagrams and installation drawings to include all 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 labeled as "AS-INSTALLED". One copy of applicable schematics and diagrams shall be placed in each control panel in a protective envelope or binder.
2. Loop Diagrams
See 1.02 C.7 specified herein before.
3. Panel Fabrication and Wiring diagrams
See 1.02 C.4 and 1.02 C.5 specified herein before.
4. Interconnecting Wiring Diagrams
See 1.02 C.6 specified herein before.
5. Instrument Installation Details
See 1.02 C.8 herein before.

B. Process and Instrumentation Diagrams

1. The Engineer will supply the ICM Supplier with one set of the P&ID's for revisions to reflect the final installed system to be updated by the ICM Supplier. The ICM Supplier may use these drawings for producing the final documentation.

C. Software Documentation

1. In addition to the reproducible hard copy of drawings and literature generated specifically for the project, one (1) set of 3.5 inch, 1.44 meg capacity diskettes shall be submitted to the Engineer with a copy of all custom files specifically created to generate the drawings, data sheets, bill of materials, operating procedures etc using computer assisted drawing (CAD). Drawing format shall be "AutoCAD Release 11". Diskettes shall be clearly identified by the following:
 - a) Project Name
 - b) Volume Number
 - c) Software Program Name and Version used to generate the files.
 - d) Labeled "AS-INSTALLED"

1.06 TRAINING REQUIREMENTS

A. General

1. Provide the services of a factory trained and field experienced instrumentation engineer to conduct group training of City's designated personnel in the operation of each instrument system. Obtain Engineer'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, panel wiring diagrams and layouts, and the operation and maintenance manuals furnished under these Specifications.
2. Duration
 - a. Training specific to the system hardware. This training shall be for a minimum time period of two (2) days, one day of which may be performed during the operational testing period.

C. Maintenance Training

1. Maintenance training shall include instruction in the calibration, maintenance, and repair required for all instruments. Manufacturer trained instruction shall be given for the following:
 - a) Level Element, Submersible
 - b) Level Element and Transmitter, Radar
 - c) Level Element and Transmitter, Ultrasonic

1.07 POST-CONTRACT SYSTEM SUPPORT

A. Maintenance Contract

1. Duration
 - a. Provide a 1 year maintenance contract for all components furnished.
2. The ICM integrator must be located within 50 miles of site and be able to respond on-site to emergencies within 2 hours. The ICM integrator must have a dedicated service group of at least 3 field engineers based out of the Atlanta area.
3. Schedule
 - a. 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 Engineer records of instrument verification and calibration on appropriate forms. For

clarification the ICM integrator will include 12 site visits after substantial completion.

1.08 GUARANTEE AND WARRANTIES

- A. Guarantee all work of Division 13 in accordance with the Conditions of Contract and Division 1. With respect to instruments and equipment, guarantee shall cover (a) faulty or inadequate design; (b) improper assembly or erection; (c) defective workmanship or materials; and (d) leakage, breakage, or other failure not caused by City misuse. For equipment bearing a manufacturer's warranty in excess of one year, furnish a copy of the warranty to Engineer with City named as beneficiary.

1.09 ICM INTEGRATOR QUALIFICATIONS

- A. The ICM integrator shall be a "systems integrator" regularly engaged in the design and the installation of instrumentation systems and their associated subsystems as they are applied to the municipal water and wastewater industry. The ICM integrator shall be Control Instruments, Inc. (C2i), MR Systems, Inc., Southern Flow, Polytron, Revere Controls or equal meeting the qualifications below. For the purposes of this Specification Section, a "systems integrator" shall be interpreted to mean an organization that complies with all of the following criteria:
 - B. Employs personnel on this project who have successfully completed ISA or manufacturers training courses on general process instrumentation and configuration and implementation of the specific programmable controllers, computers, and software proposed for this project. Key personnel shall hold ISA CCST Level 1 certification or have a minimum of 10 years of verifiable plant startup experience.
 - C. Has successfully completed work of similar or greater complexity on at least three previous projects within the last five years. Successful completion shall be defined as a finished project completed on time, without any outstanding claims or litigation involving the PCSI.
 - D. The system integrator must have completed at least 3 water/wastewater treatment projects of at least 1 million dollars each. One of the projects must be a water/wastewater treatment plant of at least 2 million dollars.
 - E. Has been actively engaged in the type of work specified in this Specification Section for a minimum of ten years.
 - F. The ICM integrator shall maintain a permanent, fully staffed and equipped service facility within 50 miles of the project site with full time employees capable of designing, fabricating, installing, calibrating, and testing the systems specified herein. At a minimum, the PCSI shall be capable of responding to site within 2 hours of notice.
 - G. PCSI shall hold a valid UL-508 and UL-698 certification for their panel fabrication facility (Must have their own in house production facility).

- H. The ICM integrator shall be GE Solution Partner.

PART 2 - PRODUCTS

2.01 HARDWARE REQUIREMENTS

A. Job Conditions

1. Drawings are diagrammatic and show the intended arrangement for system operation, piping, and appurtenances. Conform to Drawings as closely as possible and exercise care (1) to secure neat arrangement of piping, valves, conduit, and like items, and (2) to overcome structural interferences. Verify dimensions and conditions at the place of work, 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; i.e., all instruments in the plant, supplied by the Contractor, of the same type shall be by the same manufacturer. 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 supplier's recommendation. 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, catwalks, etc. All such equipment shall be weather and splash proof, and corrosion resistant and electrical equipment shall be in NEMA 4X cases unless otherwise noted.

E. Instrument Identification

1. All components provided under this section, both field and panel mounted, shall be provided with permanently mounted name tags bearing the entire ISA 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 under Section 13200, Panels.
3. Field mounted tags shall be 16-gauge, 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 all cases 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 suppressor directly to the instrument, the arrestor shall be so mounted.

G. Equipment Operating Conditions

1. All equipment shall be rated for normal operating performance with varying operating conditions over the following minimum ranges:
2. Power.
 - a. Electrical. 110 Vac +/- 10%, 60 Hz +/- 1 Hz except where specifically stated otherwise on the drawings or in the specifications.
3. Field Instruments:
 - a. Outdoor Areas:
Ambient Temperature: 0°C to +50°C
Ambient Relative Humidity: 5% to 100%
Weather: Rain, wind, sun and blowing sand.

Provide, as necessary, enclosures, and sunshields, etc. to assure normal operations under these conditions.

b. Indoor Environmentally Uncontrolled Areas:

Ambient Temperature: -15°C to +50°C

Ambient Relative Humidity: 5% to 80%

c. Indoor Environmentally Controlled Areas:

Ambient Temperature: 0°C to +50°C

Ambient Relative Humidity: 5% to 60%

H. Power Supplies

1. Provide electrical instruments and control devices for operation on 110 Vac, 60 Hz current.
2. 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 110 Vac, 60 Hz commercial power. Units shall be mounted within the control panels.

I. Signal Isolators, Converters and Conditioners

1. Insure that input-output signals of all instruments and control devices (whether furnished by the Contractor or not) are compatible. Analog signals between field and panels shall be 4 to 20 mA dc unless specifically approved otherwise. Granting such approval 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 all instruments and equipment except where in pipelines. Provide paint as required in Division 9 for non-stainless steel structural supports, brackets, etc.

L. Electrical

1. The construction work shall include all the power supply wiring, instrumentation wiring, interconnecting wiring and equipment grounding as indicated, specified and required and not specifically included under Division 16.
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.
3. Provide the materials and complete all the required installations for equipment grounding as specified in Division 16 of these Specifications and indicated on the Electrical 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 City.
5. Field Wiring. For wiring materials, refer to Division 16 and Details on the Electrical Drawings. Ring out signal wiring prior to termination. Provide wire number tags marked in indelible waterproof form of slip-on type heat shrink 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 Section 15060, Piping and Appurtenances, but coordinated by this Division.

N. Electrical Transient Protection

1. All instrument and control equipment mounted outside of protective structures (field mounted equipment) or that have interconnecting lines from outside the protective structure shall be equipped with suitable 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 120V ac inputs to field mounted equipment shall be secondary valve surge protectors conforming to the requirements of IEEE Standard 28-1972 (ANSI C62.1-1971).

2. Surge and transient protectors shall be grounded according to Division 16, ELECTRICAL.
3. Field 4 wire surge protectors are to be Edco SLAC-12036 in NEMA 4X polycarbonate enclosure. Field 2 wire surge protector are to be Edco SS64-036-1

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 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.

+++ END OF SECTION 13000 +++

SECTION 13100
INSTRUMENTATION, CONTROL AND MONITORING SYSTEM
LOOP DESCRIPTIONS

PART 1 - GENERAL

1.01 SCOPE

- A. Requirements specified in the General and Special Conditions of Contract and Divisions 1, 11, 13, 15, and 16 form a part of this Section. It is the intent of this Section to also supplement where applicable, other Sections of Division 13. It is the intent of this Section to briefly describe each main system in order that the ICM Subcontractor, as well as suppliers of packaged systems and subsystems shall be aware of the magnitude of the total ICM System. Certain systems described are supplied as package systems furnished under other divisions or by the City and are so identified. Interfacing with these systems is a part of the work of this Division.

1.02 INSTRUMENTATION AND CONTROL PHILOSOPHY

- A. The instrumentation and control equipment for the River Intake Pump Station, as described herein, is based on providing sufficient measurement, indication and/or automatic control to enable process operation within the design criteria. Automatic control loops are specified only where necessary and include manual bypass control options. Adequate monitoring equipment is specified to permit complete process operational management and evaluation and for operator protection. In general, automatic controls are confined to level, time, water quality, flow and where necessary, quality type controls. Other more sophisticated controls may be included in some packaged systems of mechanical equipment.

1. Automatic Motor Control

Except when specifically described otherwise, all motors specified for automatic operation shall be provided with Hand-Off-Auto (H-O-A) selector switches. In the Hand position, the motor shall operate continuously and automatic interlock if any, shall be by-passed. In the Off position, the motor shall be stopped. The Auto position, operation of the motor shall be dependent on the status of the output contact of the control circuit to be described for the individual equipment.

2. Alarm Processing

Alarms shall be hardware and software generated. When an alarm is detected, the alarm status shall be indicated on the local operator interface. In addition, external

alarm horn will be sounded locally when the operations mode needs to be changed. All alarms shall be automatically retransmitted to the Central Control and Monitoring System where the condition will be logged and the operator alerted. Provisions shall be provided to allow the alarms to be acknowledged locally or remotely.

Unless otherwise noted, all external generated alarms shall be activated upon the opening of the contact.

3. Auxiliary Contacts

Unless otherwise noted, all contact driven inputs and outputs shall be of the dry isolated SPDT relay type.

1.03 PROCESS INSTRUMENTATION, CONTROL & MONITORING FUNCTIONS.

- A. The overall function of the Instrumentation, Control, and Monitoring System shall be to provide an efficient control and monitoring interface between plant operations and treatment processes by presenting visual and audible information of plant operating parameters, equipment status and wear, and alarm conditions. It provides automatic control of critical parameters or parameters which would require frequent operator attention. The system shall provide means for manual override operation of any automatic function when required and shall permit control of the operation of motors and valves that are pertinent to satisfactory process performance. Control and monitoring shall be accomplished locally or remotely by the Central Control and Monitoring System. The system shall provide the following described functions in accordance with the process and instrumentation diagrams ("I"-Drawings).
- B. Included herein are functional descriptions of the process instrumentation and control systems which specify the responsibility of the Process Instrumentation, Control & Monitoring System Supplier. These descriptions are to supplement the Process and Instrumentation Drawings and neither is complete without the other. If the ICM Subcontractor requires devices other than shown on the Drawings and/or specified herein to achieve the result required by the system description, provide these devices to obtain the required result.
- C. The intent of these Specifications is to secure systems that have 4-20 mA dc analog signals between control panels and field devices throughout the plant except where specified otherwise.
- D. The system descriptions herein cover all processes in general even though no specific ICM work is required in a given system. These descriptions are provided for completeness and to indicate the relationship of the ICM work to other divisions. Where specific functions are described as to be performed under the

Division 13, Electrical, they shall be as binding upon the Contractor as if written in the Electrical Division Sections.

1.04 SYSTEM DESIGNATIONS

- A. To provide for drawing simplicity, when identical process equipment loops are shown, only the last unit is generally shown in detail with the third digit of the loop number representing the last process equipment unit. The descriptions herein shall also only discuss the last unit in detail; previous equipment is understood to be identical in function.

+++ END OF SECTION 13100+++

**SECTION 13200
GENERAL REQUIREMENTS FOR
PROCESS INSTRUMENTATION SYSTEMS**

PART 1 - GENERAL

1.01 SCOPE

- A. This section specifies general requirements which are applicable to all process instrumentation systems consisting of process sensors, monitoring and control instruments, and accessories required to provide a complete and functional monitoring and control system.
- B. Work Included:
 - 1. The Contractor shall provide, calibrate, and test the complete process instrumentation system. The Contractor shall also place the completed system in operation including tuning loops and make final adjustments to instruments as required during plant start-up. The Contractor shall provide the services of instrument technicians for testing and adjustment activities.
 - 2. The Contractor shall examine the mechanical drawings and specifications to determine actual locations, sizes, materials and ratings of process connections.

1.02 SUBMITTALS

- A. Submittals shall be made in accordance with the requirements of the General Conditions of the Contract Documents. Drawings, information and technical data for all equipment as required in Section 13000 and this section shall be submitted. All required information for this section shall be included in one complete submittal. In addition, the following specific information shall be provided:
 - 1. Data sheets for all instruments and accessories to be provided. Data sheets shall be in accordance with ISA S20. All applicable entries on the data sheet shall be completed.

1.03 QUALITY ASSURANCE

- A. Reference Standards: Comply with all Federal and State laws or ordinances, as well as all applicable codes, standards, regulations and/or regulatory agency requirements
- B. Manufacturer:
 - 1. Equipment furnished under this section shall be the products of firms regularly engaged in the design and manufacture of such equipment for a minimum of five years.

C. Installer:

1. Installation, calibration and testing of equipment furnished under this section shall be performed by qualified, skilled technicians who are regularly engaged in such activities involving systems of similar complexity, and who possess all licenses and certificates required to perform such work.

D. References:

1. References are listed in Section 13000. They are a part of this section as specified and modified.

1.04 ENVIRONMENTAL CONDITIONS

- A. Equipment provided under this section shall be suitable for operation under ambient conditions described in paragraph 13000-1.03.

PART 2 - PRODUCTS

2.01 INSTRUMENT SCHEDULE – Not used; all relevant data shown on drawings.

PART 3 - EXECUTION

3.01 INSTALLATION

A. General:

1. Installation shall be in accordance with Section 13000, this section, subsequent sections of this division, and as shown on the drawings.

B. Electrical Power Wiring:

1. Electrical power wiring shall be in accordance with paragraph 13000-3.01.

C. Signal Wiring:

1. Signal wiring shall be in accordance with paragraph 13000-3.01.

D. Process Connections:

1. Process connections shall be in accordance with paragraph 13211-3.01.

E. Tubing:

1. Tubing shall be installed in accordance with paragraph 13211-3.01.

F. Signal Transmission:

1. Signal transmission between electric or electronic instruments not located within a common panel shall be 4 to 20 milliamperes and shall operate at 24 volts DC unless otherwise specified. Milliampere signals shall be current regulated and shall not be affected by changes in load resistance within the unit's rating. Milliampere signals from field shall be converted to a 1 to 5 volt signal by dropping across a 0.1%, 250 ohm, 1/2 watt resistor at the external terminals of each panel. All instruments within the panel shall be parallel wired. Measurement loops shall be grounded at external terminals by bonding to the instrument panel signal ground bus. Isolating amplifiers for field equipment possessing a grounded input or output shall be provided.
2. High frequency (greater than 1 kHz) pulse rate signals from field transmitters shall be converted to DC voltage signals at the panel.
3. Platinum resistance temperature detector (RTD) outputs shall be carried to the control panel and converted to a dc voltage signal unless otherwise specified or shown.
4. All other transmission systems, such as impulse duration, low frequency pulse rate, and voltage regulated, will not be permitted except where specifically noted in the instrument schedule, paragraph 3.03 of this section. When transmitters with non-standard outputs are specified, their output shall be converted to 4 to 20 milliamperes at the field instrument.
5. Two wire equipment located in hazardous areas shall be made safe for the specified conditions by use of equipment and barriers approved by Underwriters Laboratories, Inc. (UL), Canadian Standards Association (CSA), or Factory Mutual (FM).

3.02 TESTS AND INSPECTIONS

A. General Requirements:

1. Materials, equipment, and construction included under this specification shall be inspected in accordance with the procedures set forth in the General and Special Conditions sections of the Contract Documents, Section 13000, and this section. Testing shall be performed in accordance with Section 13000, this section, and subsequent sections of this division.

B. Installed Tests and Inspection:

1. Test Reports: Test reports shall conform to the requirements of reference forms 13000-A through 13000-K included in paragraph 3.02C of this Section.
2. Test Equipment: 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. Each test instrument shall be calibrated prior to the commencement of a testing activity and at the completion of a testing activity. Certified calibration reports traceable to the National Bureau of Standards shall be included with the test report. Buffer solutions and reference fluids shall be provided as necessary for tests of analytical equipment.

3. Testing Stages:

- a. General: Each instrument loop shall be tested in the following sequence:

Testing sequence	Form reference
Wiring	Section 01600
Individual components	Section 01600
Individual loops	Section 01600
Loop commissioning	Section 01600

Testing of piping and wiring and individual components shall be completed with certified test reports provided to the Engineer prior to commencement of individual loop testing, which shall be completed with certified test reports provided to the Engineer prior to commencement of loop commissioning.

- b. Individual Component Calibration and Test: 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 paragraph 3.03 of this section at this time. Final elements shall be checked for range, dead band, and speed of response.

Any component which fails to meet the required tolerances shall be repaired by the manufacturer or replaced, and the above tests repeated until the component is within tolerance.

- c. Loop Test: Each instrument loop shall be tested as an integrated system. This test shall check operation from transmitter to readout components. Signals shall be injected at the signal connection to primary measuring elements.

If any output device fails to indicate properly, corrections to the loop circuitry shall be made as necessary and the test repeated until all instruments operate properly

- d. Closed Loop Commissioning Test: Commissioning test shall demonstrate stable operation of the loop under actual plant operating conditions. This test shall include adjustment of loop tuning parameters.

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. A chart recording showing loop response to a step disturbance shall be provided for each loop. Two charts shall be made for cascade loops, one showing the

secondary loop response with its set point on manual, and the second showing overall loop response. Each control loop with "batch" feature shall be adjusted to provide optimum response following start-up from an integral action saturation condition. Chart recording shall be provided showing this response. Chart recordings shall be made at sufficient speed and amplitude to clearly show 1/4 amplitude damping and shall be annotated to show loop number and title, and settings of parameters and set point.

+++ END OF SECTION 13200 +++

**SECTION 13211
PROCESS TAPS AND PRIMARY ELEMENTS**

PART 1 - GENERAL

1.01 SCOPE

- A. Work described in this Section includes furnishing all labor, materials, equipment, tools and incidentals required for a complete and operable installation of instrumentation elements which form a part of the process control systems specified in Section 13200. Application requirements are specified in ~~paragraph~~ 13200-3.03. All instrumentation elements shall be installed, adjusted, tested and placed in operation in accordance with these Specifications, the manufacturer's recommendations and as shown on the Drawings.
- B. Contract drawings show only functional features and some of the required external connections. They do not show all components required for a complete installation nor exact dimensions particular to any manufacturer's equipment. Contractor shall supply all parts, devices and equipment necessary to meet the requirements of the Contract Documents and shall make all dimensional adjustments particular to the equipment being furnished. All costs associated with such changes and adjustments shall be considered as being included in the price bid for the work shown and specified.
- C. Operating Requirements:
 - 1. The devices specified in this section quantitatively convert the measured variable energy into a form suitable for measurement and process measurement accessories.

1.02 SUBMITTALS

- A. Submittals shall be made in accordance with the requirements of the General Conditions of the Contract Documents. In addition, the following specific information shall be provided:
 - 1. In accordance with paragraph 13000-1.04 F, record documentation shall include the data sheets specified in paragraph 13200-1.04 B.

1.03 QUALITY ASSURANCE

- A. Manufacturer:
 - 1. Equipment furnished under this section shall be the products of firms regularly engaged in the design and manufacture of such equipment for a minimum of five years.
- B. Installer:

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1. Installation, calibration and testing of equipment furnished under this section shall be performed by qualified, skilled technicians who are regularly engaged in such activities involving systems of similar complexity, and who possess all licenses and certificates required to perform such work.

C. References:

1. References are listed in Section 13000. They are a part of this section as specified and modified.

1.04 ENVIRONMENTAL CONDITIONS

- A. Equipment provided under this section shall be suitable for operation under ambient conditions described in paragraph 13000-1.03.

PART 2 - PRODUCTS

2.01 INSTRUMENTATION SPECIFICATION SHEETS (INSTRUSPEC)

- A. Specific requirements for instruments included in this section are listed on INSTRUSPEC sheets in paragraph 3.03 of this section.

2.02 VALVES

A. Isolation Valves:

1. Valves shall be full port ball valves with ASTM A276, 316 stainless steel trim and body and with Teflon seats and packing. Valves shall be Whitey series 40, Hoke Flowmite, or equal.

B. Gauge Valves:

2. Gauge valves shall be globe or angle pattern units machined from ASTM A276 bar stock and shall be provided with two 1/2-inch NPT ports. Valves shall be Anderson, Greenwood & Company M9 series, Hoke 2100 series, or equal. Valve material shall be compatible with that of the gauge

C. Root Valves:

1. Root valves shall be ASTM A276, type 316 stainless steel bar stock with 1/2-inch NPT male process connection and three 1/2-inch NPT female instrument connections. One instrument connection shall be provided with an ASTM A276, type 316 stainless steel bleed valve. ASTM276, type 316 stainless steel plugs shall be provided for unused ports. Lagging type units shall be provided

for insulated vessels and pipes. Root valves shall be Anderson, Greenwood & Company M5A VS-44, Hoke 6802L8Y, or equal.

D. Manifolds:

1. Manifolds shall be three-valve bar-stock type. Manifold body shall be machined from ASTM, type 316 stainless steel bar stock. Valves shall be globe configuration with 316 stainless steel ball seats and Teflon stem packing. Manifolds shall be designed for direct mounting to differential pressure transmitters in place of the flanges normally furnished. Fabricated manifolds or manifolds employing needle or soft seat valves are not acceptable. Purge taps, $\frac{1}{8}$ -inch NPT shall be furnished on manifolds where water purge is specified. Manifolds shall be Anderson Greenwood M4T VS, HEX 8123F8Y, or equal.

2.03 TUBING AND TUBING FITTINGS

- A. Instrument tubing between the process connection and instruments shall be $\frac{1}{2}$ -inch x 0.035-inch seamless annealed ASTM A269 type 316 stainless steel.
- B. Tubing fittings shall be type 316 stainless steel and shall be the double-ferrule swage type. Flare, ball sleeve compression or single-ferrule swage type are not acceptable. Fittings shall be Crawford "Swagelok", Hoke "Gyrolok", or equal.

2.04 CHEMICAL SEALS

A. Diaphragm:

1. Seal shall be the diaphragm type with flushing connection, type 316 stainless steel body and type 316L diaphragm unless otherwise specified. Fill fluid shall be DC200 silicone oil unless otherwise specified. Seal shall be Mansfield and Green type SG, Ashcroft type 101, or equal.

B. Annular:

1. Seal shall be the in-line full stream captive sensing liquid type. Metallic wetted parts shall be 316 stainless steel. Flexible cylinder shall be Buna-N unless otherwise specified. Seals shall be rated 200 PSIG with not more than 5-inch WC hysteresis. Fill fluid shall be DC200 silicone oil unless otherwise specified. Seals shall be Ronningen-Petter Iso-Ring, Red Valve series 40, or equal.

2.05 BUSHINGS AND THERMOWELLS

- A. Bushings or thermowells shall comply with SAMA PMC13-10. Temperature taps shall be 1 inch NPT, and lagging extensions shall be provided on insulated vessels or pipes. Thermowells and bushings shall be brass unless otherwise specified. To

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ensure proper fit, thermowells shall be provided by the same supplier as the instrument or device to be installed therein.

2.06 PURGE ASSEMBLIES

A. Air:

1. Air purge assembly shall consist of a constant-differential relay, needle valve, check valve and 0.2 to 2.0 SCFH rotameter. Assembly shall be Moore Products 62VA, Fischer & Porter 10A3137N-3BR2110, or equal.

B. Water:

1. Water purge assembly shall consist of a strainer, constant-differential regulator, needle valve, check valve, and 20 to 200 cc/m rotameter. Assembly shall be Moore Products 63BD4A, Fischer & Porter 10A3137N-53BR2110, or equal. Strainer shall be 155 micron wye-type, ASCO 8600A2, Crane, or equal.

PART 3 - EXECUTION

3.01 INSTALLATION

A. General:

1. General requirements for the installation of primary elements specified in this section are listed on INSTRUSPEC sheets in paragraph 3.03 of this section.

B. Process Connections:

1. Unless otherwise specified, process taps shall comply with API RP550. Root valves shall be provided at taps, except temperature taps and pump discharge pressure taps. Process connections shall be arranged, where possible, such that instruments may be readily removed for maintenance without disruption of process units or draining of large tanks or vessels. Unions or flange connections shall be provided as necessary to permit removal without rotating equipment. Where process taps are not readily accessible from instrument locations, a block valve shall be provided at the instrument. Block valves shall also be provided for each instrument where multiple instruments are connected to one process tap.

C. Tubing:

1. Tubing shall be installed on supports spaced not more than 3 feet apart and shall run parallel of perpendicular to walls structural members, or intersections of vertical planes and the ceiling. Unless otherwise shown, tubing shall follow

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building surfaces closely or shall be carried in trays or conduit. Tubing shall not be supported from piping or equipment except at process taps or connections to the device served. Tubes supported directly on concrete surfaces shall be spaced at least -inch from the concrete. Tubing support shall be one-hole malleable iron clamps with clamp backs as required. Bends shall be formed to uniform radii without flattening. Ends of tubing shall be square-cut and deburred before installation in fittings. Fittings shall be used for splices, connections, and turns near final connections. Bulkhead fittings shall be used when tubing enters a panel.

D. Electrical Connections:

1. Final connections between rigid raceway systems and instruments shall be made with jacketed flexible conduit with a maximum length of 3 feet in accordance with paragraph 13000-3.01.

3.02 TESTING

A. General:

1. General requirements for testing of primary elements specified in this section are listed on INSTRUSPEC sheets in paragraph 3.03 of this section.

B. Process Connections:

1. Process connection piping and tubing shall be tested in accordance with Division 15.

3.03 Instruspec Sheets (starts on next page)

3.03.1 INSTRUMENT SPECIFICATION SHEET-INSTRUSPEC

Instrument Identification LW	
Instrument Function	Liquid level measurement accessory
Instrument Description	Stilling Well
Power Supply:	N/A
Signal Input	N/A
Signal Output	N/A
Process Connection	N/A
Product Data	Stilling well shall be installed in wet wells to protect level measurement devices and to provide a dampened measurement medium. Stilling wells shall be continuous over the range of the measurement device the stilling well is being installed for and a minimum of 3 inches below the end of the measurement device. Stilling wells shall be constructed of SCH 80 PVC pipe cut in half

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	lengthwise. Well shall be attached to the wet well wall by the means of 1/8 inch by 1 inch 316 stainless steel straps anchored to the wet well wall. Straps shall be anchored by 1/2 inch by 3 inch concrete anchor bolts. Straps shall be installed no less than 6 feet on center and no fewer than 3 on each well. The stilling well shall be connected to the strap by 1/4-inch diameter by 3/4-inch long, 316 stainless steel bolts. Bolts shall be no more than 6 inches apart with a minimum of 2 per strap. Minimum radii to specified in paragraph 13200-3.03.
Instrument Identification	LW (continued)
Wet Wells	Stilling wells to be installed in all wet wells shall have an end cap with flow holes. End caps shall be solvent weld attached to the pipe before the pipe is cut. One row of holes shall be drilled directly above the cap but not to direct flow of liquid directly at the measurement instrument. Holes shall be 3/4 inch diameter, one at least every 4 inches on center and one 3/4 inch hole on the bottom for complete drainage.
Execution	
Installation	Stilling wells shall be installed in the location shown on the drawings.
Test	N/A
Approved Manufacturers	N/A

3.03.2 INSTRUMENT SPECIFICATION SHEET--INSTRUSPEC

Instrument Identification PG	
Instrument Function	Pressure Measurement
Instrument Description	Pressure Gauge
Power Supply	N/A
Signal Input	N/A
Signal Output	N/A
Process Connection	½-inch male NPT
Product Data	Pressure gauges shall be 4-½-inch glycerine-filled, solid-front units with phenolic turret cases, bourdon tube elements, 270-degree milled stainless steel movements, and shatterproof glass windows. Bourdon tube shall be bronze unless otherwise specified. Gauges shall be manufactured to Grade 2A accuracy (+0.5%) in compliance with ANSI specification B40.1. Gauges shall be provided with a porous metal type snubber unless otherwise specified. Snubber material shall be compatible with that of the gauge.
Execution	
Installation	Install in accordance with manufacturer's instructions, the recommendations of API RP550, paragraph 13200-3.01, and the specified functional requirements. Pressure gauges may be supported from the process tap if this location permits observation from the floor or a permanent work platform. Pressure instruments shall be installed in such a manner that blowout discs are not obstructed.
Test	In accordance with paragraph 13200-3.02.
Application/Calibration	Application, calibration, and set points shall be as specified in paragraph 13200-3.03.
Approved Manufacturers	Ashcroft Figure 1279, U.S. Gauge Figure 1980L, or equal.

3.03.3 INSTRUMENT SPECIFICATION SHEET--INSTRUSPEC

Instrument Identification TMI	
Instrument Function	Temperature Measurement
Instrument Description	Bi-metal temperature indicator
Power Supply	N/A
Signal Input	Process
Signal Output	N/A
Process Connection	½-inch male NPT
Product Data	Temperature indicators shall be operated by the expansion or contraction of a bimetallic element. Temperature indicators shall be hermetically sealed, with an external zero adjuster. Case, ring, and stem material shall be type 304 stainless steel. Dial shall be 5 inch, 270-degree movement, with an acrylic window. Scale shall be marked at least every 2 degrees F. Major scale divisions shall be at 10 degree F. intervals and scale shall be numerically noted at 20 degree F. intervals. Dial angle shall be adjustable over a 90 degree arch with respect to the stem. Stem length shall not exceed 4 inches and diameter shall not exceed 1/4 inch unless otherwise specified. Accuracy shall be plus or minus 1 percent of span, or better.
Execution	
Installation	Install in thermowells specified in paragraph 2.05 of this section in accordance with the manufacturer's instructions, paragraph 13200-3.01, the recommendations of API RP550, and the specified functional requirements. For pipelines less than 4-inch diameter, thermowell shall be installed in a pipeline elbow if possible. Where elbow is not available, a wye fitting shall be installed in the pipeline for installation of the thermowell at a 45-degree angle with the flow.
Test	In accordance with paragraph 13200-3.02.
Application/Calibration	Application, calibration, and set points shall be as specified in paragraph 13200-3.03.
Approved Manufacturers	Ashcroft Model 50EI42E, or equal.

3.03.4 INSTRUMENT SPECIFICATION SHEET--INSTRUSPEC

Instrument Identification TRE	
Instrument Function	Temperature Measurement
Instrument Description	Resistance temperature element (RTD), insertion type
Power Supply	N/A
Signal Input	N/A
Signal Output	RTD
Process Connection	½-inch male NPT
Product Data	<p>Element shall be a 100-ohms nominal at 0 degree C, tip-sensitive, three-wire, platinum RTD in a 1/4-inch ASTM A269, type 316 stainless steel sheath with watertight connection head. Time constant in agitated water shall not exceed 6.0 seconds. RTD shall comply with PMC5-10 and PMC21-4, curve PR278. Error shall not exceed the greater of 0.5 degrees F and 0.5 percent of reading. RTDs for installation in wells shall be provided with a spring loading device and union coupler.</p> <p>RTD extension cable shall be No. 16 AWG triads as specified in Section 16120.</p>
Execution	
Installation	<p>Install in thermowells specified in paragraph 2.05 of this section in accordance with the manufacturer's instructions, paragraph 13200-3.01, the recommendations of API RP550, and the specified functional requirements. Union couplers shall be provided so that the element may be removed without turning. For pipelines less than 4-inch diameter, thermowell shall be installed in a pipeline elbow if possible.</p> <p>Where elbow is not available, a wye fitting shall be installed in the pipeline for installation of the thermowell at a 45-degree angle with the flow.</p>
Test	In accordance with paragraph 13200-3.02.
Application/Calibration	Application, calibration, and set points shall be as specified in paragraph 13200-3.03.

3.03.5 INSTRUMENT SPECIFICATION SHEET--INSTRUSPEC

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Instrument Identification FS	
Instrument Function	Flow Switch
Instrument Description	Thermal type
Power Supply	N/A
Signal Input	N/A
Signal Output	Contact
Process Connection	3/4-inch NPT with a standard "U" length suitable for mounting in a 3/4-inch threaded tee. The unit shall be designed to mount in horizontal piping in a side-mounted configuration.
Product Data	Thermal flow switch, liquid service only. Contacts: SPDT 5 amp resistive at 120 VAC. Response Time: Unit shall guarantee less than 10 seconds response time for the line sizes, flow rates and other conditions as installed in this application. Materials of Construction a. Wetted Parts: 316 stainless steel. b. Electronics Enclosure: Cast aluminum with epoxy coating, suitable for outdoor service.
Execution	
Installation	Provide rigid mounting for thermal flow switches. Weight of switch shall not be supported by the pipe on which the flow switch is mounted.
Test	In accordance with paragraph 13200-3.02.
Application/Calibration	Application, calibration, and set points shall be as specified in paragraph 13200-3.03.
Approved Manufacturers	FCI, STI or approved equal.

+++ END OF SECTION 13211 +++

**SECTION 13216
PROCESS SWITCHES**

PART 1 - GENERAL

1.01 SCOPE

- A. Work described in this Section includes furnishing all labor, materials, equipment, tools and incidentals required for a complete and operable installation of process activated switches which form a part of the process control systems specified in Section 13200. Application requirements are specified in paragraph 13200-3.03. All equipment shall be installed, adjusted, tested and placed in operation in accordance with these Specifications, the manufacturer's recommendations and as shown on the Drawings.

1.02 SUBMITTALS

- A. Submittals shall be made in accordance with the requirements of the General Conditions of the Contract Documents. drawings, information and technical data for all equipment as required in Section 13000 and this section shall be submitted. All required information for this section shall be included in one complete submittal. In addition, the following specific information shall be provided:
 - 1. In accordance with paragraph 13000-1.04 F, record documentation shall include the data sheets specified in paragraph 13200-1.04 B.

1.03 QUALITY ASSURANCE

- A. Reference Standards: Comply with all Federal and State laws or ordinances, as well as all applicable codes, standards, regulations and/or regulatory agency requirements.
- B. Manufacturer:
 - 1. Equipment furnished under this section shall be the products of firms regularly engaged in the design and manufacture of such equipment for a minimum of five years.
- C. Installer:
 - 1. Installation, calibration and testing of equipment furnished under this section shall be performed by qualified, skilled technicians who are regularly engaged in such activities involving systems of similar complexity, and who possess all licenses and certificates required to perform such work.

D. References:

1. References are listed in Section 13000. They are a part of this section as specified and modified.

1.04 ENVIRONMENTAL CONDITIONS

- A. Equipment provided under this section shall be suitable for operation under ambient conditions described in paragraph 13000-1.03.

PART 2 - PRODUCTS

2.01 GENERAL

- A. Unless otherwise specified, switches shall comply with the following requirements:
1. Contact outputs used for alarm actuation shall be ordinarily closed and shall open to initiate the alarm.
 2. Contact outputs used to control equipment shall be ordinarily open and shall close to start the equipment.
 3. Contacts monitored by solid state equipment such as programmable controllers or annunciators shall be hermetically sealed and designed for switching currents from 20 to 100 mA at 24 volts DC.
 4. Contacts monitored by electro-magnetic devices such as mechanical relays shall be rated NEMA ICS 2, designation B300.
 5. Double barriers shall be provided between switch elements and process fluids such that failure of one barrier will not permit process fluids into electrical enclosures.
 6. Switch electrical enclosures shall be rated NEMA 250, type 4 minimum.
 7. Contacts in Class 1, Division 1 and Class 1, Division 2 areas shall be made safe by suitable intrinsic safety barriers or relays as specified in paragraph 2.02 of this section.
 8. Switch range shall be selected so that the specified set point is at least 30 percent, but not more than 70 percent of the span between the upper range limit and the lower range limit.

2.02 INTRINSIC SAFETY BARRIERS AND RELAYS

- A. Intrinsic safety barriers for process switches shall be dual type; Cooper MTL 787, Panalarm 201-BR2, or equal. Intrinsic safety relays shall be Gems, Square-D, Warrick, or equal.

2.03 INSTRUMENTATION SPECIFICATION SHEETS (INSTRUSPEC)

- A. Specific requirements for instruments specified in this section are listed on INSTRUSPEC sheets in paragraph 3.03 of this section.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. General requirements for installation of instruments specified in this section are given on INSTRUSPEC sheets in paragraph 3.03 of this section.

3.02 TESTING

- A. General requirements for testing of instruments specified in this section are listed on INSTRUSPEC sheets in paragraph 3.03 of this section.

3.03 INSTRUSPEC SHEETS (starts on the next page)

3.03.1 INSTRUMENT SPECIFICATION SHEET - INSTRUSPEC

Instrument Identification:	LFS
Instrument Function	Level measurement
Instrument Description	Float switch, free-floating
Power Supply	N/A
Signal Input	Process
Signal Output	Contacts in accordance with paragraph 2.01 of this section
Process Connection	N/A
Product Data	Switch shall be free-floating type, suspended from a PVC-coated, multi-core connecting cable which also contains the conductors. The float shall contain mercury switches and shall be foam-filled, hermetically sealed and PVC coated.
Execution	
Installation	Install in accordance with the manufacturer's instructions, paragraph 13200-3.01, and the specified functional requirements.
Test	In accordance with paragraph 13200-3.02.
Application/Calibration	Application, calibration, and set points shall be as specified in paragraph 13200-3.03.
Approved Manufacturers	Kari, Enviroquip series 2900, Anchor Scientific, or equal.

3.03.2 INSTRUMENT SPECIFICATION SHEET - INSTRUSPEC

Instrument Identification:	PS
Instrument Function	Pressure measurement
Instrument Description	Pressure switch
Power Supply	N/A
Signal Input	Process
Signal Output	Contacts in accordance with paragraph 2.01 of this section
Process Connection	1/4-inch female NPT
Product Data	<p>Pressure switches shall consist of a pressure transducer and precision switches. Pressure transducer shall be the diaphragm or bellows type with wetted materials as recommended by the switch manufacturer, or as specified in paragraph 13200-3.03. Differential pressure transducer shall be provided when specified in paragraph 13200-3.03. The range spring and piston shall be isolated from process fluids by the diaphragm or bellows. Switch housing shall be cast aluminum rated NEMA type 4 with 3/4-inch conduit connections unless otherwise specified.</p> <p>Approximate set point and, if applicable, reset point shall be indicated on calibrated scales. Repeatability and sensitivity shall be 1.0 percent of operating range or better. Unless otherwise specified, switches shall be non-adjustable dead-band, automatic reset type. Unless otherwise specified, two independently adjustable, SPDT switches shall be provided in each unit. In the case of manual reset, or low range switches (80 inches WC or less) only one SPDT switch is required.</p>
Execution	
Installation	Install in accordance with the manufacturer's instructions, paragraph 13200-3.01, and the specified functional requirements.
Test	In accordance with paragraph 13200-3.02.
Application/Calibration	Application, calibration, and set points shall be as specified in paragraph 13200-3.03.
Approved Manufacturers	Ranges greater than 80 inches WC: United Electric Series H402, or equal. Ranges 80 inches WC or less: United Electric Series H400, or equal.

3.03.3 INSTRUMENT SPECIFICATION SHEET - INSTRUSPEC

Instrument Identification:	TS
Instrument Function	Temperature measurement
Instrument Description	Temperature switch
Power Supply	N/A
Signal Input	Process
Signal Output	Contacts in accordance with paragraph 2.01 of this section
Process Connection	N/A
Product Data	
General:	Temperature switch assembly shall consist of a SAMA PMC6-10, Class 2 filled thermal element and pressure switch connected by a capillary tube or, close coupled as specified. The temperature switch assembly shall be housed in a cast aluminum enclosure rated NEMA type 4, unless otherwise specified.
Switch:	Approximate set point shall be indicated on internal, calibrated scales. Repeatability and sensitivity shall be 1 percent of range, or better. Unless otherwise specified, switches shall be non-adjustable deadband, automatic reset type. Two independently adjustable, SPDT switches shall be provided.
Execution	
Installation	Install in accordance with the manufacturer's instructions.
Test	In accordance with paragraph 13200-3.02.
Application/Calibration	Application, calibration, and set points shall be as specified in paragraph 13200-3.03.
Approved Manufacturers	United Electric Series 402, Asco series SC, or equal.

+++ END OF SECTION 13216 +++

**SECTION 13271
SIGNAL CONDITIONING MODULES**

PART 1 - GENERAL

1.01 SCOPE

- A. Work described in this Section includes furnishing all labor, materials, equipment, tools and incidentals required for a complete and operable installation of panel mounted signal conditioning modules which form a part of the process control systems specified in Section 13200. Application requirements are specified in paragraph 13200-3.03. All equipment shall be installed, adjusted, tested and placed in operation in accordance with these Specifications, the manufacturer's recommendations and as shown on the Drawings.

1.02 SUBMITTALS

- A. Submittals shall be made in accordance with the requirements of the General Conditions of the Contract Documents. Drawings, information and technical data for all equipment as required in Section 13000 and this section shall be submitted. All required information for this section shall be included in one complete submittal. In addition, the following specific information shall be provided:
 - 1. In accordance with paragraph 13000-1.04 F, record documentation shall include the data sheets specified in paragraph 13200-1.04 B.

1.03 QUALITY ASSURANCE

- A. Reference Standards: Comply with all Federal and State laws or ordinances, as well as all applicable codes, standards, regulations and/or regulatory agency requirements.
- B. Manufacturer:
 - 1. Equipment furnished under this section shall be the products of firms regularly engaged in the design and manufacture of such equipment for a minimum of five years.
- C. Installer:
 - 1. Installation, calibration and testing of equipment furnished under this section shall be performed by qualified, skilled technicians who are regularly engaged in such activities involving systems of similar complexity, and who possess all licenses and certificates required to perform such work.

D. References:

1. References are listed in Section 13000. They are a part of this section as specified and modified.

1.04 ENVIRONMENTAL CONDITIONS

- A. Equipment provided under this section shall be suitable for operation under ambient conditions described in paragraph 13000-1.03.

PART 2 - PRODUCTS

2.01 GENERAL

- A. Unless otherwise specified, signal conditioning modules shall comply with the following requirements:
1. Analog signal inputs shall be 1 to 5 volts DC into 20M ohms.
 2. Analog signal outputs shall be 1 to 5 volts DC into 20k ohms.
 3. Discrete output contacts shall be SPDT rated 5 amperes at 117 volts AC and 28 volts DC.
 4. Unless otherwise specified, power supply shall be 24 volts DC plus or minus 10 percent. Power supply effect shall not exceed 0.005 percent per 1.0 percent change.
 5. Electronic trips shall be arranged so that output contact opens in case of loss of signal or loss of power supply.
 6. Modules shall be plug-in printed circuit boards.
 7. Modules shall be rated for continuous operation in an ambient temperature of 0 to 80 degrees C. Ambient temperature effect shall not exceed plus or minus 0.01 percent per degree C within that range.
 8. Span and zero adjustments shall be made by front accessible multi-turn potentiometers.
 9. Electronic trip modules shall be provided with LED indicators for relay status.
 10. Printed circuit card cages shall be suitable for 19-inch EIA RS310C rack or panel mounting as required.

River Intake Pump Station

11. Modules shall withstand 30 volts per meter radio frequency radiation between 200 and 500 MHz with not more than 0.25 percent calibration effect. Modules shall also be provided with traps on the terminals to shunt conducted radio frequency interference to ground.
12. Signal and power supply terminals shall be galvanically isolated from the card cage frame.
13. All plug-in modules specified in this section shall be the product of a single manufacturer and shall be of matching construction to permit unlimited mixing within the card cages.

2.02 INSTRUMENTATION SPECIFICATION (INSTRUSPEC) SHEETS

- A. Specific requirements for instruments specified in this section are listed on INSTRUSPEC sheets in paragraph 3.03 of this section.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. General requirements for installation of instruments specified in this section are listed on INSTRUSPEC sheets in paragraph 3.03 of this section.

3.02 TESTING

- A. General requirements for testing of instruments specified in this section are listed on INSTRUSPEC sheets in paragraph 3.03 of this section.

3.03 INSTRUSPEC SHEETS (starts on the next page)

3.03.1 INSTRUMENT SPECIFICATION SHEET - INSTRUSPEC

Instrument Identification:	YAS
Instrument Function	Signal conditioning module
Instrument Description	Analog summer
Power Supply	24 Vdc, unless otherwise specified
Signal Input	1 to 5 Vdc in accordance with paragraph 2.01 of this section, unless otherwise specified.
Signal Output	1 to 5 Vdc in accordance with paragraph 2.01 of this section, unless otherwise specified.
Process Connection	N/A
Product Data	Function modules shall be of the same manufacture and model throughout the work and shall be of plug in construction suitable for 19-inch EIA dimension card files. Span and zero adjustments shall be by multi-turn potentiometers. Frequency response shall not be down more than 3 dB at 50 hertz. analog summer shall provide algebraic addition of two to four inputs with an accuracy of 0.5 percent of span or better, time constant 50 milliseconds or better, temperature drift 0.02 percent of span per degree C or less over a range of 0 to 50 degrees C. Power supply effect shall not exceed 0.1 percent of span with power supplies provided.
Execution	
Installation	Install in panels specified in Section 13110 in accordance with the manufacturer's instructions, paragraph 13200-3.01, and the specified functional requirements.
Test	In accordance with paragraph 13200-3.02.
Application/Calibration	Application, calibration, and set points shall be as specified in paragraph 13200-3.03.
Approved Manufacturers	Moore Industries, AGM Electronics, or equal.

3.03.2 INSTRUMENT SPECIFICATION SHEET - INSTRUSPEC

Instrument Identification:	YAT
Instrument Function	Signal conditioning module
Instrument Description	Absolute signal trip
Power Supply	24 Vdc, unless otherwise specified
Signal Input	1 to 5 Vdc in accordance with paragraph 2.01 of this section, unless otherwise specified.
Signal Output	Contact in accordance with paragraph 2.01 of this section.
Process Connection	N/A
Product Data	Modules shall monitor input signals and produce an isolated output when the signal rises above the set point. Set point adjustment shall be by multi-turn potentiometer. Pickup set point shall be adjustable from 0.5 to 99 percent of span on a calibrated scale. Accuracy shall be 1.0 percent and repeatability of 0.5 percent of span or better. Deadband shall be adjustable over at least 20 percent of span, and shall be set at 2.0 percent of span unless otherwise specified. Time constant shall be 50 milliseconds or less, temperature drift 0.02 percent of span per degree C or less over a range of 0 to 50 degrees C. Power supply effect shall not exceed 0.1 percent of span with power supplies provided.
Execution	
Installation	Install in panels specified in Section 13110 in accordance with the manufacturer's instructions, paragraph 13200-3.01, and the specified functional requirements.
Test	In accordance with paragraph 13200-3.02.
Application/Calibration	Application, calibration, and set points shall be as specified in paragraph 13200-3.03.
Approved Manufacturers	Moore Industries, AGM Electronics, or equal.

3.03.3 INSTRUMENT SPECIFICATION SHEET - INSTRUSPEC

Instrument Identification:	YCC
Instrument Function	Signal conditioning module
Instrument Description	Current to current isolation amplifier
Power Supply	24 Vdc, unless otherwise specified
Signal Input	4 to 20 mAdc
Signal Output	4 to 20 mAdc into 0 to 1000 ohms, isolated
Process Connection	N/A
Product Data	Modules shall be of the same manufacture and model series throughout the work and shall be of plug-in construction suitable for 19-inch EIA dimension card racks. Load presented to input signal shall not exceed 5 ohms. Accuracy shall be 0.5 percent of span or better, time constant 50 milliseconds or less, and temperature drift 0.02 percent of span per degree C or less over a range of 0 to 50 degrees C. Power supply effect shall not exceed 0.1 percent of span with power supplies provided.
Execution	
Installation	Install in panels specified in Section 13110 in accordance with the manufacturer's instructions, paragraph 13200-3.01, and the specified functional requirements.
Test	In accordance with paragraph 13200-3.02.
Application/Calibration	Application, calibration, and set points shall be as specified in paragraph 13200-3.03.
Approved Manufacturers	Moore Industries, AGM Electronics, or equal.

3.03.4 INSTRUMENT SPECIFICATION SHEET - INSTRUSPEC

Instrument Identification:	YSS
Instrument Function	Signal conditioning module
Instrument Description	Signal selector
Power Supply	24 Vdc, unless otherwise specified
Signal Input	1 to 5 Vdc in accordance with paragraph 2.01 of this section, unless otherwise specified.
Signal Output	1 to 5 Vdc in accordance with paragraph 2.01 of this section, unless otherwise specified.
Process Connection	N/A
Product Data	Accuracy shall be 0.25 percent of span or better, time constant 50 milliseconds or less, temperature drift 0.02 percent of span per degree C or less over a range of 0 to 50 degrees C. Power supply effect shall not exceed 0.1 percent of span with power supplies provided. Frequency response shall be down not more than 3 dB at 50 hertz. Unit shall select and retransmit the higher or lower of two, three, or four inputs as specified. Module shall be Moore Industries, AGM Electronics, or equal.
Execution	
Installation	Install in panels specified in Section 13110 in accordance with the manufacturer's instructions, paragraph 13200-3.01, and the specified functional requirements.
Test	In accordance with paragraph 13200-3.02.
Application/Calibration	Application, calibration, and set points shall be as specified in paragraph 13200-3.03.
Approved Manufacturers	Moore Industries, AGM Electronics, or equal.

3.03.5 INSTRUMENT SPECIFICATION SHEET - INSTRUSPEC

Instrument Identification:	YVC
Instrument Function	Signal conditioning module
Instrument Description	Voltage to current isolation amplifier
Power Supply	24 Vdc, unless otherwise specified
Signal Input	1 to 5 Vdc in accordance with paragraph 2.01 of this section.
Signal Output	4 to 20 mAdc into 0 to 1000 ohms, isolated
Process Connection	N/A
Product Data	Modules shall be of the same manufacture and model series throughout the work and shall be of plug-in construction suitable for 19-inch EIA dimension card racks. Accuracy shall be 0.5 percent of span or better, time constant 50 milliseconds or less, temperature drift 0.02 percent of span per degree C or less over a range of 0 to 50 degrees C. Power supply effect shall not exceed 0.1 percent of span with power supplies provided.
Execution	
Installation	Install in panels specified in Section 13110 in accordance with the manufacturer's instructions, paragraph 13200-3.01, and the specified functional requirements.
Test	In accordance with paragraph 13200-3.02.
Application/Calibration	Application, calibration, and set points shall be as specified in paragraph 13200-3.03.
Approved Manufacturers	Moore Industries, AGM Electronics, or equal.

+++ END OF SECTION 13271 +++

**SECTION 13275
MISCELLANEOUS PANEL INSTRUMENTS**

PART 1 - GENERAL

1.01 SCOPE

- A. Work described in this Section includes furnishing all labor, materials, equipment, tools and incidentals required for a complete and operable installation of miscellaneous panel-mounted instruments which form a part of the process control systems specified in Section 13200. Instruments specified in this section are required to provide an interface between the operator and the process. Application requirements are specified in paragraph 13200-3.03. All equipment shall be installed, adjusted, tested and placed in operation in accordance with these Specifications, the manufacturer's recommendations and as shown on the Drawings.

1.02 SUBMITTALS

- A. Submittals shall be made in accordance with the requirements of the General Conditions of the Contract Documents. Drawings, information and technical data for all equipment as required in Section 13000 and this section shall be submitted. All required information for this section shall be included in one complete submittal. In addition, the following specific information shall be provided:
 - 1. In accordance with paragraph 13000-1.04 F, record documentation shall include the data sheets specified in paragraph 13200-1.04 B.

1.03 QUALITY ASSURANCE

- A. Reference Standards: Comply with all Federal and State laws or ordinances, as well as all applicable codes, standards, regulations and/or regulatory agency requirements.
- B. Manufacturer:
 - 1. Equipment furnished under this section shall be the products of firms regularly engaged in the design and manufacture of such equipment for a minimum of five years.
- C. Installer:
 - 1. Installation, calibration and testing of equipment furnished under this section shall be performed by qualified, skilled technicians who are regularly engaged in such activities involving systems of similar complexity, and who possess all licenses and certificates required to perform such work.
- D. References:

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1. References are listed in Section 13000. They are a part of this section as specified and modified.

1.04 ENVIRONMENTAL CONDITIONS

- A. Equipment provided under this section shall be suitable for operation under ambient conditions described in paragraph 13000-1.03.

PART 2 - PRODUCTS

2.01 INSTRUMENT SPECIFICATION (INSTRUSPEC) SHEETS

- A. Specific requirements for instruments included in this section are listed on INSTRUSPEC sheets in paragraph 3.03 of this section.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. General requirements for installation of instruments specified in this section are listed on INSTRUSPEC sheets in paragraph 3.03 of this section.

3.02 TESTING

- A. General requirements for testing of instruments specified in this section are listed on INSTRUSPEC sheets in paragraph 3.03 of this section.

3.03 INSTRUSPEC SHEETS (starts on the next page)

3.03.1 INSTRUMENT SPECIFICATION SHEET--INSTRUSPEC

Instrument Identification	KIC
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Instrument Function	Miscellaneous panel instrument
Instrument Description	Single loop control station
Power Supply	120 Vac, 60 hertz nominal unless otherwise specified
Signal Input	4 to 20 mA _{dc} unless otherwise specified
Signal Output	4 to 20 mA _{dc} into 0 to 500 ohms unless otherwise specified
Process Connection	N/A
Product Data	
General	The Single loop control station shall be a microprocessor-based unit suitable for flush panel mounting. Control station dimensions shall be nominally 3-3/4 inches high by 3-3/4 inches wide by not more than 8 inches deep. Sampling rate shall be 250 milliseconds and indicating accuracy shall be $\pm 0.25\%$, ± 1 LSD, or better. Process input and control output circuits shall be isolated from each other. All settings and adjustments shall be made by means of the front panel controls.
Display	Display functions shall include process variable, set point, and output value. The process variable and set point displays shall be in engineering units and shall be 4 digit, 7 segment red LED.
Control Functions	The set point value and upper and lower set point limits shall be adjustable from 0 to 100 % of range. The proportional band shall be adjustable from 0.5 to 999.0 %, integral shall be adjustable from 0 to 6000 seconds, and derivative shall be adjustable from 1 to 6000 seconds. Controller output shall be selectable for either automatic or manual modes and the set point source shall be selectable for remote or local.
Execution	
Installation	Install in panels specified in Section 13110 in accordance with the manufacturer's instructions, paragraph 13200-3.01, and the specified functional requirements.
Test	In accordance with paragraph 13200-3.02.
Application/Calibration	Application, calibration, and set points shall be as specified in paragraph 13200-3.03.
Approved Manufacturers	West Model 2075, Yokogawa Model UT35, or equal.

3.03.2 INSTRUMENT SPECIFICATION SHEET--INSTRUSPEC

Instrument Identification	KLI
Instrument Function	Miscellaneous panel instrument
Instrument Description	Loop powered indicator
Power Supply	N/A
Signal Input	4 to 20 mA _{dc} unless otherwise specified
Signal Output	N/A
Process Connection	N/A
Product Data	The loop-powered, two-wire indicator shall a 3-1/2 digit, 7-segment, 0.8-inch high liquid crystal display. Zero shall be adjustable from - 1999 to + 1999 counts and span shall be adjustable from 100 to 4000 counts. A switch-selectable dead zero shall allow display readings to + 19990. Four decimal point positions shall be available and switch-selectable. The enclosure shall be rated Nema 4X, suitable for outdoor mounting. The enclosure shall be suitable for in-line conduit mounting, unless otherwise specified. The indicator shall be suitable for operation within a temperature range of -15 to + 150 degrees F. Accuracy shall be + 0.1 percent of span + 1 count. Voltage drop shall not exceed 4 volts at 40 mA. A/D conversion time shall be no greater than 500 milliseconds and display update time shall be no greater than 0.5 seconds.
Execution	
Installation	Install in accordance with the manufacturer's instructions, paragraph 13200-3.01, and the specified functional requirements.
Test	In accordance with paragraph 13200-3.02.
Application/Calibration	Application, calibration, and set points shall be as specified in paragraph 13200-3.03.
Approved Manufacturers	Action Instruments Visipack V560, or equal.

3.03.3 INSTRUMENT SPECIFICATION SHEET--INSTRUSPEC

Instrument Identification	KSI
Instrument Function	Miscellaneous panel instrument
Instrument Description	Solid state indicator
Power Supply	120 Vac, 60 hertz nominal unless otherwise specified
Signal Input	4 to 20 mA _{dc} , unless otherwise specified
Signal Output	N/A
Process Connection	N/A
Product Data	The indicator shall be a 100-segment, LED, vertical bar-graph type. The display shall be red in color and shall be approximately 4 inches long. Calibrated accuracy shall be plus or minus 1 percent of scale. Indicators shall be suitable for group mounting.
Execution	
Installation	Install in panels specified in Section 13110 in accordance with the manufacturer's instructions, paragraph 13200-3.01, and the specified functional requirements.
Test	In accordance with paragraph 13200-3.02.
Application/Calibration	Application, calibration, and set points shall be as specified in paragraph 13200-3.03.
Approved Manufacturers	Crompton Instruments series FG, Sigma Instruments model 9270, or equal.

+++ END OF SECTION 13275 +++

SECTION 13300
INSTRUMENTATION, CONTROL AND MONITORING SYSTEM COMPONENTS

1.01 SCOPE

- A. Requirements of the General and Special Conditions of the Contract, Division 1 and Section 13000 form a part of this Section. This Section specifies primary and secondary elements of process instrumentation, auxiliary equipment, and supplies directly related to the installation of and operation of these elements, to perform the required functions in conjunction with information and equipment specified in other Sections of Division 13. Schedules indicating required information are attached at the end of this Section, but shall not be construed as Bills of Material or as a complete listing of all required devices.

1.02 QUALITY ASSURANCE

A. Manufacturer

- 1. In addition to requirements of Section 13000, instrumentation and control equipment shall be manufactured by a firm regularly and currently engaged in the design and manufacture of similar equipment. All equipment furnished shall be new and of current design.

B. Maintainability

- 1. All equipment shall be designed for ease of maintenance and repair, and access to critical parts shall not require a major disassembly. Internal field adjustments where permitted or required herein shall be easily accessible upon removal of a panel or cover.

C. Materials and Installation

- 1. Materials and installation shall comply with the requirements of the current editions of referenced electrical codes and standards, and the codes and standards referred to shall be used for establishing the minimum quality of the materials and equipment supplied and installed. All equipment of the same type shall be products of the same manufacturer. Capacities of all equipment shall not be less than that indicated on the Drawings or specified.

D. Operations and Maintenance Manuals

- 1. Provide three (3) bound sets of operation and maintenance (O&M) manuals at the time equipment is delivered to the site.
- 2. Include in the O&M manual the following types of information on each

Control System component and item of equipment:

1. Approved shop drawings.
2. Product information.
3. Installation instructions.
4. Operating procedures.
5. Shut-down procedures.
6. Safety instructions.
7. Calibration instructions.
8. Maintenance and repair instructions.
9. Recommended spare parts list.
10. Special tools list (if any).
11. Name, address and phone number of supplier's local representative.

1.03 STORAGE AND PROTECTION

- A. Package all equipment and materials at the factory to protect each item from damage during shipment and storage.
- B. Protect painted surfaces against impact, abrasion, discoloration and other damage.
- C. Protect equipment and materials stored at the site from the weather, moisture, corrosive liquids and gases, dust and other agents that could cause damage. Instrumentation and control components and accessories shall be stored and protected in accordance with the manufacturer's recommendations.

PART 2 - PRODUCTS

2.01 LEVEL SWITCH, FLOAT

- A. The level switch shall be a 5-1/2 inch diameter Type 316 stainless steel float switch with an internal mercury switch and flexibly supported by a PVC jacketed, heavy-duty cable. The floats shall be mounted on a vertical 1 inch diameter corrosion resistant, rigid pipe attached to the structure wall with corrosion resistant brackets and 316 stainless steel hardware. The switch shall be rated at 20 amps at 115 VAC and shall be SPST-NO or SPST-NC as required. The float switch shall be Model M-GRE-XXX-T as manufactured by Warrick Controls or approved equal.

2.02 LEVEL TRANSMITTERS – ULTRASONIC OPEN CHANNEL FLOW

- A. Operating Principle: Microprocessor-based, echo time of flight. All signal

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processing performed at the sensor.

B. System Specifications

1. Measuring Range: 1 to 39 ft
 - Minimum dead band: 1 ft.
2. Sensor Housing Material: Corrosion and chemical-resistant UPVC
 - Sensor rated to withstand full immersion.
3. Sensor Cable: Integral to sensor, PVC sheathed 2 core screened cable with sufficient length to reach the controller.
4. System Power: 115V AC
5. Manufacturer: Siemens Rosemount Model 3491 or approved equal for Universal Controller
6. Sensor Power (via Universal Controller): 12 to 30V DC
7. Sensor communication to Universal Controller: HART
8. Primary Output: 4-20mA configurable for Level or Volume
 - Additional Outputs: Five (5) SPDT relays with 5 A, 120VAC rated contacts.
9. System Configuration Options:
 - Integral Keypad
 - Handheld Communicator
10. Sensor Operating Temperature: -20 to 140 degrees F
11. Universal Controller Operating Temperature: -40 to 130 degrees F
12. Sensor Operating Pressure: Atmospheric to 43 psig
13. Speed of Sound Correction: via thermistor integral to sensor
14. Sensor Mount: 316 SST Mounting Bracket for suspended mount

C. Accessories:

1. Submersion Shield.

2.03 LEVEL TRANSMITTER - SUBMERSIBLE PRESSURE TYPE

- A. Manufacturer: Endress & Hauser
Sensor Model: Waterpilot FMX21
Measured Error: +/- 0.2% of the span
Temperature Range: -10 to 70 degrees Celsius
Material: Stainless Steel
Transmitter Model: RIA 46
Transmitter Supply Voltage: 120 VAC
Signal Output: 4 to 20 mA
Relay Outputs: 2 SPDT (can be inverted)
Applications: Water Level.

2.04 GAGE AND ABSOLUTE PRESSURE TRANSMITTERS

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- A. Provide diaphragm type actuated, low hysteresis, gage or absolute pressure indicating transmitters of the two-wire, loop powered, electronic type with a 4-20mA dc current output. Transmitter to have the high pressure port connected to sensor capsule. Other side of the Sensor capsule shall be connected to an absolute pressure chamber for absolute pressure transmitters and atmospheric pressure for gage pressure sensors. The sensor shall utilize capacitance technology in conjunction with a dry cell (no oil fill) ceramic sensor construction for measuring range up to 600 PSIG/ A. Maximum deflection of the ceramic diaphragm shall not exceed 0.001-inch full scale movement to minimize diaphragm fatigue and the effects of build-up. The ceramic diaphragm shall be immune to damage due to full vacuum. Alternatively, the sensor shall utilize a monosilicon sensing element with a metal process diaphragm (constructed of Type 316 stainless steel, Alloy C276 or other specified materials) for measuring ranges up to 10500PSIG/A. Sensor shall have over-range protection built-in. Transmitter must be able to withstand the maximum process pressure. Transmitter to be resistant to EMI/RFI interference.
- B. Transmitter shall comply with the following performance requirements.
1. Maximum measurement error shall not exceed $\pm 0.075\%$ of span, including combined effects of linearity, hysteresis and deadband. The transmitter may be turned down from the nominal sensor range 100:1 or higher upon request. Alternatively, the transmitter accuracy shall be 0.05% of calibrated span.
 2. The sensor shall incorporate all of the calibration and characterization data so as to be completely replaceable and interchangeable without the need for recalibration. The 0.075% accuracy shall be maintained on the interchanged sensor. The electronics shall also be replaceable without the need for recalibration on the sensor. The calibration of the transmitter shall be via external push-buttons which will allow the transmitter to be reranged without the need for any pressure source or other external handheld devices.
 3. Zero shifts shall not exceed $\pm 0.5\%$ of upper range limit for a temperature shift of 100 F.
 4. Temperature effect at maximum span; Zero error: $\pm 0.5\%$ of span per 100°F. Total effect including span and zero errors: $\pm 1.0\%$ of span per 100°F. ref ISA S71.01).
 5. Vibration effect ± 0.1 of upper range limit per g to 200 Hz in any axis.
 6. Power supply effect less than 0.05% of calibrated span per volt (ref ISA S71.02).
 7. Wetted materials shall be: Isolating diaphragm Type 316L stainless steel drain and vent valves Type 316 stainless steel, process flanges/adapters Type 316 stainless steel and Viton O-rings.
- C. Transmitter shall produce an output signal of 4-20 mA dc. Minimum output signal shall be equal to zero percent of span and maximum output signal shall be equal to 100% of span. Provide local indication in engineering units.
- D. Transmitter shall be factory calibrated as needed for specific application.
- E. Zero position and span of input shall be field adjustable within selected range of transmitter. Zero adjustment shall allow for zero-based, suppressed, elevated or compound ranges.

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- F. Measurement connections shall be 1/2-inch NPT (default) or 1/4-inch NPT as specified. Gage pressure transmitters shall optionally allow the reference side of the measuring capsule to be connected to a filled wet leg or other means of non-atmospheric pressure reference.
- G. The transmitter shall have versions which allow the ceramic sensor to be mounted flush with the process connection. The process connection and process seal gasket wetted parts shall be interchangeable and replaceable on-site without the need for recalibration. There shall also be options which allow no metal contacting the process.
- H. Transmitter shall have Type 316 stainless steel diaphragm and trim, unless application requires other materials of construction.
- I. The housing shall be rated NEMA4X and shall be available in Type 316 stainless steel and poly-coated aluminum versions.
- J. Absolute and Gage Pressure Indicating Transmitters shall be Rosemount Model 2088 or approved equal.

2.05 WATER QUALITY METER AND PROBES

- A. The Water Quality control system shall include:
 - 1. A multi-parameter microprocessor based sensor controller that works with the following digital sensors:
 - pH / Temperature sensor
 - Dissolved Oxygen sensor
 - Conductivity sensor
 - Nitrate sensor.
- B. Probe modules of the controller shall be capable of networking together to accommodate more than eight sensors on one network. Each probe module shall be equipped with EtherNet communication. The probes shall be rated for the actual application and installation.
- C. Performance Requirements:
 - 1. When paired with an enabled sensor, the overall status of the sensor performance is displayed as a percentage value via a measurement indicator
 - 2. When paired with an enabled sensor, the overall time remaining until maintenance tasks are due for the sensor is displayed in days
- D. Certifications
 - 1. EMC: CE compliant for conducted and radiated emissions CISPR 11 (Class A limits), EMC Immunity EN 61326-1 (Industrial limits)
 - 2. Safety: General Purpose UL/CSA 61010-1 with cTUVus safety mark

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3. IP65 dust and water ingress ratings
- E. Environmental Requirements
 1. Operating temperature: -4 to 131 °F (-20 to 55°C)
 2. Storage Temperature: -4 to 158 °F (-20 to 70°C)
 3. Humidity Requirements: 0 to 95% relative humidity, non-condensing
- F. Warranty
 1. Warranted for 12 months from the date of shipment from manufacturer's defects
- G. Maintenance Service (Unscheduled Maintenance)
 1. Clean controller keypad
 2. Calibrate mA output signals.
- H. Manufacturer
 1. Hach Model sc1000 Multi-parameter Universal Controller or approved equal.
 2. Hach 1200-S sc Digital pH sensor or approved equal
 3. Hach 3400 sc Contacting Conductivity Sensor or approved equal
 4. Hach 5740 sc Membrane Dissolved Oxygen Sensor or approved equal
 5. Hach N-ISE Nitrate Sensor or approved equal.
- I. The Multichannel transmitter shall be mounted in an Instrumentation control panel LCP-IE with Turbidity Meter, Particle Counter and Alkalinity Analyzer. The control panel enclosure and associated accessories shall be provided by System Integrator. See Instrumentation and Controls Drawings for details.

2.06 PARTICLE COUNTER

- A. General. The Particle Counter shall include Differential Head devices, interconnecting cabling, RS232/485 converter with power supplies, and all necessary components for a complete and operable system as shown on the drawings and as described herein.
- B. Sensor/Counter. The particle counter sensor shall be an on-line real-time continuous monitoring instrument utilizing light extinction technology for sizing and counting particles. The sensor light source must be a solid-state laser diode (780 nm infrared) capable of counting particles from 2 to 800 microns. The system must be capable of sorting particles into 5 or 15 user-adjustable channels depending on software used. The particle counter must have a maximum particle concentration limit of at least 20,000 particles/mL at 10% coincidence. Maximum concentration must be based on both optical and electronic coincidence limits. All sensors must be calibrated per ASTM 658. Calibration materials must be traceable to USA NIST.
- C. Sensor Count Matching. All sensors must be count matched during factory calibration to guarantee performance of $\pm 10\%$ from sensor to sensor.
- D. Calibration Verification. The sensor must facilitate a simple on-site calibration verification procedure by the user to validate the sensor is sizing and counting

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- particles correctly. The calibration verification process should not require the sensor to be taken off-line.
- E. Sensor I/O. Each sensor shall accept five 4-20 mA output signals representing particle counts in adjustable size ranges, total counts, and flow or sensor status. The sensor shall have two 4-20 mA input signals from other instruments such as turbidimeters. The particle counter system should also have network hardware that will accept additional 4-20 mA input signals from other instruments.
 - F. Internal Flowmeter. The particle counter system will have an internal flow meter that will continuously monitor flow and notify the controlling system if the flow rate is below or above acceptable limits.
 - G. Diagnostics. The sensor must track and indicate its need for periodic cleaning or maintenance automatically, either by communicating to the dedicated data acquisition system (PLC or computer) and/or by external alarm light. Each sensor shall have an LED indicator for power, sensor, sample cell and flow status (for sensors with an internal flow meter).
 - H. Sensor. The sensor optical windows shall be constructed of sapphire so that repeated cleaning with a brush will not cause damage to the sensor. Sensors using quartz optical windows shall not be allowed due to potential scratching on window surfaces exposed to sample. Quartz wetted surfaces also have a tendency to stain or form deposits resulting in poor performance or failure. To avoid clogging and maintain high concentration limit the sensor sample cell shall be no smaller than 1 x 2 mm in size. The sensor sample cell must be suitable for brush cleaning and accept a minimum sample flow rate of 200 mL/min. Slower sample rates will not be accepted due to the possible settling of suspended particles resulting in clogged sample cells and high maintenance. A capillary cleaning brush must be included with every sensor. There shall be no aluminum, brass or other materials which cause corrosion and optical surfacing fouling.
 - I. Sample Delivery. The flow rate of each sensor shall be held constant at 100ml/min. A flow control weir shall be provided with each counter to control the sample flow rate through the sensor without the use of valves or other constrictions in the sample line. This constant flow device shall function without the need for operator interaction outside of routine maintenance. A means of electronically reporting and audibly enunciating a low sample flow condition shall be provided in the system. Each counter shall measure particles continuously for the specified sample interval with no interruptions for data processing or printing. The constant flow device shall utilize a flush valve to eliminate excessive solids build-up from raw and settled water sources. A cleaning kit shall be included with each sensor.
 - J. Compliance. All sensors shall be designed to meet the UL/CSA safety and CE standards for both national and international safety and emission requirements.
 - K. Enclosures. The Particle Counter shall be mounted in an Instrumentation control panel LCP-IE with Turbidity Meter, Multichannel Controller for pH, temperature, DO, Conductivity and Nitrate and Alkalinity Analyzer. The enclosure shall house all counter electronics and electrical connections. Each counter shall have a local backlit

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display mounted on the front of the enclosure. LED's for power and communications are also located on the front of the enclosure for easy viewing. The display shall be an integral part of the counter, consisting of a single instrument containing sensor and all particle sizing electronics.

- L. Communication. The particle counting system shall communicate using RS485 Serial Communication. Particle counting system shall provide OPC server software to interface with the HMI. Sensors or other network devices may be located up to 4000 feet from the data collection system (PLC or computer). The sensor must be designed so that a sensor may be disconnected, removed for calibration or service, without interrupting the data transmission from other sensors. Junction boxes shall not be required.
- M. The Particle Counter shall be HACH Model 2200 PCX or approved equal.

2.07 TURBIDITY METER

- A. The turbidimeter shall be a continuous reading, on-line instrument using the nephelometric method of measurement. The design shall meet or exceed performance criteria as specified in USEPA Method 180.1. It shall utilize a single silicon photodiode to detect 90° scattered light. Digital display with automatic decimal point placement shall read from 0-9999 NTU. Accuracy shall be better than $\pm 5\%$ from 0-2000 NTU and $\pm 10\%$ from 2000-9999 NTU. Resolution shall be 0.01 NTU. Calibration shall be based on formazin, the primary turbidity standard. The turbidimeter shall consist of two main component parts: a sample unit and a control unit, connected with an 11-conductor cable.
- B. All optical and hydraulic components shall be housed in the sample unit. The light source shall be directed on the surface of the water sample, eliminating the use of a glass window or flow cell. The sample unit shall be constructed of corrosion resistant structural plastic. It shall be powered from the control unit and require no separate power source.
- C. The control unit shall provide a digital LED display with four digits and automatic decimal positioning. The control unit shall also provide a linear output signal which can be programmed to span all, or any portion of the 0-999 NTU range. A 4-20 mA current output and selectable voltage outputs of 0-10 mV, 0-100 mV and 0-1 Vdc shall be provided. Two set-point alarm systems shall be fully adjustable over the entire range of the instrument and actuate SPDT normally open/normally closed dry relay contacts. A bubble rejection circuit shall be provided to eliminate spikes in measurement due to transient sample conditions. Self-test diagnostics shall be provided to automatically indicate possible instrument malfunctions.
- D. The turbidimeter shall be listed by ETL to UL 1262 and ETL certified to CSA 22.2 No. 142. The instrument shall be certified to IEC 1010-1 per 73/23/EEC for safety; for emissions, it shall be certified to CISPR-11/EN 55 011 "A" limits per 89/336 EEC; and for immunity, it shall be certified to EN 50 082-1 (IEC 801-2, 801-3, 801-4).

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- E. The Turbidimeter shall be mounted in an Instrumentation control panel LCP-IE with Particle Counter, Multichannel Controller for pH, temperature, DO, Conductivity and Nitrate, and Alkalinity Analyzer. The control unit and sample unit shall be housed in NEMA-4X and NEMA-12 industrial plastic enclosures suitable for installation inside an enclosure. Power requirement shall be 115 VAC, 50/60 Hz. The manufacturer shall warrant the turbidimeter against defects in materials and workmanship for two years from date of shipment.

The turbidimeter shall be Hach Models Surface Scatter 6 or approved equal.

2.08 ALKALINITY ANALYZER

- A. Performance Requirements
 - 1. Measurement range
 - a. Total alkalinity as calcium carbonate:
1 to 500 mg/L
 - b. Phenolphthalein alkalinity as calcium carbonate: 5 to 250 mg/L
 - 2. Accuracy: ± 5 percent of reading or ± 1.0 mg/L, whichever is greater
 - 3. Repeatability: $\pm 3\%$ of reading or ± 0.6 mg/L, whichever is greater
 - 4. Response time: less than 10 minutes for 90% response to step change at sample inlet (single channel instruments)
 - 5. Cycle time: 8 minutes (average)
 - 6. Detection limit: less than or equal to 0.10 mg/L.
- B. Certifications
 - 1. Safety standards
 - a. UL 3101-1
 - b. CSA C22.2 No. 1010.1
 - c. EN61010-1 (IEC 1010-1)
 - 2. Class A limits for radio and noise emission as specified by the FCC and EN55011 (CISPR11).
- C. Environmental Requirements
 - 1. Operating and sample temperature: 5 to 50 °C (41 to 122 °F)
 - 2. Sample pressure: 0.5 to 30.0 psig (0.03 to 2.04 bar)
 - 3. Sample flow: 100 to 2000 mL/min. maximum
 - 4. Sample inputs: up to two sample streams.
- D. Equipment
 - 1. The analyzer uses m-cresol purple and bromcresol green indicators for colorimetric measurement of alkalinity at a wavelength of 600 nm.
 - 2. The analyzer has a digital display in a numeric or graphical format.
 - 3. The analyzer is capable of automatic calibration, cleaning, and self-priming.
 - 4. Samples are continuously purged to assure fresh sample to the analyzer and reduce analysis lag time. E. An automatic burette is used to dispense metered volumes of sample, standards, and reagents.

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5. Sample, standard, and reagent flow are directed to the detector module by a rotary valve.
 6. Grab-sample (10 mL) analysis is possible without interrupting continuous sample flow to the analyzer.
 7. The analyzer is equipped with the following communications capabilities.
 - a. Fourteen user-defined internal recorders, of which four can be used for PID control.
 - b. Two user-selectable recorder/controller outputs of 4-20 mA, with expansion capability up to 14.
 - c. Recorder output span is user-adjustable over the entire span of the analyzer.
 - d. Fourteen user-defined alarms. Alarms may be programmed for sample concentration alarms, analyzer system warning, and analyzer system shutdown.
 - e. Two unpowered SPDT relays, with expansion capability up to 14, for internal alarms.
 - f. Two relay contacts rated for 5 A resistive load at 230 Vac.
 8. Analyzer components are assembled to a NEMA-4X(indoor)/IEC 529 (IP66) plastic enclosure.
 9. All standards and reagents are isolated from the analyzer electronics in separate drip-proof plastic containers.
 10. Power requirement are 95 to 240 Vac, 50/60 Hz.
 11. Accessories
 - a. Cable Termination Kit
 - b. Digital Display Module (DDM)
 - c. Power Supply
 - d. Serial Input/Output Module (SIO)
 - e. Signal Output Module (SOM)
 - f. Installation Kit
 - g. Tool Kit
 - h. Maintenance Kit.
- E. The Alkalinity Analyzer shall be mounted in an Instrumentation control panel LCP-IE with Particle Counter, Multichannel Controller for pH, temperature, DO, Conductivity and Nitrate, and Turbidimeter.
- F. Manufacturer:
- Hack Model APA 6000™ Alkalinity Process Analyzer or approved equal.

2.09 ULTRASONIC TRANSIT TIME FLOW METERS

- A. See Section 11500 Transit Time Flow Meters

2.10 SELECTOR, WATERTIGHT, NEMA 4X

- A. Units shall be heavy duty, watertight, industrial type selector switches with contacts rated for 120V ac service at 10 amperes continuous. The switches shall be rated for NEMA 4X watertight, corrosion-resistant service. Units shall be used on all outdoor

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and non-conditioned area enclosures unless otherwise specified. Units shall have standard size, black field, legend plates with white markings. Operators shall be black knob type. Units shall have the number of positions and contact arrangements shown. Units shall be single hole mounting, accommodating panel thicknesses from 1/16-inch minimum to 1/4-inch maximum.

- B. Units shall be Allen Bradley, Type 800H; Square D, Type SK; or equal.

2.11 PUSHBUTTON, MOMENTARY, WATERTIGHT, NEMA 4X

A. Units shall be heavy duty, watertight/oiltight, industrial type pushbuttons with momentary contacts rated for 120V ac service at 10 amperes continuous. The pushbuttons shall be rated for NEMA 4X watertight, corrosion-resistant service. Units shall be used on all outdoor and non-conditioned area enclosures unless otherwise specified. Units shall have standard size, legend plates with black field and white markings. Button color shall be as required. Units shall have the contact arrangements as required. Units shall be single hole mounting, accommodating panel thicknesses from 1/16-inch minimum to 1/4-inch maximum.

- B. Units shall be Allen Bradley, Type 800H; Square D, Type SK; or equal.

2.12 INDICATING LIGHTS, WATERTIGHT, NEMA 4X

A. Units shall be heavy duty, watertight, push-to-test, industrial type with integral transformer for 120V ac applications, and full voltage type for 24V dc applications. The lights shall be rated for NEMA 4X watertight, corrosion-resistant service. Units shall be used on all outdoor and non-conditioned area enclosures unless otherwise specified. Units shall have factory engraved standard size, black field, legend plates with white markings. Units shall have screwed on prismatic lenses in colors as shown. When a common lamp test function is specified, the push-to-test feature will not be required. Units shall be single hole mounting, accommodating panel thicknesses from 1/16-inch minimum to 1/4-inch maximum.

- B. Units shall be Allen Bradley, Type 800H; Square D, Type SK; or equal.

2.13 FLASHING LIGHT AND HORN, COMBINATION

A. The flashing light and horn shall be a one-piece unit operating on 120V ac. Unit shall be made of heavy-duty chrome finished steel housing with aluminum retaining band and heat-tempered globes. The flashing mechanism shall be solid state flashing at 60 to 80 flashes per minute. The lamp shall be incandescent. Horn shall be rated 100db at 5 feet. Light color shall be red unless noted otherwise. Unit shall be suitable for 1" stanchion mounting.

- B. Unit shall be as manufactured by Benjamin Thomas Model KL-5011-120, Signal Division Federal Signal Corporation Model LV Siren with Model 121S light.

2.14 MISCELLANEOUS MECHANICAL

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- A. Solenoid Valves: Solenoid valves shall be packless construction two-way, three-way or four-way as required, and shall be correctly sized for the application. They shall be for normally energized or deenergized operation as required. Valve bodies shall be forged brass unless otherwise recommended by the manufacturer for a particular application. The solenoids shall be rated for continuous operation at 110 percent of rated voltage. They shall be 120VAC, 60 Hz operated. All coils shall be housed in NEMA 4 cases with provision for 1/2-in. electrical conduit Solenoid valves shall be as manufactured by ASCO, Skinner, Magnetrol, or equal.
- B. Pressure Control Valves (Self Contained): Pressure control valves of the spring loaded self contained type shall be provided as shown on the Drawings and/or specified herein. The valves shall be for regulating back pressure or discharge pressure as shown on the drawings. Wetted materials shall be entirely suitable for the process fluid as shown in the Schedule. The body shall be bronze or steel unless specified otherwise. The valves shall be sized in accordance with the required flow rate, pressure differential, inlet or outlet pressure range as shown in the Schedule. The pressure control valves shall be as manufactured by Fischer Controls, GA Industries or equal.
- C. Limit Switches shall be provided to sense limiting positions of equipment such as valves, as shown on the Drawings and/or specified in the schedules. The limit switches shall be SPDT or DPDT as required for the specified operations or as scheduled herein. The switches shall be rated for 5 amperes minimum at 120 Vac and shall be enclosed in a NEMA 4 housing unless explosion proof (XP) is specified in the schedule. Provision shall be made for 1/2" electrical conduit connection. The switches shall incorporate actuators and mounting brackets which are fabricated appropriately for the mechanical equipment being monitored. Switches shall be as manufactured by Microswitch or equal.

2.15 PRESSURE AND VACUUM GAUGES

- A. Units shall be bellows or Bourdon tube actuated pressure gauges. Gauges shall be stem mounting with 4-1/2-inch dial size, unless otherwise noted. Scale range shall be as noted and accuracy shall be plus or minus 1/2 percent of span.
- B. The sensing element material shall be phosphor-bronze, unless otherwise noted.
- C. For unit ranges below 10 psi, units shall be bellows actuated and shall be Ashcroft "General Service Series 1180", Robert Shaw "Acragage", or equal.
- D. For unit ranges above 10 psi, units shall be Bourdon tube actuated and shall be Ashcroft "Duragauge", Robert Shaw "Acragage" or equal.

2.16 PRESSURE SWITCHES

- A. General. Pressure switches shall sense gauge pressure and incorporate bourdon tubes, diaphragms, or bellows as the sensing and actuating element.
- B. Construction. The actuating element shall be 316 stainless steel. The actuating point shall be readily field adjustable in the range specified, and shall be of the adjustable differential (dead band) type. Switches shall be SPDT, rated at 10 amperes minimum at 120 vac. Enclosures shall be suitable for NEMA 7 & 9 explosion-proof (XP) applications. Process connection shall be 1/4-inch NPT.
- C. Manufacturers. The pressure switches shall be as manufactured by Mercoid, United Electric, ASCO, or equal.

2.17 PRESSURE SEAL, DIAPHRAGM

- A. Units shall consist of corrosion-resistant lower housing and diaphragm, and instrument mounting upper housing. Lower housing shall have NPT female process and flushing connections and shall be 316 stainless steel, unless otherwise noted. Diaphragm shall be 316 stainless steel, unless otherwise noted. Upper housing shall have bleed screw, NPT female instrument connection, and shall be steel, unless otherwise noted. Filling fluid shall be as noted.
- B. Where noted, capillary assembly shall be furnished to connect diaphragm seal to instrument with length as noted.
- C. Wherever practical, pressure seal shall be factory filled and assembled to sensing element (i.e., pressure switch, pressure transmitter)
- D. Units shall be Ametek, Mansfield and Green Division, Type SG; Ashcroft Type 101 or equal.

2.18 PRESSURE SEAL, ANNULAR

- A. Unit shall be of the pressure-sensing, pipe spool type suitable for measuring dirty or corrosive fluids. Unit shall consist of a carbon steel pipe spool and an elastomer liner with a space between filled with the noted fluid. Unit shall be arranged and designed to directly transmit the process pressure by means of the fluid through an opening in the spool wall to a pressure-sensing device attached and sealed to the spool by a drilled and threaded boss. Unit shall be sized as noted and have ANSI 150-pound flanges, unless otherwise noted. Seal shall be suitable for fluid pressures to 200 psig and shall be furnished with a Buna-N flexible cylinder, unless otherwise noted. Unit shall have fill connections and other features required to permit refill of the seal volume in the field.

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- B. Wherever practical, pressure seal shall be factory filled and assembled to sensing element (i.e., pressure switch, pressure transmitter)
- C. Unit shall be Ronninger-Petter Ful-Stream Pressure Sensor, Red Valves Series 40 or equal.

2.19 INDICATOR, FIELD MOUNTING

- A. Indicators shall be suitable for wall mounting. The unit shall receive a 4-20 mA dc analog signal proportional to a process variable on a mirrored 4-inch minimum scale. Scale range shall be as noted. Indication accuracy shall be plus or minus 2 percent of span. Input impedance shall be less than 50 ohms.
- B. Indicator housing shall be NEMA 4 unless otherwise noted with a gasketed viewing window or door. Unit shall be similar to Transmation Model IS210M; or equal.

2.20 ROTAMETERS

- A. Rotameters shall have boro-silicate glass tubes and stainless steel floats. The body may be anodized aluminum or stainless steel. End fittings shall be stainless steel and selected to suit the application. O-rings shall be Viton and tube shield shall be clear plastic. The meter scale shall be linear and direct reading in gph or ccpm. Scale length shall be 5 inches minimum. Furnish needle valves on rotometers for adjustment of flow. The size and capacity shall be as shown on the Drawings or as recommended by the pump manufacturer, but not less than 10 gph. Rotometers shall be as manufactured by F&P, Brooks Instrument or equal.

2.21 TEMPERATURE SWITCH

- A. Temperature switch shall be ambient compensated, filled system type with snap-action SPDT contacts rated for 10 amperes, continuous, at 120V ac. Unit shall be automatic reset type with adjustable deadband.
- B. Adjustable setpoint range shall fall between 30 and 70 percent of the adjustable range. Span shall be at least 100 degrees F.

2.22 UNINTERRUPTABLE POWER SUPPLY

- A. See Spec 13310 for UPS system requirements.

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+++ END OF SECTION 13300 +++

**SECTION 13400
INSTRUMENTATION, CONTROL AND MONITORING SYSTEM
PROGRAMMABLE LOGIC CONTROLLER**

PART 1 - GENERAL

1.01 Scope

- A. This section covers the specific work necessary for engineering, furnishing, installing, adjusting, testing, documenting, and starting up of the Programmable Logic Controller (PLC) of the Instrumentation and Control System.
- B. A Programmable Logic Controller (PLC) shall be furnished complete with all materials, equipment, and work required to implement a complete and operating system.
- C. The PLC subsystem shall be furnished integral to panel LCP-Q and LCP-H and shall include a local color graphics operator interface for monitoring and modifying control parameters.
- D. The unit shall be provided with all necessary hardware and software to communicate over EtherNet. It shall be the responsibility of the Instrumentation Subcontractor to coordinate and establish the software interface requirements with the City. Final acceptance of the PLC subsystem shall be contingent upon successfully demonstrating communications.
- E. The Instrumentation Subcontractor shall provide the PLC system and software as specified herein and as required of other sections of Division 13.
- F. Refer to the input/output schedule at the end of this Section for a summary of the minimum I/O requirements excluding spare I/O. Twenty-five percent installed spare I/O points of each type used shall be calculated and furnished after the operational requirements of the system have been satisfied.

1.02 Submittals

- A. In addition to the detailed submittal requirements of Section 13000 of this Specification, the following shall also be provided:
 - 1. All accessories.
 - 2. Listing of all PLC hardware.
 - 3. I/O arrangement drawings.
 - 4. Software program listing and I/O address mapping.
 - 5. System block diagram and cabling requirements.

1.03 Equipment and Services

- A. In order to operate the River Intake Pump Station, an integrated control system utilizing a programmable logic controller (PLC) shall be required. This specification is intended to procure a complete control system including but not limited to:
1. Programmable Logic Controller (PLC).
 2. PLC programming services.
 3. PLC hardware and software system test and start-up.
 4. Operator training.
 5. System warranty.

PART 2 - PRODUCTS

2.01 HARDWARE REQUIREMENTS

- A. General:
1. A programmable logic controller (PLC) shall be provided as specified herein and/or on the Drawings. PLC shall be installed, wired, and tested as an integral part of control panel LCP-QR and LCP-H. PLC shall receive, condition, act upon, and output analog and discrete signals required to provide a complete and functional operating system as specified.
 2. The PLC shall consist of a memory section for program instruction storage, a central processing unit (CPU) to act upon the instructions as a function of external inputs, and an input/output section to interface to field devices.
 3. The controller shall be modular and all circuit elements shall be solid state unless otherwise specified. The memory and input/output capacity shall be selected to adequately provide the required operations, with at least 25% additional unused I/O and memory after the system is fully operational.
 4. The operating environment shall be 0°C to 60°C with a relative humidity of 5% to 95% non-condensing.
 5. PLC shall be as manufactured by Allen-Bradley Model ControlLogix.
- B. System Memory Requirements
1. The standard storage medium shall consist of battery-backed read/write random access memory (RAM), and erasable/re-programmable read only memory (EPROM). The processor and associated memory shall be incorporated into the same enclosure. Under normal operating conditions, the PLC RAM shall retain a program for no less than one week in the event of power failure. Memory shall be

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sufficient to accommodate the final program plus twenty-five percent spare programmable capacity.

C. Central Processing Unit

1. The CPU shall plug directly into the I/O base and require no additional wiring to the base, power supply or the local I/O system. The unit will have indicators on the front bezel that monitor the PLC operation, the PLC battery, the CPU's mode of operation. The CPU shall incorporate all necessary logic ability to sequentially scan the inputs, the instruction memory, temporary internal memory (if any) and the outputs; and to perform all necessary logic to execute the solution of the logic equations entered via the stored instructions. The CPU shall be capable of performing PID instruction for process control applications.
2. Non-volatile memory shall store the operating system information to protect against loss in the case of power loss or system shut-down.
3. Provide Allen Bradley Model: 1756-L62
4. The PLC's for both LCP-Q and LCP-H shall be redundant and utilize an Allen-Bradley system redundancy module part number 1757-SRM.

D. PLC I/O Subsystem

1. General
 - a. All inputs and outputs shall be isolated from the field components. Modules and their rack assemblies shall contain all circuitry for interfacing inputs and outputs to the PLC system. The CPU shall allow user-configurable I/O mapping. I/O modules shall be able to be plugged into any location of any I/O base. I/O modules shall be capable of being removed from the I/O base without disconnecting field wiring through the use of removable terminal block assemblies. Standard I/O module features shall include optical isolation, load side indicators and fused outputs. I/O modules provided shall be of a consistent type for both analog and discrete signals.
 - b. As a standard feature, the PLC shall have the capability of addressing remote I/O modules up to 3,300 cable feet from the processor. The communication link between the CPU and the I/O chassis shall be via a twin axial cable or fiber optic link.
 - c. A malfunction in any remote I/O channel shall affect the operation of only the operation of only that channel and not the operation of the CPU or any other channel.

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- d. The I/O rack assemblies will provide mounting slots for the processor, power supply and I/O modules. Units shall be designed specifically for 19 inch rack mounting.
2. I/O Modules
 - a. The following standard I/O modules shall be utilized:
 - 1) a. Discrete Inputs:
Unless otherwise noted, all digital input modules shall be eight or sixteen channel 120V ac type.
 - b. Provide Allen Bradley Model: 1756 IA16I
 - 2). a. Discrete Outputs
Discrete outputs shall be eight or sixteen channel modules. Interposing relays as specified in Section 13200, shall be utilized for all outputs.
 - b. Provide Allen Bradley Model: 1756-OA16
 - 3) a. Analog Outputs
Unless otherwise noted, all analog output modules shall be of the isolated type.
 - b. Provide Allen Bradley Model: 1756-OF6I
 - 4) a. Analog Inputs
Unless otherwise noted, all analog input modules shall be of the isolated type.
 - b. Provide Allen Bradley Model: 1756-IF6I
 3. EtherNet Communication Link
 - a. An EtherNet communication interface module shall be provided.
 - b. Provide Allen Bradley Model: 1756-ENBT
 4. Terminations

All I/O wiring to field components shall pass through dedicated terminal block assemblies as specified in Section 13200. Direct connection from I/O modules to field mounted components will not be accepted.

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E. Graphic Operator Interface

1. A local operator interface unit shall be provided on panel LCP-Q and LCP-H to allow non-technical personnel to make authorized changes in setpoints controlling the process equipment. The unit shall be an intelligent interface and may be used as a stand alone operator interface.
2. Graphic Terminal shall have a 15 in. flat-panel color display with 640 x 480 resolution (minimum) and 18-bit graphics. This terminal shall support operator input via keypad (40 function keys), via touch screen or via keypad and touch screen. Unit shall be suitable for panel mounting.
4. Unit shall be connected to the control panel EtherNet switch via EtherNet link.
5. Unit shall be Allen-Bradley Bulletin 2711P PanelView™ Plus 1500 or equal.

F. Computer workstation.

1. Computer workstation shall be provided at River Intake Pump Station Electrical Room.
2. The workstation shall meet the following requirements:
 - Dell Precision Workstation T3400: Intel Core 2 Duo Processor E7400, 2.8GHz/1066MHz/3MB L2/375W
 - Operating System: Genuine Windows Vista Business Bonus-XP Professional downgrade
 - Memory: 4GB, DDR2 SDRAM memory, 800MHz, ECC (4 DIMMS)
 - Graphics Cards: 256MB PCIe x16 NVS 290, dual DVI capable
 - Hard Drive Configuration: C1 – All SATA drives, No RAID for 1 hard drive
 - Boot Hard Drive: 250GB SATA 3.0Gbps w/NCQ and 8MB DataBurst Cache
 - Additional Network Card: Broadcom NetXtreme 10/100/1000 Gigabit Enet Controller-PCIe card
 - Floppy Drive Options: No floppy drive
 - CD-ROM, DVD & RW Devices: 16x DVD +/-RW w/CyberLink PowerDVD and Roxio Creator Dell Ed
 - Sound Card: Sound Blaster X-FI XtremeMusic w/Dolby#173
 - Speakers: Dell AX510PA Sound Bar for Entry Flat Panel Displays
 - Keyboard: USB entry Quietkey, no hot keys
 - Mouse: Dell USB Optical mouse with scroll

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- Resource CD: Resource DVD – contains diagnostics and drivers
- Warranty: onsite service 3-year Basic Limited Warranty and 3 Year NBD
- Productivity Software: Microsoft Office 2007 Professional
- Monitor: Dell 24in Widescreen Flat Panel w/adjustable stand, G2410.

G. Spare Parts.

1. Ten percent (rounded up to nearest whole number but a minimum of one) of each type I/O module used (analog and discrete). This requirement is in addition to the installed spare capacity specified herein above.
2. Five fuses of each size and type per every 20 used (minimum of five each).
3. One EtherNet communication interface module designed to be housed in the I/O chassis.

2.02 SOFTWARE REQUIREMENTS

A. PLC

1. PLC System Programming

- a. The PLC software shall perform all logic and interlock functions presented in the Process and Instrumentation Drawings and Specifications in Section 13100.
- b. The method of programming shall permit entering of instructions by keyboard. The programming language shall consist of symbols and/or short English words and abbreviations representing relay contacts (switches), relay coils (outputs) and boolean algebra operators and/or their equivalents. Special functions such as timers, counters, shift registers, comparators, stepping switches, and relays shall be generated by pre-programmed instructions, addressable and controlled by the main program, or generated by detailed instructions written in the main program at the election of the Vendor.
- c. All programming services and software programs necessary to provide a complete and operational system including minor software additions during startup, whether or not specified herein, shall be included in the original bid price.

2. Math and Data Functions.

The logic program shall be capable of containing up to three comparisons on one

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line of logic. It shall be possible to perform a block data transfer of relay ladder logic. Math functions shall include addition, subtraction, multiplication, division and square root capable of generating an answer in the range -32,767 to +32,767. In the event these limits are exceeded, an overflow bit will be set, indicating that numerical conditioning is necessary to generate an accurate result. Image registers and shift registers shall operate on a first-in, first-out (FIFO) basis. There shall be an instruction that emulates an electro-mechanical drum operation.

3. Alarm Functions

a. Not in Auto Alarms

1. Before operating any field device, the PLC program shall check to see that the device has been switched to the "AUTO" mode. If the device is not in "AUTO", the PLC shall set an error bit and suspend control of the device until it is switched to "AUTO". The CCM system shall use the error bit to log a "Not in AUTO" alarm.

b. No Response Alarms

1. If at any time a field device fails to respond to an output command from the PLC, the PLC shall set an error bit. The CCM shall use the error bit to log a "No Response" alarm.

4. Timers

The preset values for all PLC timers and process setpoints shall be operator accessible and adjustable from the operator interface. Values shall be capable of being changed remotely by the CCM operator.

- B. The existing HMI software package at both the Hemphill and Chattahoochee Water Treatment Plants currently installed is GE Proficy iFix SCADA version 5.1

The ICM integrator is to provide a new iFix/ IClient runtime package for the new River Intake PC.

All existing nodes shall be upgraded to display the new graphic as required for the upgrades.

The existing GE I/O driver (IGS for Rockwell) must be upgraded to latest version.

C. Graphics Meeting

1. The graphical interface shall be developed with direction from the Engineer. Programming services shall include as a minimum, two (2) meetings with the Engineer to develop the interactive graphic displays.

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2. The first meeting will be used to present the capabilities of the software and to provide the Engineer with vendor recommended sketches of the displays he proposes to furnish. The displays shall include the following information as a minimum:
 - a. Pump Station Overview Graphic including the operating status of all major equipment (Run, Stopped, Failed), levels, and flows (10 object oriented displays minimum).
 - b. Alarm History (1 display).
 - c. Specific Equipment Data Access Displays for control and monitoring (as required).
 - d. Motor Elapsed Time Display (1 display).
 - e. Number of motor or equipment starts display (as required).

See Process and Instrumentation Diagrams for any additional HMI indication/controls requirements.

3. The second meeting will be to review the agreed format of displays generated from the first meeting and to agree on what information will be communicated to and from the CCM system.

+++ END OF SECTION 13400 +++

SECTION 15050
BASIC MECHANICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.01 SCOPE

- A. The work described in this Section and/or indicated on the Drawings shall include, except where otherwise noted, the furnishing of all materials, equipment, appurtenances, accessories, connections, labor, etc. required and/or necessary to completely install, clean, inspect, adjust, test, balance and leave in safe and proper operating condition all mechanical (HVAC and plumbing) systems.
- B. Prior to the ordering or purchase of any equipment or materials or the layout or installation of any work, the Contractor shall visit and examine the site and shall examine and understand the work shown on the Drawings and described in these Specifications. If any work involves existing equipment, ductwork, piping, buildings, etc., the Contractor shall first verify model numbers, electrical characteristics, sizes, dimensions, etc. to be compatible with the work shown on the Drawings.
- C. Throughout the course of the Project, the Contractor shall schedule and coordinate work with the Engineer and other trades to optimize space utilization and avoid conflict or interference with the work of other trades, structural elements, doors, windows, lights, conduit and other equipment or systems.
- D. Unless otherwise shown on the Electrical Drawings, the mechanical work shall include the following items. These items shall conform with the requirements of Division 16.
 - 1. All motors, motor starters, disconnect switches, relays and other controls and control wiring necessary for the proper operation of all mechanical equipment shall be furnished and installed under Division 15. Power wiring to mechanical equipment and a 120 volt source for control power shall be provided as a part of the electrical work.
 - 2. All controls and control wiring shall be provided and installed under Division 15. Where control power is not available in the vicinity of mechanical equipment, a transformer shall be furnished and installed to convert power voltage to control voltage. The transformer may be an integral part of the starter.
 - 3. Starters complete with "hand-off-automatic" switches, with running indication lights in an approved enclosure, shall be furnished and installed for mechanical equipment automatically started and stopped, or otherwise controlled by thermostats, timers, or other devices under Division 15. Starters for all manually controlled equipment shall include start-stop pushbuttons with running indication lights in an approved enclosure.
- E. All electrical items provided under Division 15 of the Specifications shall be provided in

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accordance with applicable sections of Division 16. Enclosures shall be the same NEMA type as specified in Division 16 or on the Electrical Drawings.

- F. The Contractor will be held responsible for the satisfactory and complete execution of all work included. The Contractor shall produce complete finished operating systems and provide all incidental items required as part of the work, regardless of whether such item is particularly specified or indicated.

1.02 QUALITY ASSURANCE

A. Codes and Standards

1. All mechanical work shall be performed in accordance with all applicable codes, ordinances, rules and regulations of local, state, federal or other authorities having jurisdiction. As a minimum, this shall include: (Verify with City of Atlanta Code Department for latest updates):
 - a. International Building Code 2012 with 2015 Georgia Amendments.
 - b. International Mechanical Code 2012 with 2015 Georgia Amendments
 - c. International Plumbing Code 2012 with 2015 Georgia Amendments
 - d. International Fire Code 2012 with 2015 Georgia Amendments
 - e. International Fuel Gas Code 2012 with 2015 Georgia Amendments
 - f. National Electrical Codes, 2011 Edition, with no Georgia Amendments
 - g. International Energy Conservation Code, 2009 Edition, with Georgia Supplements and Amendments
 - h. Georgia State Energy Code
 - i. National Fire Protection Association Codes, 2012 NFPA-101 Life Safety, ADA and UL.
 - j. Unless otherwise specified on the Drawings, the latest edition of all codes, ordinances, etc. shall be followed. Where code or other requirements exceed the provisions shown on the Contract Documents, the Contractor shall notify the Engineer. Where provisions of the Contract Documents exceed code or other requirements, the Work shall be performed in accordance with the Contract Documents.
 - k. Current Codes as Adopted by DCA- Permissive Codes
 - l. Current Local Amendments as Adopted;
“The requirements in the proposed local amendment cannot be less stringent than the requirements in the state minimum standard code. If the proposed local amendment differs from state minimum standard code than the more stringent requirement shall apply”.
2. All equipment, products and materials used in mechanical work shall be listed by Underwriters Laboratories, ARI or AMCA as appropriate.
3. The Contractor shall schedule all required tests and inspections with a minimum of 72 hours prior notice to the Engineer.

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- B. Allowable Tolerances: Equipment shall be readily adaptable for installation and operation in the structures shown on the Drawings. No responsibility for alteration of a planned structure to accommodate other types of equipment will be assumed by the City. Equipment which requires alteration of the structures will be considered only if the Contractor assumes all responsibility for making and coordinating all necessary alterations. All such alterations shall be made at the Contractor's expense.

1.03 SUBMITTALS

- A. Submittals shall be made in accordance with the requirements of the General Conditions of the Contract Documents.
- B. Drawings and Specifications:
 - 1. The Drawings are diagrammatic and, unless specifically dimensioned, are intended to show only the general arrangement of equipment and accessories, and the general routing of piping, ductwork, etc. The Drawings do not specifically show every fitting, offset, contour, etc. required to accomplish the intended work or to avoid every interference that may be encountered. It shall be the responsibility of the Contractor to arrange all work to fit within the allowed space without modifying any building structure or property, and to make readily accessible all equipment and accessories requiring servicing or maintenance.
 - 2. Should any changes be deemed necessary by the Contractor in items shown on the Contract Drawings, the Contractor shall submit shop drawings, descriptions, and the reason for the proposed changes to the Engineer for approval.
 - 3. Exceptions and inconsistencies in Drawings and Specifications shall be brought to the Engineer's attention before Bids are submitted.
- C. Operation and Maintenance Instructions: Operation and maintenance instructions shall be provided in accordance with the requirements of the General Conditions of the Contract Documents. The Contractor shall instruct the City's personnel during the adjustment and testing period. The Contractor shall also, in the presence of the Engineer, demonstrate the complete operation of each and every piece of apparatus.

1.04 QUALITY STANDARDS

- A. All materials shall be furnished by manufacturers fully experienced, reputable and qualified in the manufacture of the particular material to be furnished. All material shall be designed, constructed and installed in accordance with standard practices and methods and shall comply with these Specifications as applicable.
- B. The manufacturer shall provide written certification to the Engineer that all equipment furnished complies with all applicable requirements of these Specifications.

1.05 TRANSPORTATION AND DELIVERY

- A. As part of the mechanical work, the Contractor shall provide and pay for all transportation, delivery and storage required for all equipment and materials.
- B. The Contractor shall closely coordinate the ordering and delivery of all mechanical equipment with other trades to assure that equipment will be delivered in time to be installed in the building without requiring special or temporary access or building modifications. Certain equipment may have to be installed prior to the erection of the building walls or roofs.

1.06 STORAGE AND PROTECTION

- A. Equipment and materials shall be properly stored to protect against vandalism, theft, the elements and other harm or damage. Any equipment or materials received in a damaged condition, or damaged after receipt, shall not be installed. Only new undamaged equipment in first-class operating condition shall be installed.
- B. Provide protection covers, skids, plugs or caps to protect equipment and materials stored or otherwise exposed during construction.

1.07 WARRANTY

- A. All mechanical work described in the Contract Documents shall be warranted in accordance with the General Conditions of the Contract Documents.
- B. This warranty shall apply to all equipment, materials and workmanship.
- C. During the warranty period, all defects in mechanical systems shall be corrected in an acceptable manner, consistent with the quality of materials and workmanship of original construction, at no expense to the City.

PART 2 - PRODUCTS

2.01 MATERIALS AND CONSTRUCTION

- A. General
 - 1. All equipment, materials, accessories, etc. used as part of the mechanical work shall be new, of the best grade and quality and of current production, unless specified otherwise. Equipment not specified in the Contract Documents shall be suitable for the intended use and shall be subject to approval by the Engineer.
 - 2. All equipment, products and materials shall be free of defects and shall be constructed to operate in a safe manner without excessive noise, vibration, leakage

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or wear.

3. Electric motors shall be as specified in Section 16150, Electric Motors, unless otherwise specified.
- B. Piping: See appropriate sections of Division 15 for Specifications on various piping systems. See Part 3 of this Section for general stipulations on installation of piping systems.
- C. Valves: See appropriate sections of Division 15 for Specifications and Part 3 of this Section for general stipulations on valve installation.
- D. Unions
1. Provide and install unions between each item of equipment and the valve controlling and/or the various piping connections to it.
 - a. Steel Pipe: Unions 2-1/2-inches and smaller shall have ground joints. Unions 3-inches and larger shall have flanged unions.
 - b. PVC Pipe: Unions 2-inches and smaller shall be threaded and have Buna O-rings. Unions 2-1/2-inches and larger shall be flanged.
- E. Equipment Bases: Each piece of equipment which is motor driven shall be furnished with an approved base, which shall be in addition to the foundation. Each base shall be furnished integral with the equipment or apparatus, or shall be furnished as a separate item, designed to accommodate the equipment or apparatus. Submit shop drawings for all foundations and supports for review.
- F. Dielectric Isolation
1. Wherever dissimilar metals are used in piping systems, this connection shall be made with dielectric isolators. The dielectric isolators shall be so designed that non-ferrous piping materials shall be isolated by the use of Teflon or nylon isolating materials made up in the form of screwed type unions or insulating gaskets and bolt sleeves and washers for standard flanged connection. All dielectric isolators shall be selected for the pressure and contents of the system involved.
 2. Dielectric isolators shall be Watts, Epcos, Crane, Maloney, or Equal.
- G. Anchor Bolts
1. All anchor bolts shall be ANSI type 316 stainless steel and must conform to requirements of Section 01600 and the material articles in the appropriate Sections in which they are used.
 2. All anchor bolts are to be supplied by the manufacturer or fabricator of the specific

material or equipment to be installed.

PART 3 - EXECUTION

3.01 INSTALLATION

A. General

1. All equipment, materials, accessories, etc. used as part of the mechanical work shall be installed according to the manufacturer's recommendations and in accordance with the best practice and standards for the work.
2. All work shall be performed by competent personnel satisfactory to the Engineer. All work requiring particular skill shall be performed by persons that have had special training and past experience in that line of work.

B. Equipment Support

1. Major equipment supports (concrete foundations, framed structural openings, etc.) shall be furnished and installed under other Divisions of the Contract Documents as shown on the Drawings. The mechanical work shall include, however, the furnishing and installation of all miscellaneous equipment supports, housekeeping pads, structural members, rods, clamps and hangers required to provide adequate support of all mechanical equipment.
2. Unless otherwise shown on the Drawings, all mechanical equipment, piping and accessories shall be installed level, square and plumb.

C. Pipe and Ductwork Penetrations

1. Sleeves or wall pipes shall be installed in all masonry or concrete walls, floors, roofs, etc. for pipe and ductwork penetrations. See Section 15060 for pipe sleeve material requirements. Sleeves for ductwork shall be 20 gauge galvanized steel. Sleeves shall be sized to provide a minimum of ¼-inch clearance between the sleeve and pipe or duct. For insulated pipes or ducts, the clearance shall be ¼-inch between the sleeve and the insulation.
2. As far as possible, all pipe and ductwork penetrations shall be made at the time of masonry or concrete construction. Where drilling is required, only core drills shall be used. Star drills shall not be used.

D. Welding

1. All welded pipe joints shall be made by the fusion welding process, employing a metallic arc or gas welding process.

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2. All welding operations shall conform to the latest recommendations of the American Welding Society or to the applicable provisions of the Code for Pressure Piping. The Contractor shall pay for all electrical energy and/or gas used in welding.
- E. Cutting and Patching: Where cutting or patching becomes necessary to permit the installation of any work or should it become necessary to repair any defects that may appear in patching, the Contractor shall make the necessary repair at no cost to the City.
- F. Large Apparatus and Equipment: All large apparatus and equipment which is specified or shown to be furnished or installed under this Contract, and which may be too large to be moved into its final position through the normal building openings planned, shall be placed by the Contractor in its approximate final position before any obstructing structure is installed. All apparatus shall be cribbed up from the floor and cared for as specified under Paragraph 1.06 or as directed by the Engineer.
- G. Cross Connection and Interconnections
1. No plumbing fixture, device or piping shall be installed which will provide a cross connection or interconnection between a distributing supply for drinking or domestic purposes and a polluted supply, such as drainage system or a soil or waste pipe which will permit or make possible the backflow of sewage, polluted water or waste into the water supply system.
 2. The Contractor shall verify location of all existing utilities and make all connections to existing facilities as required.
- H. Thermal Expansion of Piping
1. The Contractor shall furnish and install all devices required to permit the expansion and contraction of all work installed by the Contractor, particularly in water supply and circulating systems. In the main water and circulating lines, Contractor shall employ expansion joints where required or directed by the Engineer. Swing joints, turns, expansion loops or long offsets shall be provided wherever shown on the Drawings or wherever necessary to allow for the expansion of piping within the building. Broken pipes or fittings broken due to rigid connections must be removed and replaced at the Contractor's expense.
 2. Anchor all lines having expansion joints so that expansion and contraction effect is equally distributed. Verify exact locations of anchors with the Engineer prior to making installation. The lines having expansion joints shall be accurately guided on both sides of each joint. These guides shall consist of saddles and "U" clamps properly arranged and supported. Submit complete details for approval.
 3. In installing expansion members, exercise care to preserve proper pitch on lines. Furnish and install all special fittings, connectors, etc., as required.

3.02 SURFACE PREPARATION, SHOP AND FIELD PAINTING

- A. Unless otherwise specified herein or shown on the Drawings, general painting of mechanical equipment shall be in accordance with Section 09900, Painting.
- B. Touch-up painting of mechanical equipment shall be part of the mechanical work. All equipment and materials that are painted or coated by the manufacturer shall be touched-up prior to completion to conceal any and all scratches or other finish irregularities and to maintain the integrity of the paint or coating. All painting and coating shall match the original and shall conform to the requirements detailed in other sections of these specifications.
- C. All roof-mounted equipment shall be painted with an exterior paint of a type and color as specified in Section 09900, Painting. The painting shall not impair the performance of the equipment in any manner.

3.03 INSPECTION AND TESTING

- A. The mechanical work shall include all materials and labor required to properly test and balance all mechanical systems as required by codes and as described herein.
- B. Concealed, underground and insulated piping shall be tested in place before concealing, burying or covering. Tests shall be conducted in the presence of the Engineer or designated representative. Equipment, materials and instruments required for tests shall be furnished without incurring additions to the Contract. The Contractor shall schedule all required tests and inspections with a minimum of 72 hours prior notice to the Engineer.
- C. Unless otherwise specified herein, all mechanical piping shall be tested as required by Code to 1-1/2 times the rated system pressure or 100 psig (modify as needed), whichever is greater. Care shall be taken to isolate all equipment not suitable for this test pressure by installing pipe caps or blank flanges at the equipment connections. All valves and fittings shall be tested under pressure.
- D. Soil, waste and vent piping shall be tested with water before installing fixtures. Water test shall be applied to the system either in its entirety or in sections. If the test is applied to the entire system, all openings in the piping shall be closed except to highest opening, and the system shall be filled with water to the point of overflow. If the system is tested in sections, each opening except the highest opening of the section under test shall be plugged and each section shall be filled with water and tested with at least a 10 foot head of water. Each joint or pipe in the building except the uppermost 10 feet of the system shall be submitted to a test with at least a 10 foot head of water. The water shall be kept in the system, or in the portion under test, for at least 1 hour before the inspection starts; no substantial drop in the water level will be acceptable.
- E. The services of an independent testing and balancing agency shall be used to balance the air and water distribution systems.

3.04 CLEANING

- A. At all times, the premises shall be kept reasonably clean and free of undue amounts of waste, trash and debris by periodic cleaning and removal. After completion, all foreign material, trash and other debris shall be removed from the site.
- B. After all equipment has been installed, but prior to testing and balancing, all equipment, piping, ductwork, etc. shall be thoroughly cleaned both inside and out.
- C. All air moving equipment operated during construction shall have filters in place and changed regularly so as to be clean.
- D. After testing and balancing and just prior to Engineer review and acceptance, all systems shall be finally cleaned and shall be left ready for use. Air filters shall be new and piping strainers shall be clean.
- E. All water piping shall be cleaned and disinfected in accordance with Section 15060 of these specifications.

+++ END OF SECTION 15050 +++

**SECTION 15100
PROCESS VALVES**

PART 1 GENERAL

1.1 SCOPE

- A. The Contractor shall furnish all labor, materials, equipment and incidentals required and install complete and ready for operation all valves and appurtenances as shown on the Drawings and as specified herein.
- B. Items included under this Section are:
 - 1. Gate Valves
 - 2. Air Valves
 - 3. Metal Seated Ball Valves

1.2 DESCRIPTION OF SYSTEMS

- A. All equipment and materials specified herein are intended to be standard for use in controlling the flow of water.

1.3 QUALITY ASSURANCE

- A. Reference Standards: The design, manufacturing and assembly of elements of the products herein specified shall comply with the applicable provisions and recommendations of the latest editions of the following standards, except as otherwise shown on the Drawings or otherwise specified.
 - 1. ANSI/AWWA C509 – Resilient-Seated Gate Valves for Water Supply Service
 - 2. ANSI/AWWA C600 - Installation of Ductile-Iron Water Mains and Their Appurtenances.
 - 3. ANSI/NSF Standard 61 – Drinking Water System Components – Health Effects
 - 4. ANSI/AWWA C512 – Air-Release, Air/Vacuum and Combination Air Valves for Waterworks service
 - 5. ASTM A126 – Gray Iron Castings for Valves, Flanges and Pipe Fittings
 - 6. ASTM A240 – Heat Resisting Chromium and Chromium Nickel Stainless Steel Plate, Sheet and Strip for Pressure Vessels.
 - 7. ANSI B16 – Standardization of Valves Flanges, Fittings and Gaskets
 - 8. National Electrical Code as applicable.

9. American Water Work Association (AWWA):
10. Anti-Friction Bearing Manufacturers Association (AFBMA):

1.04 SUBMITTALS

- A. Submittals shall follow the requirements of the General Conditions of the Contract Documents. In addition, the following specific information shall be provided:
 1. Complete shop drawings of all valves and appurtenances
 2. Manufacturer's certificate certifying that the products meet or exceed the specified requirements.

1.5 TOOLS

- A. Special tools, if required for normal operation and maintenance shall be supplied with the equipment.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- A. All valves and appurtenances shall be of the size shown on the Drawings and all equipment of the same type shall be from one manufacturer.
- B. All valves and appurtenances shall have the name of the maker and the working pressure for which they are designed cast in raised letters upon some appropriate part of the body.

2.2 GATE VALVES (class 150, 24-inches and larger)

- A. Gate valves shall be resilient seated type conforming to the requirements of AWWA C509 or AWWA C515.
- B. Valves shall have a minimum working pressure of 150 psi.
- C. Valve manufacturer shall submit an affidavit to the Engineer indicating valve compliance with all applicable AWWA standards.
- D. Valves shall be designed for vertical installation with tracks and rollers, and bevel gear type operator.
- E. Valve ends shall be mechanical joint type except where restrained joint ends are shown. Flanged joints shall meet the requirements of ANSI B16.1, Class 125.
- F. Valve shall be non-rising stem type with a 2-inch square operating nut and shall open right (clockwise).

- G. All internal and external ferrous surfaces shall be coated with epoxy to a minimum thickness of 4 mils. The epoxy shall conform to ANSI/AWWA C550 and shall be applied electrostatically prior to assembly. Epoxy shall be NSF61 approved.
- H. Valve shall have a ductile iron body, bonnet and stuffing box. All joints between valve parts, such as body and bonnet, bonnet and bonnet cover, shall be supplied with o-ring seals.
- I. Valve wedge shall be symmetrical, made of ductile iron and totally encapsulated in rubber. Rubber shall be permanently bonded to the wedge per ASTM D429.
- J. Valves shall be non-rising stem type with a 2-inch square operating nut and shall open right (clockwise).
- K. Valves shall be manufactured by American Flow Control, Mueller, M & H Valve, or approved equal.

2.3 AIR VALVES

A. Type

1. Air Release Valves: Air release valves (ARV) shall have a small venting orifice to vent the accumulation of air and other gases with the line or system under pressure. Size and capacity shall be as specified.
 2. Air and Vacuum Valves: Air and vacuum valves (AVV) shall have a large venting orifice to permit the release of air as the line is filling or relieve the vacuum as the line is draining or is under negative pressure. Size and capacity shall be as specified.
 3. Combination Air Valves: Combination air valves (CAV) shall have operating features of both the air and vacuum valve and the air release valve. Combination air valves include both single and dual body construction. Size and capacity shall be as specified.
- B. Air release valves shall be float operated, compound lever type, except air release valves less than 1-inch may be simple lever type.
 - C. Air and vacuum valves shall be designed to protect the float from direct contact of the rushing air and water to prevent the float from closing prematurely in the valve. The set shall be fastened into the valve cover and shall be easily removed if necessary. The float shall be center or peripheral guided for positive shut off into the seat.
 - D. Combination air valves, unless otherwise specified, shall be single body construction in sizes 1-inch through 6-inches and dual body construction in sizes 8-inches and larger. Single body construction shall be designed to provide all functions within one housing. The body inlet shall be baffled to protect the float and the large and small orifices shall be

designed so that during large orifice closure, the small air release orifice will open to allow small amounts of air to escape. Dual body construction shall combine one air and vacuum valve and one air release valve with interconnecting piping and gate valve.

- E. Air valves for vertical turbine pumps (size 4-inches and larger) shall be dual body combination air valves except the inlet shall be fitted with a surge check to prevent water column entering the valve on pump start.
- F. Valves shall be suitable for pressures up to 150 psi.
- G. Isolation valves and small-diameter piping to local drain or sump shall be provided below each air valve.
- H. All air and vacuum release valves installed in pump stations shall have piped outlets to the nearest acceptable drain, firmly supported, and installed in such a way as to avoid splashing and wetting of floors.
- I. Manufacturers shall be Vent-Tech, GA Industries, Valmatic, Apco, Ross or Approved Equal.

2.4 METAL SEATED BALL VALVES

A. Type

- 1. Pump Control Valves: Pump Control Valves (PCVs) shall be operated to minimize hydraulic shock for both pump start and stop operations by gradually opening over an adjustable duration range of 15-90 seconds.
- 2. Flow Control Valve: Flow Control Valve (FCV) shall be operated to regulate the flow passing through the valve by finely adjusting the opening amount of the valve, affecting the flow coefficient, Cv. To ensure long service life, for minimum Cv, valve shall be no less than 15% open; for maximum Cv, valve shall be no less than 85% open.

- B. The ball valve shall be metal to metal seated with flanged ends, drilled to the applicable ANSI B16.1 standard Class 125. Valve shall have a full port equal in size to the adjacent piping, when the valve is in the full open position.
- C. The valve shall be drop tight and meet or exceed the AWWA C-507-99 inspection and testing standard. The valve shall be single seated for pump control (double seated available upon request) and rated at 150 psi. The valve shall be manufactured by Pratt, DeZurik, or approved equal.

D. Construction

1. The body shall be constructed of cast ductile iron ASTM A536 GR 65-45-12 or demonstrably similar material, having an inlet and outlet flanged waterway equal to the required valve size. Flanges shall be flat-faced and machined parallel to each other to within .005 inch. Valve body shall have both a drain and vent hole drilled and tapped.
 2. The body shall have bronze bearings installed in each half accurately located in the center of the housing to receive the trunnion bearings on the ball and place the ball in the central position. The bearing load shall not exceed 2000 lb/sq. inch at 250psi differential pressure. The body seat shall be monel, electronically fused to the base metal, then accurately machined to form the seating seal, or other C507-99 approved materials. The body seat shall not protrude into the waterway.
 3. The ball shall be cast ductile iron ASTM A536 GR 65-45-12 or demonstrably similar material. It shall have integrally cast, trunnions which will be bronze-bushed. One trunnion holds the operating shaft which passes through a packing seal area and connects to the actuator. To prevent leakage around the shaft, the chevron packing is installed to form a seal. The ball seat shall be type 300 series stainless steel. It shall be pressure assisted design and by using an offset on the body and ball, the seats will only be in contact at the actual point of closing. The seat is connected to the ball by means of a stainless steel mounting ring that is securely attached and pinned into position after the correct setting has been attained. Seats threaded directly on to the ball shall not be acceptable.
 4. Valve seat assembly shall be fully adjustable and replaceable in the field without removing the valve from the line. The ball seat shall be located at the top, when the valve is in the open position.
 5. Bearings for ball and body trunnions shall be bronze of dissimilar hardness as per AWWA C507-99 standard to prevent galling or binding. Self-lubricating teflon reinforced would also be acceptable.
 6. Valve shafts shall be: ASTM A564 Type 630, H1150 (17-4PH) stainless steel, or other C507-99 approved materials.
- E. All ball valves shall be subjected to hydrostatic, shop leakage and performance tests as specified in AWWA Standard C507-99. Maximum seat leakage allowance 1fl. oz. per diameter inch per hour as per AWWA C507-99.
- F. Valve Painting: all internal ductile iron surfaces, except finished or bearing surfaces, shall be shop painted with heat-cured epoxy coating conforming to Federal Specification TT-C-494, and AWWA C550. All exterior steel or cast or ductile iron surfaces of each valve, except finished or bearing surfaces, shall be shop painted with one or more coats of Alkyd primer. For buried service valves, two coats of asphalt varnish per Federal Specification TT-C-494.

2.5 ACTUATORS

- A. Each actuator shall include electric motor, reduction gearing, reversing starters, thermal overloads, controls transformer, limit controls, non-intrusive local controls and hardwired status and control points as a complete integrated package to ensure proper coordination, compatibility, and operation of the system.
 - 1. Provide actuators capable of setting of torque, turns, and configuration of indication contacts without the necessity to remove any electrical compartment covers.
 - a. Enclosure: Watertight to IP68, BASEEFA classification. Enclosure must be certified NEMA 6 by FM (Factory Mutual), for all units except those in classified areas.
 - 2. Provide an internal watertight compartment to protect switches, contacts, motor and internal electronics from ingress of moisture and dust when the external terminal cover is removed.
 - 3. Breathers and drains are not permitted, enclosure must be totally sealed.
 - 4. Provide each actuator with a handwheel for manual operation. Provide a hammerblow device which permits motor to come up to speed before picking up load and unseating valve.

- B. Motors:
 - 1. Open/Close applications: Motors, Class F with 15-minute duty rating.
 - 2. Modulating applications: Motors, Class H with a 30-minute duty rating.
 - 3. Motor: Low inertia, high torque type to prevent over travel.

- C. Provide internal clutch that cannot engage handwheel operating mechanism and motor-operating mechanism at the same time. Friction type declutching is not acceptable.
 - 1. Provide handwheel with arrow and the word CLOSE or SHUT cast on handwheel to indicate turning direction to close.
 - 2. Handwheel must not rotate during power operation.
 - 3. Provide handwheel and low gear ratio combined to give maximum rate of movement possible with 80lb (36 kg) rim pull.

- D. Reduction Unit:
 - 1. Metal worm wheel and worm shaft type.
 - 2. Provide an oil filled gear box. Grease lubrication is not acceptable.
 - 3. Worm shaft to operate in ball or roller bearings and be machine cut, ground, and highly polished, hot rolled steel, hardness 50-60 Rockwell Scale C bronze worm wheel with large contact area. Provide mating surfaces of dissimilar metals to prevent galling. Cast metals or gears manufactured from non-metallic materials are not acceptable.
 - 4. Worm and shafts: Heat-treated steel and accurately machined. Output or driving shaft to operate in bronze bearing or in ball or roller bearings.
 - 5. Make provisions to take thrust in both directions.
 - 6. Gearing to be oil lubricated at all times.

7. Gear case: Cast iron or aluminum depending on size of actuator offered, all thrust or torque bearing components shall be ductile iron.
 8. Provide drive bushing as part of a detachable thrust base making for easy retrofit.
- E. Fully wire electric motor operators at factory and furnish complete with terminal strips for external power and control connections. Wiring: copper with tropical grade PVC cover. Internal wiring to remain in a watertight compartment with external cover removed.
- F. Provide manual or automatic control as indicated and specified.
- G. Manual Control: Provide the following Control, Status, Alarm and Diagnostic capabilities locally, at the actuator:
1. Control:
 - a. Open/Stop/Close.
 - b. Desired Valve Position Control 0-100%.
 2. Status:
 - a. Motor Running Open Direction.
 - b. Motor Running Close Direction.
 - c. Fully Open.
 - d. Fully Closed.
 - e. Percentage Open 0-100% in 1% increments.
 - f. Percentage Output Torque 0-100% in 1% increments.
 3. Alarms:
 - a. Remote Control Communications Failure.
 - b. Actuator Alarm.
 - c. Valve Alarm.
 - d. Battery Low Alarm.
- I. Each actuator shall be fitted with hard-wired dry contacts. Each Contact shall be rated at 5A, 250VAC, 30VDC and provide the following features:
1. REMOTE status.
 2. OPEN status.
 3. CLOSED status.
 4. OPEN command.
 5. CLOSE command.
 6. VALVE POSITION command (modulating actuator only).
 7. VALVE POSITION status (modulating actuator only).
 8. FAULT status.
 9. IN TRANSITION status.
- J. Provide contacts and operating parts made of non-corrodible metal and suitable for a sea

atmosphere and for contact with H₂S.

K. Control Station:

1. Provide for each actuator.
2. Enclosure:
 - a. NEMA 6 cast aluminum for all areas not classified.
 - b. Provide red, green, and yellow indicating lights on operator. Green light on when valve, gate or equipment is completely closed, red light on when valve, gate or equipment is completely opened, and yellow light when valve, gate or equipment is in mid travel.
 - c. Control circuits: 110VAC or 24VDC.
 - d. LOCAL/STOP/REMOTE switch: Padlock-able in all positions.
 - e. OPEN/CLOSE switch.

L. Starters/transformers: Consists of two relay contactors, 3-pole, mechanically interlocked, reversing, with suitable arc suppressors.

1. Provide inverse time element overload relays.
2. Provide a control transformer capable of generating either 110VAC (220VAC) or 24VDC.
3. Provide electromechanical starter capable of OPEN/CLOSE sixty starts per hour. Size solid-state starter for modulating service at 1200 starts per hour.
4. Provide replaceable fuses to protect wiring, fuses must be locally available.
5. Provide automatic phase correction.

M. For actuators located higher than 5 feet (1.5 m) above the operating level or below finished floor level (in pits, etc.), provide a separate pushbutton enclosure. Mount on a pedestal, or on adjacent structure.

1. Provide actuator capable of accepting indication input from separate pushbutton station, that pushbutton station has been selected for remote control.
2. Provide each actuator with an unfused disconnect switch.
3. Enclosure Type: Refer to 2.5L.

N. For actuators located in chemical containment areas, provide extension stems to raise actuators above containment walk levels.

O. Limit Controls:

1. Type: Positive in action ensuring tight seating and full openings.
2. Position Setting Range: 2.5 to 100,000 turns, with resolution of 7.5 degrees of one actuator output revolution.
3. Provide mechanism designed to minimize drift or overtravel and to open or close

- valve, gate or equipment to fixed, predetermined limits of opening and closing travel.
4. Provide controls that disconnect driving mechanism from stem. Geared limit or torque type as required capable of predetermined limits of opening and closing travel. Potentiometers for position transmission are not acceptable.
 5. Provide torque switches for both directions of travel.
 - a. Sensing to be independent of voltage fluctuation. Mechanical torque springs are not acceptable.
 - b. Provide torque protection to prevent repeated starting in the same direction.
 - c. The initial unseating hammer blow shall not cause over-torque.
 - d. Provide torque switch settings independent of OPEN/CLOSE position switches.
- P. Provide output shaft to accept rising stem for rising spindle valves and include roller and ball type thrust bearings.
- Q. Provide actuator sized to close valve, gate or equipment against required differential. Size actuator motor to seat and unseat valve gate or equipment and ensure torque switch trip at maximum valve torque when supply voltage is 10% below normal. Size motor to open or close valve, gate or equipment to satisfy the process dynamics.
- R. All fasteners and hardware: Type 316 stainless steel.
- S. Supply each actuator with a start-up kit comprising installation instructions, electrical wiring diagram, and sufficient spare cover screws and seals to make good any site losses during the commissioning.
- T. Manufacturer: Limitorque, Rotork, or approved equal.

PART 3 EXECUTION

3.1 INSTALLATION

- A. All valves and appurtenances shall be installed in the locations shown, 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. Buried flanged or mechanical joints shall be made with cadmium plated bolts.
- C. Prior to installation, valves shall be inspected for direction of opening clockwise, 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. Defective valves shall be corrected or held for inspection by the Engineer. Valves shall be closed before being installed.

3.2 LAYING AND JOINTING VALVES AND APPURTENANCES

- A. Valves, fittings, plugs, and caps shall be set and joined to the pipe in accordance with the manufacturer's recommendations for cleaning, laying and joining pipe.
- B. 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.
- C. A valve box shall be provided on each buried valve. The valve box shall be set over the center of the valve operating nut and plumbed. The box shall not transmit shock or stress to the valve. The bottom portion of the lower belled portion of the box shall be placed below the valve operating nut. The 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. The valve box cover shall be flush with the surrounding surface or such other level as directed by the Engineer.
- D. After installation of equipment, and after inspection, operation, testing and adjustment have been completed by manufacturer's field service engineer, conduct running test for each actuator in presence of Engineer to determine its ability to operate without vibration or jamming and to operate at the speeds specified. During tests, observe and record, motor inputs. Promptly correct or replace all defects or defective equipment revealed by or noted during tests, at no additional cost to the City, and repeat tests until specified results and results acceptable to the Engineer are obtained. Contractor to provide all labor, equipment, and materials necessary for conducting tests.

3.3 BLOW-OFFS

- A. Blow-offs shall be installed in locations as directed by the Engineer and as shown on the Drawings. Blow-offs shall not be connected to any sewer, submerged in any stream or creek, or be installed in any manner that will permit back siphonage into the water distribution system.

3.4 TESTING

- A. After installation, all valves and appurtenances shall be tested at least 1 hour at 125 psi, unless a different test pressure is specified. If any joint proves to be defective, it shall be repaired to the satisfaction of the Engineer.

VALVE SCHEDULES

Table 1: Gate Valve Schedule

Tag ID	Size	Operation	Actuator
10-V2-001	60	Open/Close	Electric
10-V2-002	48	Open/Close	Electric
10-V2-003	48	Open/Close	Electric
10-V2-004	48	Open/Close	Electric
11-V2-001	36	Open/Close	Electric
11-V2-002	36	Open/Close	Electric
11-V2-003	36	Open/Close	Electric
11-V2-007	60	Open/Close	Electric
11-V2-008	48	Open/Close	Electric
11-V2-009	48	Open/Close	Electric

Table 2: Air Valve Schedule

Site	Tag ID	Type	Orifice Diameter (inches)	Operation
CWTP	10-V9-001	Dual body combination	16	Self-Regulated
	10-V9-002	Air Release	8	Self-Regulated
	10-V9-003	Air release	8	Self-Regulated
RIPS	11-V9-001	Well service	8	Self-Regulated
	11-V9-002	Well service	8	Self-Regulated
	11-V9-003	Well service	8	Self-Regulated
	11-V9-007	Air release	2	Self-Regulated
	11-V9-008	Air release	2	Self-Regulated

Table 3: Pump Control Valve Schedule

Tag ID	Type	Size (inches)	Operation	Actuator
11-V8-001	Metal Seated Ball Valve	36	Modulating	Electric
11-V8-002	Metal Seated Ball Valve	36	Modulating	Electric
11-V8-003	Metal Seated Ball Valve	36	Modulating	Electric

Table 4: Flow Control Valve

Tag ID	Type	Size	Operation	Actuator	Min. Cv	Max. Cv
11-V1-001	Metal Seated Ball Valve	48	Modulating	Electric	5,500	32,000

+++ END OF SECTION 15100 +++

**SECTION 15102
DEHUMIDIFIERS**

PART 1 - GENERAL

1.01 SCOPE

- A. Work described in this Section includes furnishing all labor, materials, equipment, tools and incidentals required for a complete and operable installation of packaged dehumidification units. All equipment shall be installed, adjusted, tested and placed in operation in accordance with these Specifications, the Contractor's recommendations and as shown on the drawings.
- B. Contract drawings show only functional features and some of the required external connections. They do not show all components required for a complete installation nor exact dimensions particular to any specific material. Contractor shall supply all parts, devices and equipment necessary to meet the requirements of the Contract Documents and shall make all dimensional adjustments particular to the material being furnished. All costs associated with such changes and adjustments shall be included in the price bid for the Work shown and specified.
- C. Equipment specified in this Section includes the following:
 - 1. Dehumidification units.
- D. Related Work Specified Elsewhere:
 - 1. Section 15050, Basic Mechanical Materials and Methods.
 - 2. Section 15950, HVAC Controls.
 - 3. Division 16, Electrical.
- E. The following wiring shall be furnished under Division 16, Electrical:
 - 1. Provide control wiring between unit-mounted control panel and thermostats, remote control panels and any other control device furnished as Work in this Section.
 - 2. Provide factory-mounted and wired controls and electrical devices as specified in this Section.
 - 3. Additional electrical work including motor starter, disconnects, wire/cables, raceways and other required electrical devices; not Work of this Section.

1.02 SUBMITTALS

- A. Submittals shall be made in accordance with the General Conditions of the Contract Documents. In addition, the following specific information shall be provided:
 - 1. Manufacturer's technical product data, including rated capacities of selected model clearly indicated, weights, furnished specialties and accessories; and installation and start-up instructions.
 - 2. Maintenance data and parts list for each dehumidification unit, control and

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accessory; including trouble-shooting maintenance guide.

3. Submit manufacturer's assembly-type shop drawings indicating dimensions, weight loading, required clearances and methods of assembly of components.
4. Submit manufacturer's electrical requirements for power supply wiring for dehumidification units. Submit manufacturer's ladder-type wiring diagrams for interlock and control wiring required for final installation of dehumidification units and associated controls. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.

1.03 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of dehumidification units, of types and in similar service for not less than 5 years.
- B. Reference Standards: Comply with all Federal and State laws or ordinances, as well as the latest edition of all applicable codes, standards, regulations and/or regulatory agency requirements including the partial listing below:
 1. ASTM, American Society for Testing Materials.
 2. ASME, American Society of Mechanical Engineers.
 3. OSHA, Occupational Safety and Health Act.
 4. ANSI, American National Standards Institute.
 5. ASHRAE, American Society of Heating, Refrigerating and Air Conditioning Engineers.
 6. ARI, Air Conditioning and Refrigeration Institute.
 7. NFPA, National Fire Protection Association.
 8. FM, Factory Mutual Engineering Corporation.
 9. UL, Underwriters Laboratories, Inc.

1.04 QUALITY STANDARDS

- A. Manufacturer's offering products that comply with these specifications include:
 1. Munters
 2. Or equal.

1.05 STORAGE AND HANDLING

- A. Handle dehumidification units and components carefully to prevent damage, breaking, denting and scoring. Do not install damaged units or components; replace with new.
- B. Store dehumidification units and components in a clean and dry environment. Protect from weather, dirt, fumes, water, construction debris and physical damage. Storage area location shall be approved by the Engineer.
- C. Comply with manufacturer's rigging and installation instructions for unloading dehumidification units and moving them to final location for installation.

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1.06 WARRANTY

- A. Provide a warranty against defective equipment and workmanship in accordance with the requirements of the General Conditions of the Contract Documents.
 - 1. Provide written warranty on motors, fans and drive unit, signed by manufacturer, agreeing to replace/repair, within warranty period, motors/fans/drive units with inadequate and defective materials and workmanship. Replacement is limited to component replacement only and does not include labor for removal and reinstallation. Warranty period shall be 5 years from Date of Substantial Completion.

PART 2 - PRODUCTS

2.01 DEHUMIDIFICATION UNIT

- A. Dehumidification unit shall be Munters model GC-150 or equal.
- B. Dehumidifier shall be of a type proven in satisfactory operation for a minimum of ten years.
- C. Dehumidifier shall be of the non-cycling sorption type with a single desiccant rotary structure.
- D. Unit casing shall be fabricated as a unitized body with welded aluminum construction for maximum strength and durability. Suitable access panel shall allow access for inspection or servicing without disconnecting ducting or electrical wiring.
- E. Airflow balancing dampers shall be furnished with dehumidification units.
- F. Dehumidifier rotary structure shall be a monolithic fabricated extended surface consisting of inert silicates reinforced with uniform diameter glass fibers for maximum strength. The fabricated structure shall be smooth and continuous in the direction of airflow without interruptions or sandwich layers which restrict airflow or create a leakage path at joining surfaces.
- G. Desiccant shall not channel, cake or fracture due to repeated temperature and moisture cycling.
- H. The materials of construction shall be non-toxic and NFPA 225-ASTM E84 compliant.
- I. Full face contact pressure seals shall be provided to separate the process and reactivation air streams and eliminate detrimental leakage of air or moisture with static pressure differentials of up to 3" of water gauge.
- J. Dehumidifier shall be factory assembled. fully automatic, complete with desiccant wheel, reactivation heaters, reactivation energy control system, roughing filters,

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motors, fans, non-racheting desiccant drive unit, automatic controller and all components' auxiliaries.

- K. Reactivation energy modulation shall be stepless solid state proportioning type.
- L. Dehumidifier shall be functionally tested at the manufacturer's factory and shipped complete with all components necessary to maintain normal operation.
- M. The standard unit shall operate on a 60 Hz power supply, three phase for 480V as specified with a total connected load not to exceed 10 amps.
- N. Dehumidification units shall operate at process flow rates of 125-150 SCFM at 2" ESP with a nominal moisture removal capability of 2-4 lbs/hr and be capable of processing saturated, conditioned or outside air.
- O. Dehumidification filters shall be of "permanent" design and be washable.
- P. Dehumidification units' electrical control shall allow for continuous automatic operation and include motor starters, control relays and overload protection devices.
- Q. Unit drive system shall have a simple drive belt arrangement with as few moving parts as possible.
- R. Process and reactivation air shall be separate with air seals to provide minimum leakage and with a 5-year minimum life expectancy.
- S. All unit fans shall be of a centrifugal, direct drive design and be totally enclosed and non-ventilated.
- T. Dehumidifier housing shall be of welded aluminum construction. Housing shall be constructed such that controls are insulated.
- U. Unit cabinet finish shall be light gray enamel MIL-E-15090 paint.

2.04 SPARE PARTS

- A. Furnish to the Engineer with receipt, the manufacturer-recommended spare parts for each packaged unit:

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine areas and conditions under which units are to be installed. Do not proceed with Work until unsatisfactory conditions have been corrected in a manner acceptable to Installer.

3.02 INSTALLATION OF DEHUMIDIFIER UNITS

A. General

Install dehumidification units in accordance with manufacturer's installation instructions. Install units plumb and level, firmly anchored in locations indicated and maintain manufacturer's recommended clearances.

B. Electrical Wiring

Install and connect electrical devices furnished by manufacturer but not specified to be factory-mounted. Furnish copy of manufacturer's electrical connection diagram submittal to electrical contractor.

C. Piping Connections

Install and connect devices furnished by manufacturer but not specified to be factory-mounted. Furnish copy of manufacturer's piping connection diagram submittal to piping contractor.

D. Field Quality Control

Start dehumidification units in accordance with manufacturer's startup instructions. Test controls and gauges and demonstrate compliance with requirements. The system shall be designed to maintain humidity conditions in the vaults. The manufacturer shall design and furnish all equipment to be fully compatible with heat dissipation requirements.

3.03 FIELD QUALITY CONTROL

A. Start-up dehumidification units, in accordance with manufacturer's start-up instructions. Test controls and demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment.

B. Provide services of manufacturer's technical representative for 1-half day to instruct City's personnel in operation and maintenance of dehumidification units.

1. Schedule training with the Engineer, provide at least a 7-day notice to Contractor and Engineer of the training date.

+++END OF SECTION 15102+++

**SECTION 15700
ELECTRICAL UNIT HEATERS**

PART 1 - GENERAL

1.01 SCOPE

- A. Work described in this Section includes furnishing all labor, materials, equipment, tools and incidentals required for a complete and operable installation of all electrical unit heaters and controls. All equipment shall be installed, adjusted, tested and placed in operation in accordance with these Specifications, the manufacturer's recommendations and as shown on the Drawings.

- B. Contract drawings show only functional features and some of the required external connections. They do not show all components required for a complete installation nor exact dimensions particular to any manufacturer's equipment. Contractor shall supply all parts, devices and equipment necessary to meet the requirements of the Contract Documents and shall make all dimensional adjustments particular to the equipment being furnished. All costs associated with such changes and adjustments shall be included in the price bid for the Work shown and specified.

1.02 SUBMITTALS

- A. Submittals shall be made in accordance with the requirements of the General Conditions of the Contract Documents. In addition, the following specific information shall be provided:
 - 1. Manufacturer's Certification.
 - 2. Manufacturer's data.
 - 3. Operation and maintenance manuals.
 - 4. Complete wiring and control diagrams.

1.03 QUALITY ASSURANCE

- A. Reference Standards. Comply with all Federal and State laws or ordinances, as well as the latest edition of all applicable codes, standards, regulations and/or regulatory agency requirements including the partial listing below:
 - 1. NEC, National Electric Code.
 - 2. NEMA, Standards of National Electrical Manufacturers Association.
 - 3. OSHA, Occupational Safety and Health Act.
 - 4. ANSI, American National Standards Institute.
 - 5. ASTM, American Society for Testing Materials.
 - 6. AISI, American Iron and Steel Institute.
 - 7. AGMA, American Gear Manufacturer's Association.
 - 8. AFBMA, Anti-Friction Bearing Manufacturer's Association.
 - 9. NFPA, National Fire Protection Association.

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- B. Experience. Equipment furnished under this Section shall be of a design and manufacture that has been successfully used in similar applications. The manufacturer shall have furnished equipment for a minimum of five similar applications that have a demonstrated record of successful operation. Provide a list of such installations complete with installation description contact names, addresses, telephone numbers. This reference list shall be submitted with the shop drawings.

1.04 QUALITY STANDARDS

- A. The electrical unit heaters shall be furnished by a single manufacturer who shall assume sole responsibility for providing a complete, operating system designed for long life with a minimum of required maintenance meeting the requirements specified herein and as shown on the Drawings.
- B. Manufacturer shall provide written certification that the equipment provided under this Specification has been amply designed and is a suitable application for these service conditions. A certificate of unit responsibility shall be provided. Nothing in this provision, however, shall be construed as relieving the Contractor of his overall responsibility for this portion of the work.
- C. Unit responsibility certificates provided by suppliers, vendors, or other second party representatives of the electrical unit heater manufacturer shall not be accepted.
- D. Manufacturer's offering products that comply with these specifications include:
 - 1. Unit Heaters-Chromalox, Model HD3D
 - 2. Or equal.

1.05 WARRANTY

- A. Provide a warranty against defective equipment and workmanship in accordance with the requirements of the General Conditions of the Contract Documents.

PART 2 - PRODUCTS

2.01 ELECTRICAL UNIT HEATER

- A. Provide and install electrical unit heater as described herein and as indicated on the Drawings.
 - 1. Unit heater shall be horizontal and wall mounted.
 - 2. Furnish electrical heater with mounting brackets.
 - 3. Unit heater heat bank shall consist of patented chromalox spiral metal sheath fintube electric heating elements with built-in overheat protection.
 - 4. Furnish heavy duty magnetic control contactor.
 - 5. Unit heater shall be hose-down corrosion resistant blower type.

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2.02 CONTROLS

- A. Unit heaters shall be energized by their respective 2-stage thermostats set at 48⁰. The unit heater shall de-energize when room temperature is 50⁰ F.

PART 3 - EXECUTION:

3.01 INSTALLATION

- A. The equipment shall be installed in strict conformance with the approved shop drawings and manufacturer's installation instructions.

3.02 EQUIPMENT TESTING

- A. After completion of the work, test and regulate heating coils, and unit heaters, to conform to conditions indicated on the Drawings. Contractor shall adjust apparatus for securing proper volumes and conditions.

+++ END OF SECTION 15700 +++

SECTION 15775
PACKAGED AIR CONDITIONING UNITS

PART 1 – GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Vertical wall-mount air conditioning units.

1.02 REFERENCES

- A. Air-Conditioning and Refrigeration Institute:
 - 1. ARI 390-2003 – Vertical Air-Conditioners.
- B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:
 - 1. ASHRAE 90.1 - Energy Standard for Buildings Except Low-Rise Residential Buildings.

1.03 SUBMITTALS

- A. Product Data: Submit data indicating capacity, dimensions, rough-in connections, and electrical characteristics and connection requirements.
- B. Manufacturer's Installation Instructions: Submit assembly, support details, connection requirements, and include start-up instructions.
- C. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.04 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: Submit manufacturer's descriptive literature, operating instructions, installation instructions, and maintenance and repair data.

1.05 QUALITY ASSURANCE

- A. Test and rate vertical wall mounted air conditioners in accordance with ARI 390-2003.
- B. Performance Requirements: Conform to minimum cooling mode efficiency prescribed by ASHRAE 90.1 when tested in accordance with ARI 390-2003.

1.06 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years experience.
- B. Installer: Company specializing in performing work of this section with minimum three years of experience.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Accept units on site in factory packaging. Inspect for damage.
- B. Protect units from damage by providing temporary covers until construction is complete.
- C. Protect items shipped loose with units in original packaging and store in secured area.

1.08 FIELD MEASUREMENTS

- A. Verify by field measurements size and configuration are compatible with wall construction and layout.

1.09 COORDINATION

- A. Coordinate wall openings, and electrical rough-in locations to accommodate work of this Section.

1.010 WARRANTY

- A. Provide a warranty against defective equipment and workmanship in accordance with the requirements of the General Conditions of the Contract Documents.
- B. Provide five-year manufacturer's warranty for compressors.

PART 2 - PRODUCTS

2.01 VERTICAL WALL MOUNTED AIR CONDITIONING UNITS

- A. Manufacturers: Marvair or approved equal.
- B. Product Description: Vertical wall mounted air conditioning units, with electric refrigeration system, remote temperature controls and a factory installed full flow economizer with enthalpy controller.
- C. Cabinet: Construction shall be a single, enclosed, weatherproof casing constructed of 20-gauge galvanized steel. Unit base shall be constructed of 16-gauge galvanized steel. Each exterior casing panel shall be bonderized and finished with baked-on exterior polyester enamel paint prior to assembly. The baked-on cured paint finish shall pass the industry rub test with a minimum of 72 rubs MEK (Methyl Ethyl Ketone) or standard rub test of a minimum of 100 rubs using Toluene. Cooling section shall be fully insulated with 1-inch fiberglass to prevent sweating and to muffle sounds. Openings shall be provided for power connections. Access openings shall be appropriate for outside structure to all fan motors and compressor for making repairs and for removing internal components without removing unit from its permanent installation. Fresh air intake and outdoor coil shall be protected from intrusions by a sturdy metal grating with less than 1/4-inch openings. Separate filter service door shall provide easy access for filter change.

- D. Drain Pan: Drain pan shall be constructed of 20-gauge galvanized steel, bonderized and finished with baked-on exterior polyester enamel paint.
- E. Insulation: Insulation shall be foil-faced for ease of cleaning.
- F. Mounting Brackets: Full-length side mounting brackets shall be an integral part of the cabinet.
- G. Refrigeration System: All models shall use a high efficiency scroll compressor. The compressor shall be covered by a 5-year parts warranty. The refrigeration circuit shall be equipped with factory installed high and low pressure controls and liquid line filter dryer. Compressor shall be mounted on rubber grommets. Unit shall be provided with R-410A (HFC) non-ozone depleting refrigerant.
- H. Condenser Fan Motor: The condenser fan, motor and shroud shall be of slide out configuration for easy access.
- I. Indoor Blower Motor: The indoor blower motor shall be high efficiency ECM motor providing low sound levels with soft start capability and high efficiency operation. Motor will automatically respond to higher static ducted applications without user adjustment or wiring changes.
- J. Electric Heat: The unit shall have a factory installed electric resistance heater. Heater shall include automatic limit safety controls.
- K. Economizer: The built-in economizer system shall be internally mounted and shall allow outside air to be introduced through the air inlet openings. The amount of outdoor air shall vary in response to the system controls and settings. The economizer module shall be factory installed in the ventilation section. The economizer module shall be easily removed for service. The economizer shall have the following features:
 - 1. Exhaust air damper control for positive closed position. Damper shall be furnished and installed with building louver by Contractor.
 - 2. Unit controls shall interface with an actuator motor (furnished and installed by Contractor) that shall be 24-volt with power to open, spring return actuator and built-in torque limiting switch
 - 3. Proportioning type control algorithm
 - 4. Moisture eliminator & pre-filter with permanent, washable aluminum construction
 - 5. Enthalpy control with outdoor temperature and humidity monitoring for precise control of economizer operation
 - 6. Minimum position potentiometer to control minimum damper blade position for ventilation purposes
 - 7. Mixed air sensor to monitor outside and return air to automatically modulate damper position
- L. Filters shall be 2" fiberglass, pleated, MERV 11 that are changeable from the outside.

M. Controls

1. Lead/Lag Microprocess Controller with capability to run both units upon demand.
2. Low Ambient Control: Unit shall have low ambient temperature controls for operation down to 0°F.

N. Capacity:

1. See schedule on drawing.

2.02 ELECTRICAL CHARACTERISTICS AND COMPONENTS

- A. Electrical Characteristics: see schedule on drawing.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify wall opening is ready for wall sleeve installation.
- B. Verify wall construction is ready for unit installation.
- C. Verify electrical rough-in is at correct location.

3.02 PREPARATION

- A. Coordinate to assure correct opening size for wall sleeve.

3.03 INSTALLATION

- A. Install units level.
- B. Install unit with wall sleeve, and outside air louver.
- C. Connect controls.
- D. Install condensate drain piping to grade.

3.04 CLEANING

- A. After construction is completed, including painting, clean exposed surfaces of units.
- B. Vacuum clean coils and inside of cabinets.
- C. Touch up marred or scratched surfaces of factory finished cabinets, using finish materials furnished by manufacturer.
- D. Install new throwaway filters in units after Substantial Completion.

3.05 DEMONSTRATION

- A. Demonstrate unit operation and maintenance.

3.06 PROTECTION OF FINISHED WORK

- A. Protect finished surfaces of cabinets with protective covers during remainder of construction.

+++ END OF SECTION 15775 +++

**SECTION 15830
HVAC FANS**

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Roof mounted exhaust fans

1.02 REFERENCES

- A. Air Movement and Control Association International, Inc.:
 - 1. AMCA 99 Standards Handbook
 - 2. AMCA 204 - Balance Quality and Vibration Levels for Fans.
 - 3. AMCA 210 Laboratory Methods of Testing Fans for Rating Purposes
 - 4. AMCA 300 Test Code for Sound Rating Air Moving Devices
- B. International Mechanical Code
- C. Underwriter's Laboratories (UL) Standards
 - 1. UL 705 Power Ventilators
- D. National Fire Protection Association (NFPA) Standards
 - 1. NFPA 70 National Electrical Code
 - 2. NFPA 90A Installation of Air Conditioning and Ventilating Systems

1.03 SUBMITTALS

- A. Shop Drawings: Indicate size and configuration of fan assembly, materials of construction, mountings, weights, ductwork and accessory connections.
- B. Product Data: Submit data on each type of fan and include accessories, fan curves with specified operating point plotted, AMCA certification, power, RPM, sound power levels for both fan inlet and outlet at rated capacity, electrical characteristics and disconnects where specified or shown.
- C. Roof curbs and fan accessories
- D. Manufacturer's Installation Instructions: Submit fan manufacturer's instructions.
- E. Spare parts list
- F. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.04 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: Submit instructions for lubrication, motor and drive replacement, spare parts list, and wiring diagrams.

1.05 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years experience.
- B. Installer: Company specializing in performing Work of this section with minimum three years experience.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Protect motors, shafts, and bearings from weather and construction dust.

1.07 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.08 WARRANTY

- A. Furnish one-year manufacturer's warranty for fans.

PART 2 - PRODUCTS

2.01 ROOF MOUNTED CENTRIFUGAL EXHAUST FANS

- A. Manufacturers: Fan shall be manufactured by Greenheck, Loren Cook, or Acme.
- B. Fan Unit: Downblast or upblast type and V-belt or direct drive as indicated on the Fan Schedule on the Drawings, with spun aluminum housing; resilient mounted motor; aluminum wire bird screen; square base to suit roof curb with continuous curb gaskets.
- C. Sheaves: Cast iron or steel, dynamically balanced, bored to fit shafts and keyed; variable and adjustable pitch motor sheave selected so required rpm is obtained with sheaves set at mid-position; fan shaft with self-aligning pre-lubricated ball bearings.
- D. Self-flashing curb: Roof Curb: minimum 12-inch high self-flashing of aluminum construction with continuously welded seams, built-in cant strips, 1-inch insulation and curb bottom, interior baffle with acoustic insulation, curb bottom, ventilated double wall, and factory installed nailer strip.
- E. Disconnect Switch: Factory wired, non-fusible, in fan housing for thermal overload protected motor, NEMA 250 Type 3R enclosure.
- F. Accessories:
 - 1. Gravity Backdraft Damper.

2. Variable speed controller where indicated on the Fan Schedule on the Drawings.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify roof curbs installations dimensions are coordinated between existing and/or proposed structures and the rooftop equipment supplier.

3.02 INSTALLATION

- A. Secure wall, roof and structure mounted fans with stainless steel screws/anchors to structure.
- B. Install backdraft dampers on inlet to roof and wall exhaust fans and gravity ventilators used in relief air applications.

3.03 CLEANING

- A. Vacuum clean inside of fan cabinet.

3.04 PROTECTION OF FINISHED WORK

- A. Do not operate fans until ductwork is clean, and fans have been test run under observation.

+++ END OF SECTION 15830 +++

**SECTION 15950
HVAC CONTROLS**

PART 1 - GENERAL

1.01 DESCRIPTION

- A. The work consists of providing controls for the HVAC system as shown on the Drawings or indicated in these specifications. Controls shall be electric or DDC.
- B. The Contractor shall provide all engineering, installation, supervision, hardware, labor, materials and checkout to provide a fully functioning system. The Contractor shall furnish and install all items normally included on systems of this type which, while not mentioned directly herein, are essential to the installation and operation of the system.

1.02 SCOPE

- A. Extent of electric control systems work required by this Section is indicated on drawings and schedules, and by requirements of this Section. Control sequences are specified both in this Section and on drawings.
- B. Refer to other Division-15 Sections for installation of manual volume dampers in mechanical systems.
- C. All work shall be in compliance with the National Electrical Code.
- D. Refer to Division-16 Sections for the following work:
 - 1. Power supply wiring for power source to control panels, starters, disconnects, and required electrical devices, except where specified as furnished, or factory-installed, by manufacturer.
- E. Furnish control and interlock wiring under this section between field installed controls, indicating devices, motorized damper operators and unit control panels in compliance with the requirements of Division 16.
- F. Control panel enclosures, starters, and disconnect switches shall be furnished under this section in accordance with the requirements specified under Division 16.

1.03 SUBMITTALS.

- A. Submittals shall be made in accordance with the requirements of the General Conditions of the Contract Documents. In addition, the following specific information shall be provided:
 - 1. Product Data. Manufacturer's technical product data for each control device furnished, indicating dimensions, capacities, performance characteristics, electrical characteristics, finishes of materials, and including installation instructions and start-

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up instructions.

2. Schematic flow diagram of system showing fans, dampers, and control devices.
3. Label each control device with setting or adjustable range of control.
4. Control interlock wiring diagrams. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.
5. Details of faces of control panels, including controls, instruments, and labeling.
6. Written description of sequence of operation.
7. Wiring diagrams.
8. Operation and maintenance manuals.

1.04 GUARANTEE

- A. All materials and equipment shall be fully guaranteed by the Contractor to be free of defects. Contractor shall keep his entire portion of the work in repair without additional cost to the Owner, so far as defects in workmanship, apparatus, material or construction are concerned for one year from the date of final acceptance. Any equipment which fails to meet the ratings specified shall be removed and replaced without cost to the Owner.

1.05 QUALITY ASSURANCE.

- A. Manufacturer's Qualifications. Only firms regularly engaged in the manufacture of electric control equipment of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years shall be eligible to provide and install the equipment specified herein.
- B. Codes and Standards.
 1. Electrical Standards. Provide electrical products which have been tested, listed and labeled by UL and comply with NEMA standards.
 2. NEMA Compliance. Comply with NEMA standards pertaining to components and devices for electric control systems.
 3. NFPA Compliance. Comply with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems" where applicable to controls and control sequences.

1.06 QUALITY STANDARDS

- A. Manufacturer. Subject to compliance with requirements, provide electric control systems from one of the following manufacturers.
 1. Honeywell, Inc.
 2. Johnson Controls, Inc.
 3. Siemens.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Provide factory shipping cartons for each piece of equipment, and control device. Maintain cartons through shipping, storage and handling as required to prevent equipment damage,

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and to protect equipment from dirt and moisture. Store equipment and materials inside and in original shipping packaging.

PART 2 - PRODUCTS

2.01 MATERIALS AND EQUIPMENT.

- A. DDC Control System: shall include an operator interface for display, adjustment and override. The equipment shall be appropriately protected from power surges or overload. Controller memory shall be protected from power failure for a minimum of 48 hours.
- B. DDC controller: Controller shall be provided for all major equipment scheduled and accept analog or digital inputs, as required and provide digital outputs. Standard functions shall include: time-of-day scheduling, power failure/auto restart, override control and schedule adjustment. System memory and clock time shall not be erased by a power failure. Controller shall have an alphanumeric keypad to change schedules and to display output status. Controller shall be equipped with lightning arrestor and power surge protection.
- C. Room Thermostats. Provide room thermostats with locking covers, and with concealed or readily-accessible adjustment devices and dead band, as indicated.
 - 1. Except where unit mounted, thermostats shall be installed five feet above the finished floor in administrative areas. In warehouse and maintenance areas, thermostats and switches shall be mounted 6'-6" A.F.F. with heavy duty steel cages to prevent damage. This Contractor shall install and wire thermostats and control switches for all infrared heaters, rooftop units, heat pumps, HV units and makeup air units. Baseboard heaters and air rotation units shall have unit mounted thermostats.
 - 2. Electronic space temperature sensors shall be located in warehouse areas as shown on Drawings, eight feet above finished floor. The outside air sensors shall be located a minimum of five feet above the roofline.
 - 3. Provide thermostats with spiral bimetallic thermometers.
 - 4. Thermostats. Provide 24 VAC thermostats of the bimetal actuated open contact, or bellows actuated enclosed snap-switch type, or equivalent solid-state type. Thermostat shall be UL-listed at electrical rating comparable with application. Provide bimetal thermostats which employ heat anticipation.
 - 5. Thermostat for air-conditioning units shall be by the unit manufacturer.
- D. Electric Contactors. Provide contactors for operating or limit control of electric heating loads which are UL-listed for 100,000 cycles of resistive loads. Equip with replaceable molded coils and replaceable silver cadmium oxide contacts. Coat core laminations with heat-resistant inorganic film to reduce core losses. Provide line and load terminals on contactors with higher-than-35-amp rating, or provide one-piece formed-and-welded pressure type. Provide screw-type contactors for 35-amp-or-lower rating. Equip field-mounted contactors with suitable steel enclosures; and provide open-type mounting for those installed in factory-fabricated panels.

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- E. Fan Switches: Provide fan switches where indicated on the Drawings. Switches shall be factory sealed, shall be rated 600 VAC heavy duty and shall have indicating lights. Selector switches shall be two or three position as indicated on the Drawings:
 - 1. START/STOP
 - 2. HAND/OFF/AUTO

- F. Control Wiring: All control, interlock and starting circuit wiring, except where otherwise specified or noted on the plans, is to be furnished under this Section.
 - 1. Line voltage wiring shall not be smaller than #14, 600 volt wire. All wire shall be run in conduit with outlet boxes and fittings in compliance with the requirements of Division 16, Electrical.
 - 2. 24 volt wiring shall be not less than #18 gauge, with 600 volt insulation. Wiring run in partitions or above ceilings shall be run in plenum rated cable.
 - 3. Control voltage shall not exceed 120 volts. Provide transformers and relays to comply with this requirement.

2.02 TIMECLOCKS

- A. Timeclocks shall be 7-day, 24-hour electronic type as manufactured by Paragon or equal. Clock and programmed start-stop schedules shall be fully protected from power failure. Contact rating shall be adequate for equipment served, or 3 Amp minimum. LEDs will indicate run status.

- B. A DDC controller may be installed in lieu of timeclocks with a separate digital output for each timeclock grouping. Controller shall accept analog or digital inputs, as required and provide digital outputs. Standard functions shall include: time-of-day scheduling, power failure/auto restart, override control and schedule adjustment. System memory and clock time shall not be erased by a power failure. Controller shall have an alphanumeric keypad to change schedules and to display output status. Controller shall be equipped with lightning arrestor and power surge protection.

PART 3 – EXECUTION

3.01 WORKMANSHIP

- A. All work shall be executed in a workmanlike manner and shall present a neat appearance when completed. All material and equipment shall be installed in accordance with the manufacturer's recommendations and applicable codes.

3.02 INSTRUCTIONS

- A. Upon complete installation, provide a minimum of 4 hours of training for operating personnel. Provide copies of as-built drawings indicating all terminations. Provide also written operating instructions and equipment manufacturers cut-sheets.

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3.03 INSPECTION

- A. Examine areas and conditions under which electric control systems are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.04 INSTALLATION OF ELECTRIC CONTROL SYSTEMS

- A. General. Install systems and materials in accordance with manufacturer's instructions and roughing-in drawings, and details on drawings. Install electrical components and use electrical products complying with requirements of applicable Division-16 Sections of these specifications. Mount controllers at convenient locations and heights.
- B. Control Wiring. The term "control wiring" is defined to include provision of wire, conduit and miscellaneous materials as required for mounting and connecting electric control devices.
- C. Wiring System. Install complete control wiring system for electric control systems. Conceal wiring, except in mechanical rooms and areas where other conduit and piping are exposed. Provide multi-conductor instrument harness (bundle) in place of single conductors where number of conductors can be run along common path. Fasten flexible conductors bridging cabinets and doors, neatly along hinge side, and protect against abrasion. Tie and support conductors neatly.
- D. Number-code or color-code conductors, excluding those used for local individual room controls, appropriately for future identification and servicing of control system.

3.05 ADJUSTING AND CLEANING.

- A. Start-Up. Start-up, test, and adjust electric control systems in presence of manufacturer's authorized representative. Demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment.
- B. Cleaning. Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.
- C. Final Adjustment. After completion of installation, adjust thermostats, damper operators, motors and similar equipment provided as work of this Section. Final adjustment shall be performed by specially trained personnel in direct employ of the manufacturer of primary temperature control system.

3.06 CLOSEOUT PROCEDURES

- A. City's Instructions. Provide services of manufacturer's technical representative for four hours to instruct City's personnel in operation and maintenance of electric control systems. Schedule instruction with Engineer, provide at least 7-days of notice to Contractor and

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Engineer for training date.

3.07 SEQUENCE OF OPERATION

- A. Wall Mounted AC units (Electric Building):
 1. When the unit's ON/OFF switch is in OFF position, the units shall be off.
 2. When the switch is in ON position, the unit shall be controlled by factory furnished lead/lag controller to maintain space temperature and humidity.
 3. The units shall operate simultaneously as needed to meet the space loads.
 4. The units shall operate in economizer mode with factory furnished enthalpy controls.
 4. When the space temperature rises above the space high temperature set point, a high temperature alarm shall be activated for remote reporting at the HMI. See P&ID drawings.
 5. When the fire alarm is activated, the AC units shall be shut-off.
- B. Desiccant Dehumidification units (Metering and Valve Vaults):
 1. When the unit's ON/OFF switch is in OFF position, the unit shall be off.
 2. When the switch is in ON position, the unit shall be controlled by factory furnished controls with in-built hygrometer and humidistat for space humidity control.
- C. Exhaust Fans (Metering and Valve Vaults):
 1. When the fan's ON/OFF switch (with timer) located at the entrance of the vault is in OFF position, the fan shall be off.
 2. When the switch is in ON position, the fan shall run till the timer setpoint.
- D. Electric Unit Heaters (Metering and Valve Vaults):
 1. The electric unit heaters shall be controlled by their own factory furnished thermostats.

3.08 FIRE ALARM INTERFACE

- A. This Contractor shall install wiring, associated conduit, fittings and pilot relays to shut down and start fans when initiated from the fire alarm panel. Division 16 Contractor shall provide a dry contact initiation signal near the fire alarm panel for use by this Contractor. There shall be one shutdown and one start signal provided for each fire compartment. The fire alarm panel start signal shall have the highest priority, the fire alarm panel shutdown signal shall have the next highest priority, followed by the starter hand-off-auto switch, and finally the normally sequenced start-stop command.
- B. Outside air ventilation damper control shall be overridden by the fire alarm panel. When a fire compartment is shutdown by the panel, all ventilation dampers within the compartment shall close. When a start signal is initiated by the alarm panel, all ventilation dampers within the compartment shall open.
- C. Each fire zone, Fire Alarm Riser and Schedule, constitutes a fire compartment.

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- D. Wiring shall meet Factory Mutual approval. Control shall not be through DDC system but shall be hard wired.

3.09 GENERAL

- A. Install end switches, relays, contactors, wiring, etc., to make a complete and operable system in accordance with the intent of this specification

+++ END OF SECTION 15950 +++

SECTION 16000
ELECTRICAL POWER AND SYSTEMS

PART 1 - GENERAL

1.01 SCOPE

- A. Work described in this Section includes furnishing all labor, materials, equipment, tools and incidentals required for a complete installation of all electrical power and systems. All equipment shall be installed, adjusted, tested and placed in operation in accordance with these Specifications, the manufacturer's recommendations and as shown on the Drawings.
- B. Contract drawings show only functional features and some of the required external connections. They do not show all components required for a complete installation nor exact dimensions particular to any manufacturer's equipment. Contractor shall supply all parts, devices and equipment necessary to meet the requirements of the Contract Documents and shall make all dimensional adjustments particular to the equipment being furnished. All costs associated with such changes and adjustments shall be considered as being included in the price bid for the Work shown and specified.

1.02 DEFINITIONS

- A. Provide: Furnish, install, and connect
- B. Product Data: Catalog cuts and descriptive literature
- C. Shop Drawings: Factory prepared specific to the installation
- D. Indicated: Shown on the Contract Drawings
- E. Noted: Indicated or specified elsewhere
- F. Control Diagram: A control diagram shows by means of graphic symbols, the electric connections and functions of a specific circuit arrangement. The control diagram facilitates tracing the circuit and its functions without regard to the actual physical size, shape, or location of the component devices or parts.
- G. One-Line Diagram: A one-line diagram shows by means of single lines and graphic symbols the course of an electric circuit or system of circuits and the components, devices, or parts used therein. Physical relationships are usually disregarded.
- H. Block Diagram: A block diagram is a diagram of a system, instrument, computer, or program which selected portions are represented by annotated boxes and interconnecting lines.
- I. Wiring Diagram: A wiring or connection diagram includes all the devices in a system and shows their physical relationship to each other including terminals and interconnecting wiring in an assembly. This diagram shall be a) in a form showing interconnecting wiring only by terminal designation (wireless diagram), or b) a panel layout drawing showing the physical location of devices plus the control diagram.
- J. Interconnection Diagram: Interconnection diagrams shall show all external connections between terminals of equipment and outside points, such as motors and auxiliary devices. References shall be shown to all connection diagrams which interface to the interconnection diagram. Interconnection diagrams shall be of the continuous line type. Bundled wires shall be shown as a single line with the direction of entry/exit of the

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individual wires clearly shown. Wireless diagrams and wire lists are not acceptable. Each wire identification as actually installed shall be shown. The wire identification for each end of the same wire shall be identical. All devices and equipment shall be identified. Terminal blocks shall be shown as actually installed and identified. All jumpers, shielding and grounding terminations not shown elsewhere shall be shown here. Signal and DC circuit polarities shall be shown. Spare wires shall be shown.

- K. Arrangement, Layout, or Outline Drawings: An arrangement, layout, or outline drawing is one which shows the physical space and mounting requirements of a piece of equipment. It may also indicate ventilation requirements or the location to which connections are to be made.

1.03 SUBMITTALS

- A. Submittals shall be made in accordance with the requirements of the General Conditions of the Contract Documents. In addition, the following specific information shall be provided:
1. Information required "for reference" such as product samples, similar unit test reports, and time current curves is for the purpose of determining the suitability of a product, selecting breaker settings, etc. This information is to be submitted at the same time as approval data; however, this information will not be returned and stamped approval is not required prior to installation.
 2. Except as noted, installation instructions are not required to be submitted. However, it is the Contractor's responsibility to obtain installation information from the manufacturer for all equipment prior to installing the equipment.
 3. Interconnecting diagrams depicting all cable requirements together with actual terminations as specified under paragraph 1600-1.02J.

1.04 QUALITY ASSURANCE

- A. Provide complete electrical installation in accordance with the National Electrical Code (NFPA 70), Life Safety Code (NFPA 101), and in accordance with applicable local codes. Obtain all necessary permits and have all work inspected by appropriate authorities.
- B. All products shall be designed, manufactured, and tested in accordance with industry standards. Where applicable, products shall be labeled or listed by third party certification agencies.
- C. Industry Standards: Standards organizations and their abbreviations, as used herein, are as follows. Applicable date for industry standards is that in effect on the date of advertisement of the project.
1. American National Standards Institute (ANSI).
 2. American Society for Testing and Materials (ASTM).
 3. Federal Specifications (FS).
 4. Institute of Electrical and Electronics Engineers (IEEE).

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5. Insulated Cable Engineers Association (ICEA).
6. National Electrical Manufacturers Association (NEMA).
7. National Fire Protection Association (NFPA).
8. Underwriters Laboratories, Inc. (UL).
9. National Electrical Testing Association (NETA).

1.05 WORK PROVIDED OUTSIDE THIS CONTRACT

- A. New power service from Georgia Power Company.

1.06 WORK INCLUDED IN DIVISION 16, ELECTRICAL

- A. Electrical power and systems.
- B. Basic materials and methods.
- C. Conduit.
- D. Conductors.
- E. Boxes.
- F. Wiring devices.
- G. Electric motors.
- H. Cabinets and enclosure.
- I. Instrument transformers and meters.
- J. Dry type transformers.
- K. Panelboards.
- L. Acceptance testing and calibration.

1.07 MATERIALS AND EQUIPMENT FURNISHED AND INSTALLED UNDER OTHER DIVISIONS WITH RACEWAY AND ELECTRICAL CONDUCTORS FURNISHED, INSTALLED, AND CONNECTED UNDER DIVISION 16, ELECTRICAL

- A. Equipment, Instrumentation and control system components indicated on the Drawings by filled circumscribed diamond symbol.

1.08 INTENT OF DRAWINGS

- A. Electrical plan drawings show only general locations of equipment, devices, and raceway, unless specifically dimensioned. The Contractor shall be responsible for proper routing of raceway, subject to the approval of Engineer.

1.09 ELECTRICAL NUMBERING SYSTEM

- A. Raceway Numbers:
 1. Raceways shall be tagged at all terminations. Where raceway numbers have not been assigned, Contractor shall assign raceway numbers in accordance with the following system:

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Raceway Prefix	Type of Function
C	Control and/or 120V or less power
H	Power above 600V
N	Pneumatic tubing
P	Power 208V to 600V
S	Low level signal (less than 90 volt communication or less than 30 volt instrumentation)
X	Spare

2. Prefixes shall be followed by a 5-digit equipment number. Where there is more than one raceway to a particular equipment, a letter suffix is added to distinguish the raceways.

3. Example:

Raceway number = P31109A
31109 = unique 5-digit equipment number
A = Letter to distinguish from other raceways to same equipment

B. Conductor Numbers:

1. Conductors shall be identified with numbers at both ends. Conductor tag numbers shall consist of the 5-digit equipment number followed by a dash followed by the conductor number specified on the control diagram.

2. Example:

Tag number = 19000-L1
Where:
19000 = Cable number
L1 = Conductor number

3. Conductors which are in parallel or in series between equipment shall have the same conductor number. Neutral conductors shall have the same conductor number. Wherever possible, the conductor shall be the same as the terminal to which it connects.
4. When factory-wired equipment has terminal numbers different than the conductor number shown on the control diagram, both shall be shown on the interconnection diagram, and a copy of the interconnection diagram shall be fastened to the inside of the equipment cabinet.

1.11 DELIVERY, STORAGE, AND HANDLING

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- A. Ship products to the job site in their original packaging. Receive and store products in a suitable manner to prevent damage or deterioration. Keep equipment upright at all times.
- B. Investigate the spaces through which equipment must pass to reach its final destination. Coordinate with the manufacturer to arrange delivery at the proper stage of construction and to provide shipping splits where necessary.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Provide only new products of the manufacturer's latest design.
- B. Equipment shall be applied only within its rating. Equipment ratings shown are minimums. Voltage and current ratings shall be as required to adequately power the connected equipment. Fault current ratings shall be as shown for the particular item or for the next upstream device that has a fault current rating shown.
- C. The following areas are classified hazardous:
 - 1. Head works.
 - 2. All sump pits.
- D. The following areas are classified as corrosive:
 - 1. Primary sludge pumping stations.
 - 2. Mixed liquor channel.
 - 3. Mixed liquor pumping station.
 - 4. Aerated tanks.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Maintain continuity of electric service to all portions of the process or buildings at all times. Temporary outages will be permitted during cutover work at such times and places as can be prearranged with Engineer and the electric utility company providing service to the facility. Such outages shall be kept to a minimum number and minimum length of time. Make no outages without prior written authorization of the Engineer. Include all costs for temporary wiring and overtime work required in the Contract price. Remove all temporary wiring at the completion of the work.
- B. Wherever the requirements of the Specifications or Drawings exceed those of the above items, the requirements of the Specifications or Drawings govern. Code compliance is

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- mandatory. Construe nothing in the Contract Documents as permitting work not in compliance with these codes.
- C. Unless otherwise indicated, all material required to be removed and salvaged shall become the property of the City.
 - D. Carefully modify existing electrical equipment, as necessary to carry out proposed changes. Rehabilitate and relocate items of equipment as required and as indicated or specified.

3.02 CERTIFICATION AND TESTS

- A. Prior to request for final review, test all systems and repair or replace all defective work. Submit, with request for final review, written certification that all electrical systems are complete and operational.
- B. At the time of final review of electrical work, demonstrate the operation of electrical systems. Furnish labor, apparatus and equipment for systems' demonstration.
- C. After final review and acceptance, turn over to the Engineer all keys for electrical equipment locks. Present to the City's designated representatives, demonstrations and oral instructions for proper operation and maintenance of the electrical equipment and systems.

+++END OF SECTION 16000+++

**SECTION 16050
BASIC ELECTRICAL MATERIAL AND METHODS**

PART 1 - GENERAL

1.01 SCOPE

- A. This Section covers basic materials and methods not included in other Sections of Division 16.

1.02 SUBMITTALS

- A. Submittals shall be made in accordance with the requirements of the General Conditions of the Contract Documents.

PART 2 - PRODUCTS

2.01 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 for fractional sizes.
- B. Magnetic Starters: NEMA ICS-2 Type A; NEMA size 1 minimum; magnetically held contactor with field replaceable coil and contacts; bimetallic or melting alloy overload relay, manually reset. Starters shall be rated and sized in accordance with NEMA size designations; fractional sizes and ratings per IEC recommendations are not acceptable.
- C. Magnetic Starter Controls: All controls, unless otherwise noted or shown, shall be 120 volts. Equip each starter with a control power transformer fused on the primary and secondary. Provide starter and overload relay auxiliary contacts for red run light, green stop light and amber overload light on the enclosure door. Provide one (1) spare normally open starter auxiliary contact, and door mounted start-stop pushbuttons or hand-off-auto selector switch and other controls as indicated.
- D. Combination Starters: Molded case circuit breaker rated 42,000 amps.
- E. Acceptable Manufacturers: General Electric, Square D, Allen Bradley, Siemens, Westinghouse or equal.

2.02 FUSES

- A. Fuses: Current limiting, non-renewable type, rated 200,000 AIC, with rejection feature; Class RK-5 for motors and transformers for ratings 600 amp and below and Class L for feeders rated 601 amp and above.
- B. Acceptable Manufacturers: Bussmann, Brush, Littelfuse or equal.

2.03 TERMINAL JUNCTION BOXES (TJB)

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- A. Provide hinged-cover terminal junction boxes of the required type and size where indicated. Utilize enclosures as required in 16000-2.01. Provide terminal blocks with a separate connection point for each conductor entering or leaving the box. Provide metal back plate for mounted terminal blocks. Provide 20 percent spare terminal points. Paint interior surfaces with white enamel or lacquer.

2.04 PUSHBUTTONS, INDICATING LIGHTS, AND SELECTOR SWITCHES

- A. For nonhazardous, indoor, dry locations, including motor control centers, control panels, and individual stations, provide heavy-duty, oiltight type pushbuttons, indicating lights, selector switches, and stations for these devices. Utilize General Electric Type CR 104P, or equivalent by Square D, Cutler-Hammer, or equal.
- B. For nonhazardous, outdoor, or normally wet locations, or where otherwise indicated, provide heavy-duty corrosion resistant, watertight type pushbuttons, indicating lights, or selector switches mounted in NEMA 4X stainless steel (316) enclosures. Provide special gasketing required to make complete station watertight. Utilize Square D Type SK, General Electric, Cutler-Hammer, or equal.
- C. Provide devices meeting the requirements of NEMA ICS 2, and having individual, extra large nameplates indicating their specific function. Provide pushbutton stations with laminated plastic nameplates indicating the drive they control. Provide contacts with NEMA designation rating A600.
- D. Utilize selector switches having standard operating levers. Make all indicating lights push-to-test type. Provide ON or START pushbuttons colored black. Provide OFF or STOP pushbuttons colored red.

2.05 TERMINAL BLOCKS 0 TO 600 VOLTS

- A. Provide 600-volt terminal blocks for termination of all control circuits entering or leaving equipment, panels, or boxes. Provide screw clamp compression, dead front barrier type terminal blocks with current bar providing direct contact with wire between the compression screw and yoke. Provide yoke, current bar, and clamping screws constructed of high strength and high conductivity metal. Utilize yoke that guides all strands of wire into the terminal. Utilize current bar providing dependable vibration-proof connection. Supply terminals constructed to allow connection of wire without any special preparation other than stripping. Rail mount individual terminals to create a complete assembly and provide terminals constructed such that jumpers can be installed with no loss of space on terminal or rail.
- B. Size all terminal block components to allow insertion of all necessary wire sizes and types. Supply terminal blocks with marking system allowing the use of preprinted or field-marked tags. Supply CSA certified and UL approved terminal blocks manufactured by Weidmuller, Ideal, Electrovert, or equal.

2.06 CONTROL RELAYS

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- A. Provide magnetic control relays, NEMA Class A600 (600 volts, 10 amps continuous, 7,200VA make, 720VA break), industrial control type with field convertible contacts, and meeting the requirements of NEMA ICS 2. Provide General Electric Type CR120B, Cutler-Hammer Type M-600, or equal.
- B. Where time delay relays are specified or required, unless otherwise noted, provide magnetic control relays with a timer attachment adjustable from 0.2 to 60 seconds (minimum) and field convertible from ON delay to OFF delay and vice-versa.
- C. Where latching (mechanically held) relays or motor thermal detector relays are specified, provide magnetic control relays with mechanical latch attachment with unlatching coil and coil clearing contacts. Utilize an attachment allowing 01 easy manual latching and unlatching.

2.07 ELAPSED TIME METERS

- A. Provide synchronous-motor-driven, elapsed time meters, to 99,999.9 hours range, nonreset type, suitable for semiflush, panel mounting. Provide General Electric Type 240, 2-1/2-inch Big Look unit, Eagle Signal Bulletin 705 unit, or equal.

2.08 CIRCUIT BREAKERS, INDIVIDUAL, 0 TO 600 VOLTS:

- A. Mount individual circuit breakers complying with requirements for circuit breakers in this section in enclosure required for the location, unless otherwise indicated. Provide circuit breakers with handles that can be locked in the OFF position. Interlock enclosure and circuit breaker to prevent opening the cover with the circuit breaker in the ON position.

2.09 CIRCUIT BREAKERS, 0 TO 600 VOLTS

- A. General: Provide circuit breakers of the indicating type showing ON/OFF and TRIPPED positions of the operating handle. Do not use single-pole circuit breakers with handle ties where multipole circuit breakers are indicated. Utilize multipole circuit breakers designed so that an overload on one pole automatically causes all poles to open. Provide circuit breakers meeting the requirements of NEMA AB 1. Circuit breakers shall have a minimum interrupting rating equal to the maximum fault current available at the point of application or they shall be part of an assembly with an integrated equipment short circuit rating at least as great as the fault current available at the point of application. Where circuit breakers are used as service entrance equipment, provide units UL labeled for that use. Provide circuit breakers suitable for use with 75 degrees C wire at full NEC 75 degrees C ampacity.
- B. Inverse Time Type:
 - 1. Provide thermal-magnetic circuit breaker, unless otherwise shown, for one- and two-pole breakers, breakers operating- at 240V or less, and three-pole branch circuit breakers operating at 480V.
 - 2. Provide solid state trip circuit breakers with an adjustable short-time function, unless another type breaker is required for coordination, or otherwise indicated on the Drawings, for three-pole, 480V feeder circuit breakers with not more than

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one downstream, 480V, overcurrent protective device, excluding protective devices provided as part of a process equipment package. Such breakers shall be Westinghouse Seltronic Circuit Breakers, Square D, Type ME or PE Circuit Breakers, or equal.

3. Provide solid-state trip circuit breakers with at least the following adjustment: long time pickup, long time delay, short time pickup, short time delay, I-squared t, for circuit breakers not covered by either of the above cases. Such breakers shall be General Electrical Circuit Breakers with Microversatrip; Westinghouse Circuit Breakers with Digitrip; or equal.

- C. Instantaneous Only Type: Instantaneous only circuit breakers shall have only an instantaneous trip element. The breakers shall be used only as part of a listed combination motor starter. Instantaneous only breakers shall be sized with a continuous rating of at least 115 percent of the full-load current of the motor served. The trip setting shall be continuously adjustable from a lowest setting of not more than 700 percent to a highest setting of not less than 1,300 percent of the motor full-load current. Instantaneous only breakers shall be General Electric Mag-Break; Westinghouse MCP; Square D Mag-Guard; or equal.

2.10 SUPPORTING DEVICES

- A. Support Channel: Fiberglass, according to 16000-2.01
- B. Hardware: Stainless steel, according to 16000-2.01.

2.12 ELECTRICAL IDENTIFICATION

- A. Nameplates: Engraved three-layer laminated plastic, black letters on white background.
- B. Wire and Cable Markers: Plastic, split sleeve or tubing type.

2.13 PLYWOOD BACKBOARDS

- A. Backboards: Grade BC plywood, 3/4-inch thick. Paint with two coats of flat black paint.

PART 3 - EXECUTION

3.01 INDIVIDUAL MOTOR STARTERS

- A. Select and install heater elements in motor starters to match installed motor characteristics. Do not use NEC motor full load ampere data for heater selection.
- B. Provide a typed label inside each motor starter enclosure door identifying the motor served and listing the motor nameplate data. Provide an engraved nameplate on the exterior of the enclosure door identifying the motor served, the horsepower, voltage, and phase rating.
- C. Enclosure type, unless otherwise indicated, enclosures shall be according to Section 16000-2.01.

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- D. Install starters so they are rigidly supported and readily accessible. Where mounted on stud walls, provide a non-flammable backboard secured to the studs with the starter secured to the backboard. Provide stainless steel mounting channel or phenolic spacers to give nominal ½ inch separation from concrete walls in wet or damp locations.

3.02 FUSES

- A. Equip all fusible devices with fuses. Replace all blown fuses up to final acceptance of the Project. At the completion of the Project, turn over to the Owner spare fuses for each type and size installed; six each for ratings 60 amps and below, and three each for ratings above 60 amps.

3.03 TERMINAL JUNCTION BOXES (TJB)

- A. Install in accordance with all the requirements detailed under Section 16130, BOXES. Label each block and terminal with a permanently attached, nondestructible tag.

3.04 SUPPORTING DEVICES

- A. Fasten hanger rods, support stands, conduit clamps, etc. to building structure using approved material.
- B. Do not fasten supports to piping, ductwork, mechanical equipment, or conduit. Do not use powder actuated fastening devices. Do not drill structural steel members.

3.05 ELECTRICAL IDENTIFICATION

- A. Provide nameplates for all switchboards, panelboards, transformers, disconnect switches, individual motor starters, and other items of electrical distribution equipment. Engrave with the equipment identification as indicated, and the voltage rating. Attach nameplates with screws or rivets; adhesives are not acceptable.

+++ END OF SECTION 16050 +++

**SECTION 16060
GROUNDING AND BONDING**

PART 1 - GENERAL

1.01 SCOPE

- A. This Section includes grounding of electrical systems and equipment and basic requirements for grounding for protection of life, equipment, circuits, and systems. Grounding requirements specified in this Section may be supplemented in other Sections of these Specifications.
- B. Documents and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- C. Related Sections include but are not limited to:
 - 1. Section 01300 – Submittals.
 - 2. Section 02222 – Excavation, Trenching and Backfill.
 - 3. Section 16120 – Wire and Cable (600V).

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. American Society for Testing and Materials (ASTM).
 - a. ASTM B3 – Specification for Soft or Annealed Copper Wire.
 - b. ASTM B8 – Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.
 - c. ASTM B33 – Specification for Tinned Soft or Annealed Copper Wire for Electrical Purposes.
 - 2. National Electrical Code (NEC).
 - a. NEC – National Electrical Code.
 - 3. Underwriters Laboratories Inc. (UL).
 - a. UL 467 – Standard Grounding and Bonding Equipment.
 - b. UL 486A and UL 486B – Standard Wire Connectors.
 - 4. National Fire Protection Association (NFPA).
 - a. NFPA 70 – National Electrical Code.

1.03 SUBMITTALS

- A. General: Submit each item in this Article according to the requirements of Section 01300 - Submittals.

- B. Product Data for grounding rods, connectors and connection materials, and grounding fittings.
- C. Qualification data for firms and persons specified in the “Quality Assurance” Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.
- D. Field tests and observation reports certified by the testing organization and indicating and interpreting the test reports for compliance with performance requirements.

1.04 QUALITY ASSURANCE

- A. Testing Agency Qualifications: A “Nationally Recognized Testing Laboratory” (NRTL) as defined in OSHA Regulation 1910.7, or a full member company of the international Electrical Testing Association (NETA).
 - 1. Testing Agency Field Supervision: Use persons currently certified by NETA or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3 of this Section.
- B. Comply with NFPA 70.
- C. Comply with UL 467.
- D. Listing and Labeling: Provide products specified in this Section that are UL listed and labeled.
 - 1. The Terms “Listed” and “Labeled”: As defined in the National Electrical Code, Article 100.
- E. See Also Spec 16010 – General Electrical Requirements, Part 1 for listing of applicable reference standards.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Acceptable Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Apache Grounding; Nashville Wire Products.
 - 2. Chance: A. B. Chance Co.
 - 3. Erico Products- Cadweld.
 - 4. Burndy Co.
 - 5. Fushi Int.- Copperweld
 - 6. Continental Industries – Thermoweld.

7. Heary Brothers Lightning Protection Co.
8. Ideal Industries, Inc.
9. Kearney.
10. Lightning Master Corp.
11. O-Z/Gedney Co.
12. Thomas & Betts, Electrical.
13. Or approved equal.

2.02 GROUNDING AND BONDING PRODUCTS

- A. Governing Requirements: Where types, sizes, ratings, and quantities indicated are in excess of National Electrical Code (NEC) requirements, the more stringent requirement and the greater size, rating, and quantity indications shown shall be adhered.

2.03 WIRE AND CABLE GROUNDING CONDUCTORS

- A. Comply with Section 16120 - Wire and Cable (600V). Conform to NEC Table 8, except as otherwise indicated, for conductor properties, including stranding.
- B. Equipment Grounding Conductors: Insulated with green color insulation.
- C. Grounding-Electrode Conductors: Stranded copper cable.
- D. Underground Conductors: Bare, tinned, stranded copper except as otherwise indicated.
- E. Bare Copper Conductors: Conform to the following:
 1. Solid Conductors: ASTM B 3.
 2. Assembly of Stranded conductors: ASTM B 8.
 3. Tinned Conductors: ASTM B 33.

2.04 MISCELLANEOUS CONDUCTORS

- A. Grounding Bus: Bare, annealed-copper bars of rectangular cross section.
- B. Braided Bonding Jumpers: Copper tape, braided No. 3/0 AWG bare copper wire, terminated with copper ferrules.
- C. Bonding straps: Soft copper, 0.05-inch thick and 2-inches wide, except as indicated.

2.05 GROUNDING PRODUCTS

- A. Pressure connectors: High-conductivity-plated units.
- B. Bolted Clamps: Heavy-duty type.

- C. Exothermic-Welded Connections: Provided in kit form and selected per manufacturer's written instructions for specific types, sizes, and combination of conductors and connected items.

2.06 GROUNDING ELECTRODES AND TEST WELLS

- A. Grounding Rods: Copper-clad steel.
 - 1. Size: 3/4-inch by 120-inches.
- B. Test Wells: Grounding rod, as above, driven through drilled hole in bottom of handhole. Handhole minimum size 12-inch x 1-inch x12-inch with cover. See 3.02 below.

PART 3 - EXECUTION

3.01 APPLICATION

- A. Equipment grounding Conductors: Comply with NEC Article 250 for types, sizes, and quantities of equipment grounding conductors, except where specific types, larger sizes, or more conductors than required by NEC are indicated.
 - 1. Install equipment grounding conductor with circuit conductors for the items below in addition to those required by Code:
 - a. Feeders and branch circuits.
 - b. Lighting circuits.
 - c. Receptacle circuits.
 - d. Single-phase motor or appliance branch circuits.
 - e. Three-phase motor or appliance branch circuits.
 - f. Flexible raceway runs.
 - 2. Metallic Raceways: Raceways, conduits and cable trays, etc. shall be made electrically and mechanically continuous, and shall be bonded/ grounded to earth. Utilize jumpers, clamps, etc. as necessary to meet requirements for NEC. Install a grounding conductor in each metallic raceway, conduit and cable tray.
 - 3. Nonmetallic Raceways: Install a grounding conductor in nonmetallic raceways unless they are designated for telephone or data cables.
 - 4. Air-Duct Equipment Circuits: Install a grounding conductor to duct mounted electrical devices operating at 120 V and above, including air cleaners and heaters. Bond conductor to each unit and to air duct.
 - 5. Water Heater, Heat-Tracing, and Antifrost Heater Circuits: Install a separate grounding conductor to each electric water heater, heat-tracing assembly, and antifrost heating cable. Bond conductor to heater units, piping, connected equipment, and components.
- B. Signal and Communication Systems: For telephone, alarm, voice and data, and other communication systems, provide a No. 4 AWG minimum insulated grounding conductor

in raceway from grounding-electrode system to each service location, backboard, terminal cabinet, wiring closet, and central equipment location.

1. Service and Central Equipment Locations and wiring Closets: Terminate grounding conductor on a 1/4-inch x 2-inch x 12-inch grounding.
 2. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.
- C. Separately Derived Systems: Where NEC requires grounding, ground according to NEC.
- D. Metal Poles Supporting Exterior Lighting Fixtures: Ground pole to a grounding electrode in addition to separate equipment grounding conductor run with supply branch circuit.
- E. Grounding and Bonding for Piping and Metallic Parts:
1. Ground and bond piping to meet NEC and requirement of local Authority Having Jurisdiction.
 2. Ground and bond metallic structures, supports, fences, handrails, misc. metallic parts and similar items which are in proximity to electrical equipment, conduit and wiring and which are likely to become electrified upon fault or short of the electrical equipment, conduit or wiring.
- F. Grounding and Bonding Metal Air Ducts: Ground and Bond metal air ducts to equipment grounding conductors of associated fans, blowers, heaters and air cleaners. Install tinned bonding jumper to bond across flexible duct connections to achieve continuity.

3.02 INSTALLATION

- A. General: Ground electrical systems and equipment according to NEC requirements, except where Drawings or Specifications exceed NEC requirements.
- B. Grounding Electrode System: Where available on the premises, at each building or structure served, a metal underground water pipe, the metal frame of the building or structure, concrete encased electrodes, any ground ring encircling the building or structure and all made electrodes (ground rods, etc.) shall be bonded together to form the grounding electrode system. The main bonding jumper and the grounding electrode conductor shall be installed and sized per NEC except where larger sizes than required by NEC are indicated.
- C. Electrical Room Grounding Bus: Space 1-inch from wall and support from wall 6-inches above finished floor, except as otherwise indicated.
- D. Grounding Rods: A minimum of two (2) ground rods shall be installed where the ground rod serves as the grounding electrode per NEC. Locate a minimum of 1-rod length from each other and at least the same distance from any other grounding electrode.
1. Drive until tops are 2-inches below finished floor or final grade, except as otherwise indicated.

2. Interconnect with grounding-electrode conductors. Except at test wells and as otherwise indicated, use exothermic welds. Make these connections without damaging copper coating or exposing steel.
- E. Grounding Conductors: Route along the shortest and straightest paths possible, except as otherwise indicated. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- F. Underground Grounding Conductors: Use bare, soft-drawn copper wire: Bury at least 30-inches below ground.
- G. Metal Water Service Pipe: Provide insulated copper grounding conductors, sized as indicated, 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 by grounding-clamp connectors. Where a dielectric main water fitting is installed, connect grounding conductor to street side of fitting. Do not install a grounding jumper across dielectric fittings. Bond grounding-conductor conduit at each end.
- H. Test Wells: Minimum of two at each building/ structure ground loop, except as otherwise indicated. Set top of well flush with finished grade or floor. Fill with 1-inch maximum-size crushed stone or gravel.

3.03 CONNECTIONS

- A. General: Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.
 1. Use electroplated or tin-coated materials to assure high conductivity and to make contact points closer in order of galvanic series.
 2. Make connections with clean, bare metal at points of contact.
 3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
 4. Make aluminum-to-galvanized steel with tin-plated copper jumpers and mechanical clamps.
 5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.
- B. Exothermic-Welded Connections: Use for connections to structural steel and for underground connections, except those at test wells. Comply with manufacturer written instructions. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.
- C. Equipment Grounding-Wire Terminations: For No. 8 AWG and larger, use pressure-type grounding lugs. No. 10 AWG and smaller grounding conductors may be terminated with winged pressure-type connectors.

- D. Non-contact metal Raceway Terminations: Where metallic raceways terminate at metal housings without mechanical and electrical connection to housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to grounding bus or terminal in housing. Bond electrically non-continuous conduits at both entrances and exits with the grounding conductors, except as otherwise indicated.
- E. Tighten screws and bolts for grounding and bonding connectors and terminals according to manufacturer's published torque-tightening values. Where these requirements are not available, use those specified in UL 486A and UL 486B.
- F. Compression-Type Connections: Use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Use tools and dies recommended by manufacturer of connectors. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on grounding conductor.
- G. Moisture Protection: Where insulated grounding conductors are connected to grounding rods or grounding buses, insulate entire area of connection and seal against moisture penetration of insulation and cable.

3.04 UNDERGROUND DISTRIBUTION SYSTEM GROUNDING

- A. Manholes and Handholes: Install a driven grounding rod close to wall and set rod depth so 4-inches will extend above finished floor. Where necessary, install grounding rod before manhole is placed and provide a No. 1/0 AWG bare copper conductor from grounding rod in to manhole through a waterproof sleeve in manhole wall. Protect grounding rods passing through concrete floor with a double wrapping of pressure-sensitive tape or heat-shrunk insulating sleeve from 2-inches above to 6-inches below concrete. Seal floor opening with waterproof, non-shrink grout.
- B. Connections to Manhole Components: Connect exposed metal parts, such as inserts, cable racks pulling irons, ladders, and cable shields within each manhole or handhole, to grounding rod or grounding conductor. Make connections with minimum No. 4 AWG stranded, hard-drawn copper wire. Train conductors plumb or level around corners and support to manhole walls. Connect to cable armor and cable shields as recommended by manufacturer of splicing and termination kits.
- C. Grounding System: Ground Pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes.

3.05 FIELD QUALITY CONTROL

- A. Testing Agency: Engage an electrical testing organization to perform tests described below.
- B. Test: Subject the completed grounding system to a megger test at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding

terminal, and at ground test wells. Measure ground resistance not less than 2 full days after the last trace of precipitation, and without the 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. Perform tests by the 2-point method according to IEEE 81

- C. Maximum grounding to resistance values are as follows:
 - 1. Equipment rated 500 KVA and Less: 10 ohms.
 - 2. Unfenced Substations and Pad-Mounted Equipment: 5 ohms.
 - 3. Manhole Grounds: 10 ohms.
- D. Excessive Ground Resistance: Where resistance to ground exceeds specified values, notify Owner promptly and include recommendations to reduce ground resistance and to accomplish recommended work.
- E. Report: Prepare test reports, certified by the testing organization, or ground resistance at each test location. Include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

3.06 ADJUSTING AND CLEANING

- A. Restore surface features, including vegetation, at areas disturbed by work in this Section. Reestablish original grades, except as otherwise indicated. Where sod has been removed, replace it as soon as possible after backfilling is completed. Restore areas disturbed by trenching, storing of dirt, cable laying, and other activities to their original condition. Include topsoil, fertilizer, lime, seed, sod, sprigs, and mulch. Comply with Section 02222 – Excavation, Trenching and Backfill. Maintain restored surface. Restore disturbed paving to the original condition.

+++ END OF SECTION 16060 +++

**SECTION 16110
RACEWAYS, BOXES, AND SUPPORTS**

PART 1 - GENERAL

1.01 SCOPE

This section covers the furnishing and installation of electrical conduits, wireways, pull boxes, manholes, handholes, cable trays, fittings and supports. Raceways shall be provided for lighting, receptacles, power, control, instrumentation, signaling and grounding systems.

1.02 REFERENCES

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 the listed documents, the requirements of this section shall prevail.

<u>Reference</u>	<u>Title</u>
ANSI	Rigid Steel Conduit-Zinc Coated
ANSI	Electrical Metallic Tubing-Zinc Coated
ASTM	Smooth-Wall Polyvinylchloride Conduit and Fittings for Underground Installation
FEDSPEC	Conduit, Metal, Rigid and Intermediate; and Coupling, Elbow, and Nipple, Electrical Conduit; Zinc Coated
FEDSPEC	Conduit and Conduit Fittings, Plastic, Rigid
NEMA	Industrial Control and Systems Enclosures
NEMA	Electrical Plastic Tubing (EPT) and Conduit (EPC 40 and EPC 80)
NEMA	PVC and ABS Plastic Utilities Duct for Underground Installation
NEMA	Cable Tray Systems

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NEMA	Enclosures for Electrical Equipment (1000 volts maximum)
NFPA 70	National Electrical Code (NEC)
UL	Flexible Metal Electrical Conduit
UL	Rigid Metal Electrical Conduit
UL	Liquid Tight Flexible Electrical Conduit
UL	Rigid Nonmetal Electrical Conduit
UL	Electrical Metallic Tubing

1.03 SUBMITTALS

The following information shall be provided in accordance with the General Conditions:

1. Manufacturer's descriptive literature for all materials.
2. 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. Check marks (☐) shall denote full compliance with a paragraph as a whole. 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. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications. 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(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.

PART 2 - PRODUCTS

2.01 BOXES AND FITTINGS

A. PULL BOXES AND WIRING GUTTERS:

Indoor boxes larger than FD boxes shall be constructed of sheet steel and galvanized after fabrication. Similar enclosures outdoors shall be provided with neoprene gaskets

on the hinged doors or removable covers. Box and gutter sizes, metal thickness, and grounding shall comply with the National Electrical Code. Bolt-on junction box covers 3 feet square or larger, or heavier than 25 pounds, shall have a rigid handle. Covers larger than 3 by 4 feet shall be split.

B. TERMINAL CABINETS:

Terminal cabinets located indoors shall be NEMA 12. Cabinets located outdoors and in corrosive areas shall be NEMA 4X. Cabinets shall be provided with hinged doors. Adjustable terminal strip mounting accessories shall be provided. Cabinets shall be provided with channel mounted terminal blocks.

C. MANHOLES:

Unless otherwise specified, manholes shall be precast concrete, 3000 psi strength at 28 days, with reinforcing and cover designed for H-20 bridge loading. Manhole dimensions shall be as indicated on the drawings. Necking and shaft shall have 36-inch minimum clear opening.

Manhole cover and frame shall be Class 30B grey cast iron per ASTM A48 with machine finished flat bearing surfaces. Manholes shall be watertight. Exterior walls of manholes shall be provided with 6 mils of waterproof membrane, Sonneborn HLM 5000 Series, or equal.

Duct entrees shall be no less than 14 inches above floor and below ceiling. Cable supports, clamps or racks shall be provided to support the cable at minimum 2-foot intervals. Concrete inserts shall be embedded in walls and ceiling. Floor shall slope 2 percent in all directions to a sump. Sump shall be a minimum of 18 by 18 by 12 inches deep.

Manhole walls shall be provided with boxouts with waterstops on all sides of each boxout. Waterstops shall be as specified in the Cast-in-Place Concrete section. Boxouts shall be sized to accommodate the penetrating underground duct banks.

D. HANDHOLES:

Handholes shall be precast concrete with checker plate, galvanized, traffic covers designed for H-20 loading. Dimensions shall be as specified on the drawings. Handholes shall be provided with precast solid concrete slab bottoms with sumps. Handholes shall be constructed of 3000 psi reinforced concrete. Handhole cover shall be engraved "ELECTRICAL" or "SIGNAL" as applicable.

Handhole walls shall be provided with boxouts, as specified for manholes.

2.02 RACEWAY SUPPORTS

A. CONDUIT SUPPORTS:

Hot-dip galvanized framing channel with end caps shall be provided to support groups of conduit. Individual conduit supports shall be one-hole galvanized malleable iron pipe straps used with galvanized clamp backs and nesting backs where required. Conduit supports for PVC coated rigid steel and PVC conduit systems shall be one-hole PVC coated rigid steel or clamps conduit wall hangers.

B. CEILING HANGERS:

Ceiling hangers shall be adjustable galvanized carbon steel rod hangers as specified. Straps or hangers of plumber's perforated tape are not acceptable. Unless otherwise specified, hanger rods shall be 1/2 inch all-thread rod and shall meet ASTM A193. Hanger rods in corrosive areas and those exposed to weather or moisture shall be stainless steel.

C. SUSPENDED RACEWAY SUPPORTS (RACKS):

Suspended raceway supports shall consist of concrete inserts, galvanized carbon steel rod hangers, and jamb nuts supporting hot-dip galvanized framing channel or lay-in pipe hangers as required. Hanger rods shall be 1/2 inch all-thread rod and shall meet ASTM A193, unless otherwise specified. All suspended raceway supports shall be braced at 30-foot intervals (alternating from one side to the other) to meet specified seismic requirements.

2.03 CONCRETE ENCASED DUCT BANKS

Concrete used for duct banks shall be Class F with red oxide added as specified in the Cast-in-Place Concrete section.

2.04 UNDERGROUND MARKING TAPE

Underground marking tape shall be for early warning protection of digging around reinforced concrete duct banks. Tape shall be low density polyethylene plastic, nominally 6 inches wide and 4-mil thickness. The plastic color shall be red. A warning shall be imprinted continuously along the length, with message reading similar to "CAUTION - STOP DIGGING - BURIED ELECTRIC LINE BELOW." Tape shall be Brady "Identoline"; Services and Materials "Buried Underground Tape"; Somerset (Thomas & Betts) "Protect-A-Line"; or equal.

Underground marking tape for directly buried cables and conduits shall be 6-inch-wide metallic lined tape with red polyethylene film on top and clear polyethylene

film on the bottom. The message shall be clearly printed with black over red tape and shall read "CAUTION ELECTRIC LINE BURIED BELOW".

2.05 NAMEPLATES

Nameplates shall be provided for all boxes in accordance with the requirements of Section 16000. Nameplate wording shall be as indicated on the drawings. Where no wording is specified, the Contractor shall provide the functional description of the device on the nameplate.

2.06 FIRESTOPS

Firestops and seals shall be Flamemastic 77, Vimasco No. 1-A, or equal, and shall be applied in accordance with manufacturer's recommendations. Products which are affected by water are not acceptable.

2.07 RACEWAY IDENTIFICATION

Raceway number tags shall conform to the requirements of raceway markers, Section 16000.

PART 3 - EXECUTION

3.01 CONDUIT

A. GENERAL:

The number of directional changes of a conduit shall be limited to 270 degrees in any run between pull boxes.

Conduit runs shall be limited to a maximum of 400 feet between pull boxes, less 100 feet or fraction thereof, for every 90 degrees of change in direction.

B. INDOOR AND OUTDOOR CONDUIT SYSTEMS:

In general, conduit inside structures shall be concealed unless otherwise specified or indicated on the drawings. No conduit shall be exposed in water chambers unless so indicated on the drawings.

Unless otherwise indicated on the drawings, the Contractor shall be responsible for determining conduit routing that conforms to the installation requirements set forth herein.

Conduit installation shall conform to the following:

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1. Exposed conduit shall be installed either parallel or perpendicular to structural members and surfaces.
2. Two or more exposed conduits in the same general routing shall be in parallel with symmetrical bends.
3. Exposed conduit shall be run on supports spaced not more than 10 feet apart.
4. Where three or more conduits are located in parallel run, they shall be spaced out from the wall using framing channel.
5. Conduits support systems shall comply with the requirements of Section 16000.
6. Conduit rack supports shall be secured to concrete walls and ceilings by means of cast-in-place anchors or framing channel concrete inserts.
7. Conduits shall be at least 6 inches from high temperature piping, ducts, and flues with temperatures higher than 90 degrees C.
8. Conduits shall be installed between the reinforcing steel in walls or slabs which have reinforcing in both faces. In slabs which have only a single layer of reinforcing steel, conduits shall be placed under the reinforcement.
9. Conduit shall be routed clear of structural openings and indicated future openings.
10. Conduits through roofs or metal walls shall be flashed and sealed watertight.
11. Conduit shall be neatly grouted into any openings cut into concrete and masonry structures.
12. Conduits shall be capped during construction to prevent entrance of dirt, trash, and water.
13. Exposed conduit stubs for future use shall be terminated with galvanized pipe caps.
14. Concealed conduit stub-up locations shall be determined from the manufacturer's shop drawings.
15. Concealed conduit for future use shall be terminated in equipment or by galvanized couplings plugged flush with structural surfaces.

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16. Where the drawings indicate future duplication of equipment wired hereunder, concealed portions of conduits for future equipment shall be provided.
17. Conduit installed horizontally shall allow headroom of at least 7 feet except where it may be installed along structures, piping, and equipment, or in other areas where headroom cannot be maintained because of other considerations.
18. All conduits that enter enclosures shall be terminated by fittings which ensure that the NEMA rating of the enclosure is not affected or changed.
19. Underground metallic or nonmetallic conduit which turns out of concrete, masonry or earth shall be connected to a 90-degree elbow of PVC-coated rigid steel conduit before emergence.
20. Conduit across structural joints where structural movement is allowed shall have an O-Z "Type DX" or Crouse-Hinds "Type XD," bonded, weathertight expansion and deflection fitting of that conduit size.

C. UNDERGROUND CONDUIT SYSTEM:

All excavation, backfilling, and concrete work shall conform to respective sections of these specifications. Underground conduit shall conform to the following requirements:

1. All underground conduits not indicated otherwise on the drawings shall be concrete encased. All concrete encasement shall be reinforced.
2. Concrete encased conduit shall have minimum concrete thicknesses of 3 inches between conduits, 1 inch between conduit and reinforcing, and 3 inches over reinforcing.
3. Concrete encasement on exposed outdoor conduit risers shall continue to 3 inches above grade, with top crowned and edges chamfered.
4. Underground conduit bend radius shall be not less than 2 feet minimum at vertical risers nor less than 3 feet elsewhere.
5. Where conduit and concrete encasement are terminated underground, the conduit and reinforcing shall both extend at least 2 feet past the concrete. Conduits shall be capped and threads shall be protected. All steel surfaces shall be given two coats of thixotropic coal tar paint.
6. Underground conduits and conduit banks shall have 2 feet minimum earth cover except where indicated otherwise.

7. Underground conduit banks through building walls shall be cast in place or concreted into boxouts with waterstops on all sides of the boxout. Waterstops shall be as specified in the Cast-in-Place Concrete section.
8. Conduits not encased in concrete and passing through walls which have one side in contact with earth shall be sealed watertight with special rubber gasketed sleeve and joint assemblies or with sleeves and modular rubber sealing elements.
9. Conduits shall be thoroughly swabbed on the inside, immediately upon completion of pouring concrete. After the concrete has set, and before backfilling, a mandrel having a diameter equal to the nominal conduit inside diameter minus 1/2 inch, and not less than 4 inches long, shall be pulled through each conduit. If the mandrel showed signs of protrusions on the inside of the conduit, the conduit shall be repaired or replaced.
10. All spare raceways shall be provided with a nylon pull rope.

D. SEALING OF CONDUIT:

Conduits passing from a hazardous or corrosive area into a nonhazardous or noncorrosive area, or between Class 1, Division 1 area and Class 1, Division 2 area shall be provided with a sealing fitting which shall be located at the boundary in accordance with NEC.

Seal fittings for conduit systems in hazardous atmosphere locations shall be hot-dip galvanized cast ferrous alloy. Sealing compound shall be hard type, UL listed for explosion proof sealing fittings. Sealing compound shall be nonhardening type for corrosive areas. Seal fitting and sealing compound shall be as manufactured by Appleton, Crouse-Hinds, or equal.

3.02 MANHOLES AND HANDHOLES

Unless otherwise specified, manhole and handhole installation shall be as follows:

1. Manholes and handholes shall be set on a minimum of 6 inches of crushed rock on top of undisturbed or compacted earth.
2. Manholes and handholes shall be set plumb, so that water shall drain properly to the sump.
3. Manhole covers, unless otherwise specified, shall be set at 1 to 2 inches above finish grade with surrounding pavement sloping away from the manhole cover.

4. All metallic hardware inside manholes and handholes shall be grounded by connection to the ground plate. Connections shall be made using bolted connections, bonding jumpers and grounding bushings.

3.03 CABLE TRAY

Unless otherwise specified, cable tray installation shall be as follows:

1. Cable trays shall be supported at intervals not to exceed 5 feet.
2. Corners shall be supported by two supports installed as close as possible to the corner, with one support on each side of the corner.
3. All field cuts shall be treated with zinc rich paint.
4. Expansion joint splice plates shall be used to allow 1 1/2-inch free movement between adjacent trays when crossing building expansion joint.
5. Cable tray shall have minimum clearance of 3/4 inch from concrete surfaces and minimum spacing of 12 inches from other trays. The top of the tray shall be minimum 9 inches from the ceiling.
6. Signal cable trays shall be provided with covers. Covers shall be solid or louvered type.
7. Each cable tray shall be provided with No. 2/0 AWG minimum bare copper equipment ground conductor. The ground conductor shall be attached to the outside of each tray section using UL Listed bolted bronze or brass ground clamp.
8. Power cables shall be placed in cable trays not more than two layers deep.
9. Cables shall be arranged in trays so as to provide minimum cross-over.

3.04 RACEWAY NUMBERING

Each conduit shall be provided with a number tag at each end and in each manhole and/or pull box. Trays shall be identified by stencils at intervals not exceeding 50 feet, at intersections, and at each end.

3.05 RACEWAY SCHEDULE

A. GENERAL:

The Raceway Schedule is on the drawings.

B. UNSCHEDULED RACEWAY:

With the exception of lighting, communication, paging, fire alarm, security and receptacle circuits, the type and size of raceway shall be as specified on the drawings or schedules. Lighting and receptacle raceway are unscheduled and shall be sized by the Contractor in accordance with the NEC. Minimum size shall be 3/4 inch for exposed and 1 inch for embedded raceway.

The number and size of communication, paging, fire alarm, and security raceways shall be as required for the particular equipment provided subject to the minimum sizes specified above.

+++END OF SECTION 16110+++

**SECTION 16111
CONDUIT**

PART 1 - GENERAL

1.01 SCOPE

- A. Work described in this Section includes furnishing all labor, materials, equipment, tools and incidentals required for a complete and operable installation of conduit, including rigid metal conduit and fittings, flexible metal conduit and fittings, liquidtight flexible metal conduit and fittings, non-metallic conduit and fittings, explosion proof flexible steel conduit, manholes, handholes and ductbanks. All conduit shall be installed, adjusted, tested and placed in operation in accordance with these Specifications, the manufacturer's recommendations and as shown on the Drawings.

- B. Contract drawings show only functional features and some of the required external connections. They do not show all components required for a complete installation nor exact dimensions particular to any manufacturer's equipment. Contractor shall supply all parts, devices and equipment necessary to meet the requirements of the Contract Documents and shall make all dimensional adjustments particular to the equipment being furnished. All costs associated with such changes and adjustments shall be considered as being included in the price bid for the work shown and specified.

1.02 SUBMITTALS

- A. Submittals shall be made in accordance with the requirements of the General Conditions of the Contract Documents. In addition, the following specific information shall be provided:
 - 1. Equipment data specified in this Section.
 - 2. Catalog cuts.

1.03 QUALITY ASSURANCE

- A. Reference Standards. Comply with all Federal and State laws or ordinances, as well as all applicable codes, standards, regulations and/or regulatory agency requirements including the partial listing below:
 - 1. ANSI C80.1
 - 2. ASTM F 512
 - 3. Fed Spec WW-C-581E
 - 4. Fed Spec WW-C-1094A
 - 5. NEMA TC2
 - 6. NEMA TC6
 - 7. NFPA 70
 - 8. UL 1
 - 9. UL 6

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- 10. UL 360
- 11. UL 651

1.04 QUALITY STANDARDS

- A. All products covered by these specifications shall be in conformance with NEMA standards, and shall be UL approved.
- B. Manufacturers offering products that comply with these specifications include:
 - 1. Conduit: Allied, Republic, Triangle, Wheatland or equal.
 - 2. PVC Coated Conduit: Permacote, Robroy or equal.
 - 3. PVC Conduit: Amoco, Carlon, Certainteed or equal.
 - 4. Flexible Conduit: Anamet, Columbia, Electrilex or equal.
 - 5. Fittings: Appleton, Crouse-Hinds, Thomas & Betts or equal.

PART 2 - PRODUCTS

2.01 GENERAL

- A. The type and size of raceway shall be as specified on the Drawings or schedules. Lighting and receptacle raceways are not scheduled and shall be sized by the Contractor in accordance with the NEC. Minimum size shall be ¾-inch for exposed and 1-inch for embedded raceway. The number and size of communication and security raceways shall be as required for the particular equipment provided, subject to the minimum sizes specified above.

2.02 RIGID METAL CONDUIT AND FITTINGS

- A. Rigid Steel Conduit: UL 6; ANSI C80.1; hot dip galvanized. Minimum size ¾-inch, exposed, 1-inch embedded or inaccessible.
- B. PVC Coated Conduit: NEMA RN-1; galvanized rigid steel conduit with factory applied external 40 mil PVC coating and 2 mil urethane interior coating. Prior to coating, treat conduit with a heat polymerizing adhesive so the bond between metal and coating is greater than the tensile strength of the coating. Minimum size ¾-inch.
- C. Fittings and Conduit Bodies: NEMA FBI; zinc coated; taper-threaded type, material to match conduit. Where PVC coated conduits are indicated all couplings, fittings, conduit bodies, pipe straps, U bolts, beam clamps, and other accessories are to be PVC coated.

2.03 FLEXIBLE METAL CONDUIT AND FITTINGS

- A. Conduit: UL 1; FS WW-C-566; single steel continuous strip with galvanized coating. Minimum size ½-inch.
- B. Fittings and Conduit Bodies: NEMA FB-1; malleable iron squeeze type.

2.04 LIQUIDTIGHT FLEXIBLE CONDUIT AND FITTINGS

- A. Conduit: UL listed liquidtight consisting of an extruded thermoplastic cover over a galvanized steel core. Minimum size $\frac{3}{4}$ -inch.
- B. Fittings and Conduit Bodies: NEMA FB-1; galvanized steel compression type with O-ring.

2.05 RIGID NONMETALLIC CONDUIT AND FITTINGS

- A. Use rigid PVC Schedule 40 conduit, UL listed for concrete-encased, underground direct burial, concealed and direct sunlight exposed use, and UL listed and marked for use with conductors having 90 degrees C insulation. Use conduits, couplings, bushings, elbows, nipples, and other fittings meeting the requirements of NEMA TC 2 and TC 3, Federal Specification W-C-1094, UL, NEC, and ASTM specified tests for the intended use. Use only conduit with a factory formed bell on one end. Conduit that requires the use of couplings for straight runs will not be acceptable. Minimum size $\frac{3}{4}$ -inch exposed, 1-inch embedded or encased.
- B. Fittings for PVC conduit shall comply with Standard for PVC Fittings for use with Rigid Conduit and Tubing, NEMA TC3, and shall be NEMA Type IV.

2.06 PRECAST HANDHOLES AND MANHOLES

- A. Install handholes and manholes with 28-day, 2,500 psi minimum compressive strength concrete and designed for AASHTO H-20 loading. Minimum dimensions for handholes and manholes are shown on the Drawings. Increase these as required by use of extension sections to accommodate the several raceway entrances at their required elevations.
- B. Slope floors toward drain points, leaving no pockets or other nondraining areas. Provide a drainage outlet at the low point of the floor constructed with a heavy, cast iron, slotted or perforated hinged cover, and 4-inch minimum outlet and outlet pipe.
- C. Provide raceway entrances on all four sides. For raceways installed under this Contract, knockout panels or precast individual raceway openings may be used. On sides where no raceways are installed under this Contract, provide 12-inch high by 24-inch wide (minimum) knockout panels for future raceway installation.
- D. For manholes, utilize heavy-duty type frames and covers made of stainless steel, suitable for H-20 loading, and having machined bearing surfaces. Provide indented type covers, solid top design, with two drop handles each. On the upper side of each cover, cast or burn by welder, in integral letters not less than 2 inches high appropriate titles, ELECTRIC HV (for above 600 volts), ELECTRIC LV (for 600 volts and below), or COMMUNICATION. Field stamp covers with handhole and manhole numbers indicated on the Drawings.
- E. For handholes, frames and covers shall conform to ASTM A48-83 and shall be slab type with letters as indicated above.

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- F. Provide heavy weight cable racks with adjustable arms and acceptable insulators for all cables in each handhole and manhole. Set adjustable inserts in the concrete walls for the attachment of racks. Do not use bolts or studs embedded in concrete for attaching racks. Set racks and inserts on not greater than 3-foot centers around the entire inside perimeter of the manhole, arranged so that all spare conduit ends are clear for future cable installation. Provide racks with a sufficient number of arms and insulators to accommodate cables for each conduit entering or leaving the handhole, including spares.
- G. Provide pulling irons. Utilize ¾-inch round stock securely fastened to the overall steel reinforcement before concrete is poured.
- H. Utilize handhole and manhole hardware of steel, hot-dip galvanized after fabrication.
- I. Manufacturers: Brooks Products, Inc.; Penn-Cast Products, Inc.; Concrete Conduit Company; Associated Concrete Products, Inc.; or equal.

2.08 WARNING TAPE

- A. Provide heavy-gauge, yellow plastic tape of 6-inch minimum width for use in trenches containing electric circuits. Utilize tape made of material resistant to corrosive soil. Use tape with printed warning that an electric circuit is located below the tape. Manufacturers and types: ITT Blackburn Type YT or RT; Griffolyn Co. Terra-Tape; or equal.

2.09 RACEWAY IDENTIFICATION

- A. Raceways number tags shall be brass with stainless steel attachment wire. Raceway number shall be embossed on to the tag with ¼-inch letters.

PART 3 - EXECUTION

3.01 CONDUIT SCHEDULE

- A. Use rigid steel conduits for indoor clean area.
- B. Use liquidtight flexible steel conduit for connections to motors, transformers, and other vibrating equipment.
- C. Non-jacketed flexible steel conduit may be used for connections to lighting fixtures in suspended ceilings.
- D. Use PVC coated conduits where conduits are in direct contact with earth or where conduits are installed in corrosive areas.
- E. Use PVC conduits where conduits are embedded in concrete structures, encased in concrete duct bank or concealed in concrete block CMU.

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- F. Where PVC conduit is indicated, make a transition to PVC coated rigid steel below grade or slab and continue above with PVC coated rigid steel conduit.
Exception: PVC may enter switchboards, motor control centers or other floor standing electrical equipment enclosures.

3.02 CONDUIT ARRANGEMENT AND SUPPORT

- A. Arrange conduit to maintain headroom and present a neat appearance. Run exposed conduits parallel or perpendicular to building surfaces and adjacent piping. Group conduit in parallel runs where practical and provide rack space for 25 percent additional conduits.
- B. Avoid sources of heat when possible. Where unavoidable, maintain 6-inch clearance when crossing hot pipes and 12-inch clearance between parallel hot pipes, flues, heating appliances, and other heat sources.
- C. Support conduits to prevent distortion of alignment by wire pulling operations. Fasten single conduits with one hole malleable iron straps. For multiple runs use galvanized steel channel and clamps. Wire, perforated pipe straps and the like are not acceptable support means.
- D. Support conduit at a maximum of 7 feet on center and within 3 feet of each box, cabinet, or fitting. Hang trapeze assemblies with threaded rods not less than 3/8-inch diameter. Remove all temporary supports prior to pulling conductors.

3.03 CONDUIT INSTALLATION

- A. Cut conduit square using a saw or pipecutter and de-burr and ream cut ends. Paint threads with zinc compound. Bring conduit to the shoulder of fittings and couplings and fasten securely. All connections are to be wrench tightened and electrically continuous. No running threads are permitted.
- B. Use conduit hubs for fastening conduit to boxes. Use conduit bodies to make sharp changes in direction. For sizes 2-inches and larger, use "LD" or similar fittings to permit a straight pull from either direction.
- C. The maximum length between pull points is 400 feet. This length shall be reduced by 100 foot for each 90 degree of bend.
- D. Use hydraulic one-shot shoe bender or factory elbows for bends in conduit larger than 2-inch size. Crushed or deformed conduits may not be installed.
- E. Avoid moisture traps where possible; where unavoidable, provide junction box with drain fitting at conduit low point.
- F. Use suitable conduit caps to protect installed conduit against entrance of dirt and moisture. Install threaded PVC end caps on conduits stubbed up for future use.

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- G. Unless otherwise specified, conduit entering field equipment enclosures shall enter the bottom or side of the box.
- H. Provide a 200 pound tensile strength polyolefin line pulled through and tied off at each end of all empty conduits.
- I. Install expansion joints where conduit crosses building expansions joints and for straight runs in excess of 100 feet.
- J. Where conduit penetrates fire-rated walls and floors, provide mechanical fire-stop fittings with UL listed fire rating equal to wall or floor rating.
- K. Provide watertight seals, equal to OZ type WSK or FSK, where conduit penetrates exterior walls and where conduit passes between spaces normally at different temperatures.
- L. Provide clamp backs for conduits on exterior or damp surfaces to prevent the raceway from bearing directly on the damp surface.
- M. Route conduits in slabs above the bottom reinforcing and below the top reinforcing. Maximum size for conduits in slabs above grade is 1-inch. Route so conduits in slabs above grade do not cross.
- N. PVC conduit bends: Use PVC-coated rigid steel factory elbows.
- O. PVC coated conduit: Exercise care not to damage the coating during cutting, threading, bending, and assembly. Follow the manufacturer's installation instructions. Use vise jaws, bending equipment, strap wrenches, and other tools which are specifically designed for coated conduits. Do not use chain vise, pipe wrench, channel locks or the like.
- P. Provide sealing compound equal to Chico A or Chico B where conduit passes from hazardous or corrosive area in to a nonclassified area.
- Q. Each conduit shall be provided with a number tag at each end.

3.04 UNDERGROUND DUCT BANK INSTALLATION

- A. Install top of duct bank minimum 24-inches below finished grade with plastic warning tape 12-inches below finished grade.
- B. Install conduit with minimum grade of 4-inches per 100 feet.
- C. Terminate conduit in end bell at manhole entries.
- D. Provide minimum 3-inch concrete cover at bottom, top, and sides of duct bank. Use suitable separators and chairs installed not greater than 4 feet on centers to provide conduit spacing as indicated. Securely anchor conduit to prevent movement during concrete placement. Stagger conduit joints in concrete encasement 6-inches minimum.

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- E. Construct duct banks with 3,000 psi concrete. Provide reinforcing bars as indicated. Each 50 lb. bag of concrete shall include 3 lbs of red oxide.
- F. Where duct bank passes beneath footings or slabs resting on grade excavate to provide a minimum of 6-inch clearance between the ductbank and the structure.
- G. Thoroughly swab inside of conduits upon completion of pouring concrete. Before backfilling, a mandrel, ½-inch smaller than the conduit diameter, shall be pulled through each conduit.

3.05 HANDHOLES AND MANHOLES

- A. Install handholes and manholes where shown on the Drawings. Provide excavation, shoring, bracing, backfilling, grading, etc., in accordance with requirements specified in Division 2 of these Contract Documents.
- B. Do not install handholes or manholes until final conduit grading, including field changes necessitated by underground interferences, has been determined. Set frames to final grades as required.
- C. Install one ground rod in each handhole and/or manhole. Connect all noncurrent-carrying metal parts in the manhole or handhole and any metallic raceway grounding bushings to this ground rod with No. 6 AWG (minimum) copper conductor.

+++END OF SECTION 16111+++

**SECTION 16119
UNDERGROUND DUCTS AND UTILITY STRUCTURES**

1. GENERAL

1.01 SCOPE

- A. This Section includes underground conduits and ducts, duct banks, pull boxes and handholes, manholes, and other underground utility structures.
- B. Products furnished and installed under this Section include pulling eyes, cable stanchions, cable arms, and insulators.
- C. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- D. Related Sections include but are not limited to:
 - 1. Section 01300 – Submittals.
 - 2. Section 02225 – Excavation, Trenching, and Backfill for general requirements for excavation, backfill and related items for ducts, manholes, and handholes.
 - 3. Section 03200 – Concrete Reinforcement and Dowelling.
 - 4. Section 03300 – Cast-In-Place Concrete for cast-in-place concrete requirements.
 - 5. Section 16195 – Electrical Identification.

1.02 REFERENCES

- A. Publication 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. Industry Standards:
 - a. American National Standards Institute, Inc. (ANSI).
 - i. ANSI C2 – National Electrical Safety Code
 - ii. ANSI C80 – Rigid Steel Conduit
 - b. National Electrical Manufacturers Association, Inc. (NEMA).
 - i. NEMA TC-2 – Rigid Nonmetallic Conduit
 - ii. NEMA TC-3 – PVC Conduit and Tubing Fittings
 - c. National Fire Protection Association (NFPA):
 - i. NFPA 70 – National Electrical Code (NEC)
 - 2. Government Standards:

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- a. U.S. Department of Labor, Occupational Safety and Health Administration (OSHA). Code of Federal Regulations, Title 29, Chapter XVII
 - i. 1910 – Part 1910, Subpart S, Electrical, Revised by CFR 4056, January 16, 1981.
 - ii. 1926 – Part 1926, Subpart K, Electrical, Revised by 51 CFR 25318, July 11, 1986.

1.03 SUBMITTALS

- A. General: Submit the following according to the requirements of Section 01300 - Submittals.
- B. Product data for metal accessories for manholes and handholes, conduit and duct, duct bank materials, and miscellaneous components.
- C. Field test reports indication and interpreting test results relative to compliance with performance requirements of Paragraph 3.06, “Field Quality Control” Article in Part 3 of this Section.
- D. Record Documents: Show dimensioned locations of underground ducts.

1.04 QUALITY ASSURANCE

- A. Comply with NFPA 70, and ANSI C2 for components and installation.
- B. Listing and Labeling: Provide products that are UL listed and labeled for their applications and installation conditions and for the environments in which installed.
 1. The Terms “Listed” and “Labeled”: As defined in the “National Electrical Code”, Article 100.
- C. Coordinate layout and installation of ducts, manholes, and handholes with final arrangement of other utilities as determined in the field.
- D. Coordinate elevations of duct and duct bank entrances into manholes and handholes with final profiles of conduits as determined by coordination with other utilities and underground obstructions. Revise locations and elevations from those indicated as required to suit field conditions and ensure duct runs drain to manholes and handholes, and as approved by the Engineer.

1.05 DEFINITIONS

- A. Duct: PVC conduit used underground, embedded in concrete.
- B. Duct Bank: 2 or more PVC conduits installed underground in the same concrete envelope.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Store nonmetallic ducts with supports to prevent bending, warping, and deforming.

2. PRODUCTS

2.01 CONDUIT AND DUCT MANUFACTURERS

- A. Acceptable Manufacturers: Subject to compliance with requirements, manufacturers offering the specified products that may be incorporated in the Work include:
 - 1. Nonmetallic Ducts:
 - a. CANTEX, Inc.
 - b. Carlon; Lamson & Sessions Company.
 - c. Pipe & Plastic Group; Certainteed Products Corp.
 - d. Or approved equal.

2.02 CONDUIT AND DUCT

- A. Rigid Steel Conduit: ANSI C80.1, galvanized.
- B. Rigid Plastic Conduit: NEMA TC 2, Schedule 40 PVC, rated for use with 105°C conductors under all installation conditions. Suitable for above ground, direct burial, concrete encased, and direct sunlight applications, ASTM class DB (suitable for direct burial without concrete encasement). Use Schedule 80 PVC for locations subject to damage.
- C. PVC Conduit and Tubing Fittings: NEMA TC3.

2.03 CONDUIT AND DUCT ACCESSORIES

- A. Duct Supports: Rigid PVC spacers selected to provide minimum duct spacing and concrete cover depths indicated, while supporting ducts during covering.
- B. Duct Sealing Compound: Non-hardening, safe for human skin contact, not deleterious to cable insulation, workable at temperatures as low as 35°F, withstands temperature of 300°F without slump, and adheres to clean surfaces of plastic ducts, metallic conduits, conduit coatings, concrete, masonry, lead, cable sheathes, cable jackets, insulation materials, and the common metals.

2.04 CONDUIT AND DUCT CONSTRUCTION MATERIALS

- A. Concrete: Conform to Section 03300 - Cast-In-Place Concrete for concrete and Section 03300 – Concrete Reinforcement and Dowelling, for reinforcing steel.

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1. Strength: Class D 3000 psi (20.7 Mpa) minimum 28-day compressive strength.
2. Aggregate for Duct Encasement: 3/8-inch maximum size.

2.05 MANHOLE AND HANDHOLE MANUFACTURERS

- A. Acceptable Manufacturers:
1. Old Castle precast, Inc.
 2. Brooks Products Co.
 3. Jensen Precast Products.
 4. Or approved equal.

2.06 MANHOLE AND HANDHOLE CONSTRUCTION MATERIALS

- A. Concrete: Where applicable, conform to Section 03300 - Cast-In-Place Concrete, for concrete and reinforcing.
1. Strength: 3000 psi (20.7 Mpa) minimum 28 day compressive strength.
 2. Aggregate for Duct Encasement: 3/8-inch maximum size.
- B. 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 Section 03200 – 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.

2.07 MANHOLES AND HANDHOLES

- A. Cable racks, supports, pulling-in-irons, manhole steps and hardware shall be hot dipped galvanized steel as manufactured by Line Materials Co. or approved equal.
- 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.

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- 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. Bell ends and plastic duct spacers shall be as manufactured by Carlon or approved equal.
- 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.

3. EXECUTION

3.01 APPLICATION

- A. Underground Ducts for Electrical Utility Service: Plastic conduit encased in concrete.
- B. Underground Ducts for Electrical Feeders: Plastic conduit encased in concrete.
- C. Underground Ducts for Telephone Utility Service: Plastic conduit encased in concrete.
- D. Underground Ducts for Communication Circuits: Plastic conduit encased in concrete.

3.02 EXAMINATION

- A. Examine site to receive ducts and manholes for compliance with installation tolerances and other conditions affecting performance of the underground ducts and manholes. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.03 EARTHWORK

- A. Excavation and Backfill: Conform to Section 02225 – Trench Excavation and Backfill, but do not use heavy-duty, hydraulic-operated compaction equipment.
- B. Restore surface features at areas disturbed by excavation, and reestablish original grades except as otherwise indicated. Replace removed sod as soon as possible after backfilling is completed. Restore all areas disturbed by trenching, storing or dirt, cable lay, and other work. Restore vegetation and include necessary topsoil, fertilizing, liming, seeding, sod, sprigging, or mulching.

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- C. Restore disturbed paving to the original condition.

3.04 CONDUIT AND DUCT INSTALLATION

- A. Install Non-metallic conduit and duct as indicated according to manufacturer's written instructions.
- B. Slope: Pitch ducts minimum of 4-inches per 100-feet (1:300) to drain toward manholes and handholes and away from buildings and equipment. Slope ducts from a high point in runs between 2 manholes to drain in both directions.
- C. Curves and Bends: Use manufactured elbows for stub-ups at equipment and at building entrances.
- D. Make joints in ducts and fittings watertight according to manufacturer's instructions. Stagger couplings so those of adjacent ducts do not lie in the same plane.
- E. Concrete-Encased Nonmetallic Ducts: Support on plastic separators coordinated with duct size and require duct spacing, and install according to the following:
 - 1. Separator Installation: Space separators close enough to prevent sagging and deforming of ducts, and secure separators to the earth and to ducts to prevent floating during concreting.
 - 2. Concreting: Spade concrete carefully during pours to prevent voids under and between conduits and at exterior surface of envelope. Do not use power-driven agitating equipment unless specifically designed for duct bank application. Pour each run of envelope between manholes or other terminations in 1 continuous operation. When more than one pour is necessary, terminate each pour in a vertical plane and install 3/4-inch reinforcing rod dowels extending 18-inches into the concrete on both sides of joint near the corners of the envelope.
 - 3. Reinforcing: Reinforce duct banks where they cross disturbed earth and where indicated.
 - 4. Forms: Use the walls of the trench to form the side walls of the duct bank where the soil is self-supporting and concrete envelope can be poured without soil inclusions, otherwise, use forms.
 - 5. Minimum Clearances Between Ducts: 3-inches between ducts and exterior envelope wall, 2-inches between ducts for like services, and 4-inches between power and signal ducts.
 - 6. Depth: Except as otherwise indicated, install top of duct bank at minimum of 18-inches below finished grade in general areas and at maximum of 30-inches below finished grade in vehicular traffic areas.
 - 7. Install identification marker tape in accordance with Section 16195 – Electrical Identification.
 - 8. Run #1/0 bare copper grounding conductor in all concrete encased duct banks.
- F. Pulling Cord: Install 100-pound-test nylon cord in ducts, including spares.

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- G. Building Entrances: Transition from underground duct to conduit 10-feet minimum outside the building wall. Use fittings manufactured for the purpose. Follow appropriate installation instructions below:
 - 1. Concrete-Encased Ducts: Install reinforcing in duct banks. Coordinate duct bank with structural design to support duct bank at wall without reducing structural or watertight integrity of building wall.
 - 2. Waterproofed Wall and Floor Entrances: Install a watertight entrance-sealing device with the sealing gland assembly on the inside. Anchor device into masonry construction with 1 or more integral flanges. Secure membrane waterproofing to the device to make permanently watertight
- H. Overall underground electrical ductbanks are shown on the electrical site plans. Final stub-up locations (entry/exit) into equipment inside electrical rooms and at each site area shall be field coordinated and determined by contractor.
- I. Equipment drawings shall be used to determine where embedded conduits may be stubbed-up at or beneath equipment. For all embedded conduits contractor shall determine routing of conduit based on site conditions.
- J. Conduits embedded in concrete slab shall not interfere with equipment or building structures. Interferences with embedded conduits stubbed-up at or beneath equipment shall also consider accessibility at such equipment. Interferences with embedded conduits shall be the contractor's responsibility and cost to remedy.
- K. Spare empty conduits shall be installed embedded in slabs as required, and as part of underground ductbanks.

3.05 MANHOLE AND HANDHOLE INSTALLATION

- A. 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.
- B. Install pulling-in irons opposite all raceway entrances to manholes. Pulling irons shall be cast into the walls and floor. Bolt on style pulling irons are not acceptable.
- C. Cables shall be completely looped and trained in manholes and supported on racks and hoods at intervals not greater than 3-feet 0-inches and supports shall be installed on each side of all splices.
- D. Furnish cast in place inserts on all manhole walls for mounting future racks as well as racks required for present installation.
- E. Manhole covers in streets shall finish flush with finished paving and in other areas shall finish 3-inches above crown adjacent roadway.
- F. Floor elevations of manholes shall be so set that the center line of the lowest conduit entering will be not less than 1-foot below the roof slab or top.
- G. A 3/4-inch by 10-foot copperclad ground rod shall be driven in the bottom of each manhole. All bond wires, galvanized conduits and metal cable racks shall be bonded to the ground rod.

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- H. Polyethylene warning tape shall be provided for all underground raceways, duct banks, etc.
- I. Install a bare copper cable in the concrete encased duct bank. Size shall be as shown on the Drawings. In the absence of cable size being shown on the Drawings, it shall be #1/0. It shall be continuous from one end to the other for the entire length of the ductwork and shall be bonded to building steel on each end and to all manhole-handhole ground loops and associated manhole-handhole ground rods.
- J. Install expansion deflection fittings as required by the NEC and duct bank raceway manufacturer.
- K. Record drawings shall be furnished showing each conduit termination, elevations, locations, manholes, etc.

3.06 FIELD QUALITY CONTROL

- A. Testing: Demonstrate capability and compliance with requirements upon completion of installation of underground duct and utility structures.
 - 1. Grounding: Test manhole grounding to ensure electrical continuity of bonding and grounding connections. Measure ground resistance at each ground rod and report results. Use an instrument specifically designed for ground-resistance measurements.
 - 2. Duct Integrity: Rod ducts with a mandrel 1/4-inch smaller in diameter than internal diameter of ducts. Where rod indicates obstructions in ducts, remove the obstructions and retest.
- B. Correct installations where possible, and retest to demonstrate compliance. Otherwise, remove and replace defective products and retest.

3.07 CLEANING

- A. Pull brush through full length of ducts. Use round bristle brush with a diameter 1/2-inch greater than internal diameter or duct.

+++ END OF SECTION 16119 +++

**SECTION 16120
600 VOLT CONDUCTORS, WIRE, AND CABLE**

PART 1 – GENERAL

1.01 DESCRIPTION

- A. This section specifies stranded copper cables, conductors, and wire rated 600 volts insulation used for power; lighting, analog, digital, or pulse signals and control circuits.

1.02 REFERENCES

- A. This section contains references to the following documents. They are a part of this section. In case of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.
- B. Unless otherwise specified, references to document 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). 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. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, whether or not the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
ASTM B3	Soft or Annealed Copper Wire
ASTM B8	Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
ASTM B33	Tinned Soft or Annealed Copper Wire for Electrical Purposes
ICEA S-68-516	Ethylene-Propylene-Rubber-Insulated Wire
NEMA WC7	Cross-Linked-Thermosetting Insulated Wire and Cable for the Transmission and Distribution of Electric Energy
NFPA 70	National Electrical Code (NEC)
UL 44	Rubber-Insulated Wires and Cables
UL 83	Thermoplastic-Insulated Wires and Cables

1.03 SUBMITTALS

- A. The following information shall be provided in accordance with the General Conditions.
 - 1. Submittals specified in Section 16000.
 - 2. Complete catalog cuts for all conductors, wire, and cable.

PART 2 – PRODUCTS

2.01 GENERAL

- A. **Unscheduled Conductors and Cables:**
 - 1. Where not specified on the Drawings, conductors and cables shall be sized in accordance with the National Electrical Code for the particular equipment served with the minimum size as specified herein.
 - 2. Unscheduled conductor with insulation shall be provided in accordance with the following:
 - a. CABLESPEC "MEPR/CPE" multi-conductor power and control cable
 - b. CABLESPEC "RHW" for single conductors
 - c. CABLESPEC "XHHW or THWN" for indoor lighting and receptacles
- B. **Cable Specification Sheets (CABLESPEC):** General requirements for conductors and cables specified in this Section are listed on CABLESPEC sheets in paragraph 16120-3.06.

2.02 COLOR CODING

- A. **Control Conductors:** Single-conductor control conductors shall have the following colors for the indicated voltage:

Control Conductor	120V
Power (AC)	Black
Control (AC)	Red
Neutral	White
Ground	Green
Foreign Voltage (DC)	Blue/White
Foreign Voltage (AC)	Yellow
Power (DC)	Blue
Control (DC)	Violet

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B. Power Conductors:

1. Power conductors shall have the following colors for the indicated voltage:

Power Conductor	480V	208/120V
Phase A	Brown	Black
Phase B	Orange	Red
Phase C	Yellow	Blue
Ground	Green	Green
Neutral	Gray	White

2. Cables may be black with colored 3/4 inch vinyl plastic tape applied at each cable termination. Tape shall be wrapped with 25 percent overlay to provide 3 inches minimum coverage.

- C. Signal Conductors: Signal cable conductors shall be color coded black and white for pairs or black, white, and red for triads. Each conductor and each group of conductors shall be numbered.

2.03 POWER AND CONTROL CONDUCTORS AND CABLE, 600 VOLT

- A. Single Conductor: Provide stranded conductors for all cable or wires. Provide minimum conductor size of 12 AWG for power and lighting circuits and minimum conductor size of 14 AWG for control circuits.
- B. Multiconductor Cable: Provide multiconductor power cable and multiconductor control cable where identified on the drawings. Provide stranded conductors for all cable or wires.

2.04 SIGNAL CABLES

A. General:

1. Factory cable between manufactured instrument system components shall be provided in compliance with the instrument manufacturer's recommendations.
2. Signal cable shall be provided for instrument signal transmission. Single instrument cable (SIC) and multiple-circuit instrument cable (MIC) shall be provided in accordance with the following examples:
 - a. CABLESPEC "SIC":
Cable designation: 1PR#16S shielded twisted pair (STP)
Cable designation: 1TR#16S triad (STT)

b. CABLESPEC "MIC":

Cable designation example: 4PR#16S with individual shields for each of the four pair and an overall shield and jacket for the multiconductor instrument cable.

- B. Communication, Paging, and Security System Cables: Voice communication, paging, and security system cables shall be specified in their respective specification sections.

2.05 PORTABLE CORD

- A. Portable cord shall be provided in accordance with CABLESPEC "CORD," unless otherwise specified. Cords shall contain an equipment grounding conductor.

2.06 SPLICING AND TERMINATING MATERIALS

- A. Connectors shall be tool applied compression type of correct size and UL listed for the specific application. Connectors shall be tin-plated high conductivity copper. Wire nuts for a splice is prohibited.
- B. Signal and control conductors shall be connected to terminal blocks and field devices and instruments shall be terminated with conductor terminals as specified in paragraph 16175.
- C. Connectors for wire sizes No. 8 AWG and larger shall be compression tool installed one-hole lugs up to size No. 3/0 AWG, and two-hole or four-hole lugs for size No. 4/0 and larger. Mechanical clamp, dimple, screw-type connectors are not acceptable. In-line splices and taps shall be used only by written consent of the Construction Manager.
- D. Power conductor splices shall be compression type, made with a compression tool die approved for the purpose, as made by Thomas and Betts Corp., or approved equal. Splices shall be covered with electrical products designed for the application, insulated, and covered with a heat-shrinkable sleeve or boot, as specified elsewhere.
- E. Motor connection kits shall consist of heat-shrinkable, polymeric insulating material over the connection area and high dielectric strength mastic to seal the ends against ingress of moisture and contamination. Motor connections may use the Tyco Electronics removable boot product line.
- F. Motor connection kits shall accommodate a range of cable sizes for both in-line and stub-type configurations. Connection kits shall be independent of cable manufacturer's tolerances. Refer to the electric motor specification Section 16150.

2.07 CORD GRIPS

- A. Cord grips shall be provided where indicated on the Drawings to attach flexible cord to equipment enclosures. Cord grips shall consist of a threaded aluminum body and compression nut with a neoprene bushing and stainless steel wire mesh for strain relief. Cord grip shall provide a watertight seal at enclosure interface and sized to accommodate the flexible cord.

PART 3–EXECUTION

3.01 GENERAL

- A. Conductors shall be identified at each connection terminal and at splice points. The identification marking system shall comply with Section 16000.
- B. Pulling wire and cable into conduit or trays shall be completed without damaging or putting undue stress on the insulation or jacket. Manufacture recommended and UL Listed pulling compounds are acceptable lubricants for pulling wire and cable. Grease is not acceptable.
- C. Raceway construction shall be complete, cleaned, and protected from the weather before cable is installed. Where wire or cable exits a raceway, a wire or cable support shall be provided.
- D. Provide tin-plated bus bar. Scratch-brush the contact areas and tin plate the connection where flat bus bar connections are made with un-plated bar. Bolts shall be torqued to the bus manufacturer's recommendations.

3.02 600 VOLT CONDUCTOR AND CABLE

- A. Conductors in panels and electrical equipment shall be bundled and laced at intervals not greater than 6 inches, spread into trees and connected to their respective terminals. Lacing shall be made up with plastic cable ties. Cable ties shall be tensioned and cut off by using a tool specifically designed for the purpose such as a Panduit GS2B. Other methods of cutting cable ties are unacceptable.
- B. Conductors crossing hinges shall be bundled into groups not exceeding 10 to 15 conductors and protected using nylon spiral flexible covers to protect conductors. Provide oversized plastic panel wiring duct within panels and panelboards.
- C. Slack shall be provided in junction and pull boxes, handholes and manholes. Slack shall be sufficient to allow cables or conductors to be routed along the walls. Amount of slack shall be equal to largest dimension of the enclosure. Provide dedicated electrical wireways and insulated cable holders mounted on unistrut in manholes and handholes.
- D. Raceway fill limitations shall be as defined by NEC and the following:
 - 1. Lighting and receptacle circuits may be in the same conduit in accordance with derating requirements of the NEC. Lighting and receptacle circuits shall not be in conduits with power or control conductors. Signal conductors shall be in separate conduits from power conductors. Motor feeder circuits shall be in separate conduits including small fan circuit unless combination fan-light fixture.
 - 2. Power conductors derived from uninterruptible power supply systems shall not be installed in raceways with conductors of other systems. Install in separate raceways.

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3. Slices and terminations are subject to inspection by the Construction Manager prior to and after insulating.
4. Motor terminations at 460-volt motors shall be made by bolt-connecting the lugged connectors.
5. In-line splices and tees, where approved by the Construction Manager, shall be made with tubular compression connectors and insulated as specified for motor terminations. Splices and tees in underground handholes or pull boxes shall be insulated using Scotch-cast epoxy resin or Raychem splicing kits.
6. Terminations at solenoid valves, 120 volt motors, and other devices furnished with pigtail leads shall be made using self-insulating tubular compression connectors within the termination box.
7. Terminations at valve and gate motor actuators shall be made directly into the actuator where possible. Power termination shall be made in the actuator power disconnect. Control and signal cable may be routed to a termination box near the actuator on 20-ampere rated terminal strips with label identification for the control and signal conductors. Single wire control conductors and analog cable (SIC or MIC) then installed in flexible conduit to the actuator control and signal termination compartments.

3.03 SIGNAL CABLE

- A. Provide terminal blocks at instrument cable junctions within dedicated terminal boxes provided by the installer. Signal circuits shall be run without splices between instruments, terminal boxes, or panels.
- B. Circuits shall not be made using conductors from different pairs or triads. Triads shall be used wherever 3 wire circuits are required.
- C. Shields are not acceptable as a signal path, except for circuits operating at radio frequencies utilizing coaxial cables. Common ground return conductors for two or more circuits are not acceptable.
- D. Shields shall be bonded to the signal ground bus at the control panel only and isolated from ground at the field instrument or analyzer and at other locations. Shields or drain wires for spare circuits shall not be grounded at either end of the cable run. Terminals shall be provided for running signal leads and shield drain wires through junction boxes.
- E. Spare circuits and the shield drain wire shall be terminated on terminal blocks at both ends of the cable run and be electrically continuous through terminal boxes.
- F. Where instrument cable splicing is required, provide an instrument stand with terminal box rated for the area and environment and mounted approximately 3 feet above grade for instrument cable splices with the circuits and individual conductors provided with label as specified in Section 16000.

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- G. Cable for paging, security, voice communication, and telephone systems shall be installed and terminated in compliance with the manufacturers and the Utilities recommendations.

3.04 PORTABLE CORD

- A. Portable power cords feeding permanent equipment, such as pendant cords feeding motors for pumps, cranes, hoists, and portable items shall have a wire mesh cord grip of flexible stainless steel wire to relieve the tension from the cable termination. Connection of portable cords to permanent wiring shall be accomplished with dedicated boxes and terminals blocks.

3.05 TESTING

- A. The Contractor shall test conductors, wire, and cable in accordance with Section 16999.

3.06 CABLE SPECIFICATION SHEETS (CABLESPEC)

- A. General: Conductor, wire, and cable types for different locations, service conditions and raceway systems are specified on individual cable specification sheets. Scheduled and unscheduled conductors, wires, and cables shall be installed in accordance with the CABLESPEC SHEETS.

- B. Cablespec Sheets: The following CABLESPEC sheets are included in this section:

Type	Volt	Product	Purpose
MIC	600	SP-OS: Multiple Pair PR#18 or 16SH With Overall Shield and Jacket	Cable Tray Rated Instrument Cable
SIC	600	P-OS: 1-PR#18 or 16SH or 1-TR#18 or 16SH	Cable Tray Rated Instrument Cable
THWN	600	PVC-insulated with nylon jacket building- grade conductor	Lights & receptacles
XHHW-2	600	XLP-insulated industrial-grade conductor	Power, control, lighting, & receptacles
MEPR / [XLP] [CPE]	600	Multi-conductor rubber insulated cable with jacket Examples: Power cable: 3/c #500 kcmil with factory ground conductor within cable Control cable: 19/C #14	Cable tray rated power & control

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Type	Volt	Product	Purpose
MXLPE / S / PVC	1000	Multiconductor shielded motor cable with PVC jacket	Flexible 3/C cable with NEC ground conductor. motor feeder range:16 AWG - 500KCMIL
CORD	600	Heavy Duty Cable: SJOOW	Portable Items

3.06 CABLE SPECIFICATION SHEET - CABLESPEC

Cable System Identification:	MIC
Description:	Multiple twisted, shielded pairs, 18 or 16 AWG, with overall shield instrumentation cable; Number of pairs as shown; UL listed, Cable Tray rated.
Voltage:	600 volts
Conductor Material:	Bare annealed copper; Class-B stranded per ASTM B-8
Insulation:	15 mil, Polyvinyl Chloride (PVC) with 4 mil nylon, 90 degree C temperature rated Color Code per ICEA Method-1: Pairs- Black and White with one conductor in each pair printed alpha-numerically for identification
Lay:	Twisted on a 2-inch lay
Shield:	100 percent, 1.35 mil aluminum/polyester or mylar tape with 7-strand tinned copper drain wire
Overall Shield:	2.35 mil aluminum-Mylar tape with 7-strand tinned copper drain wire
Jacket:	Flame-retardant, moisture and sunlight resistant 45 mil Polyvinyl Chloride (PVC)
Flame Resistance:	UL 1277 and UL 1581 vertical tray flame test
Manufacturer(s):	Okonite, Okoseal-N type SP-OS (Shielded Pairs with Overall Shield); or Cooper Industries-Belden; General Cable or approved equal
Execution:	
Installation:	Install in accordance with paragraph 16120-3.03.
Testing:	Test in accordance with paragraph 16999.

3.06 CABLE SPECIFICATION SHEET - CABLESPEC

Cable System Identification:	SIC
Description:	Single twisted, shielded pair or triad, 18 or 16 AWG, instrumentation and signal cable; UL listed; Cable Tray rated
Voltage:	600 volts
Conductor Material:	Bare annealed copper; stranded per ASTM B8
Insulation:	15 mil, Polyvinyl Chloride (PVC) with 4 mil nylon, 90 degree C temperature rated Color Code per ICEA Method-1: Pairs- Black and White with one conductor in each pair printed alpha-numerically for identification
Lay:	Twisted on a 2-inch lay
Shield:	100 percent, 1.35 mil aluminum-Mylar tape with a 7-strand tinned copper drain wire
Jacket:	45 mil Polyvinyl Chloride (PVC)
Flame Resistance:	UL 1277
Manufacturer(s):	Okonite, Okoseal-N Type P-OS (Pair(s) Overall Shield) and Type TOS (Triad(s) Overall Shield); or Cooper Industries-Belden; General Cable or approved equal
Execution:	
Use:	Analog signal cable and RTD device Triad extension cable.
Installation:	Install in accordance with paragraph 16120-3.03.
Testing:	Test in accordance with paragraph 16999.

3.06 CABLE SPECIFICATION SHEET - CABLESPEC

Cable System Identification:	THWN
Description:	Single conductor lighting and receptacle type; Indoor branch circuit conductor.
Voltage:	600 volts
Conductor Material:	Bare annealed copper; stranded per ASTM B8
Insulation:	THWN/THHN, 90 degree C dry, 75 degree C wet, Polyvinyl Chloride (PVC) per UL 83.
Jacket:	Nylon
Flame Resistance:	UL 83
Manufacturer(s):	Okonite, Okoseal-N, series 116-67-XXXX; or approved equal.
Uses Permitted:	Lighting, receptacle and appliance circuits
Execution:	
Installation:	Install in accordance with paragraph 16120-3.02.
Testing:	Test in accordance with paragraph 16999.

3.06 CABLE SPECIFICATION SHEET - CABLESPEC

Cable System Identification:	XHHW-2
Description:	Industrial grade single conductor Sizes: 14 AWG through 750 kcmil as shown
Voltage:	600 volts
Conductor Material:	Bare annealed copper; stranded per ASTM B8
Insulation:	NEC Type XHHW-2; 90 degree C dry and C wet; Cross-Linked Polyethylene (XLP) per ICEA S-66-524 and UL-44; Color in sizes 14, 12 and 10 AWG: Black, Green, Yellow, White, Orange, Brown, Red, Blue
Jacket:	None
Flame Resistance:	UL 83
Manufacturer(s):	Okonite, X-Olene; Cablec, Durasheath XLP; or approved equal.
Uses Permitted:	Power, control, lighting and outlet circuits.
Execution:	
Installation:	Install in accordance with paragraph 16120-3.02.
Testing:	Test in accordance with paragraph 16999.

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3.06 CABLE SPECIFICATION SHEET - CABLESPEC

Cable System Identification:	MEPR / CPE
Description:	Multiconductor Power Cable and Multiconductor Control Cable: 14 AWG stranded conductors; Cable tray rated.
Power Cable:	Insulated green grounding conductor sized per the NEC.
Ground Conductor Size:	Multiple sets of multiconductor power cable: Oversize the grounding conductor per NEC 250.
Control Cable Type:	ICEA Method 1, E-2, without white neutral conductor or green ground conductor
Control Cable Identification:	Conductors color coded per ICEA and conductors numbered
Voltage:	600 volts
Conductor Material:	Bare annealed copper; stranded per ASTM B8, coated per ASTM B33
Insulation:	RHW/RHH, 90 degree C dry, 75 degree C wet, ethylene propylene rubber (EPR) per ICEA 2-68-516 and UL 44.
Jacket:	Cross-linked Polyethylene (XLP)
Flame Resistance:	IEEE 383
Manufacturer(s):	Okonite, Okonite-Okolon-Okoseal series 202-11-3XXX; Cablec, Durasheath EP; or approved equal.
Execution:	
Installation:	Install in accordance with paragraph 16120-3.02.
Testing:	Test in accordance with paragraph 16999.

+++END OF SECTION 16120+++

**SECTION 16141
WIRING DEVICES**

PART 1 - GENERAL

1.01 SCOPE

- A. Work described in this Section includes furnishing all labor, materials, equipment, tools and incidentals required for a complete and operable installation of wall switches, receptacles, device plates and box covers. All equipment shall be installed, adjusted, tested and placed in operation in accordance with these Specifications, the manufacturer's recommendations and as shown on the Drawings.
- B. Contract drawings show only functional features and some of the required external connections. They do not show all components required for a complete installation nor exact dimensions particular to any manufacturer's equipment. Contractor shall supply all parts, devices and equipment necessary to meet the requirements of the Contract Documents and shall make all dimensional adjustments particular to the equipment being furnished. All costs associated with such changes and adjustments shall be considered as being included in the price bid for the work shown and specified.

1.02 SUBMITTALS

- A. Submittals shall be made in accordance with the requirements of the General Conditions of the Contract Documents. In addition, the following specific information shall be provided:
 - 1. Catalog cuts.

1.03 QUALITY STANDARDS

- A. All products covered by these specifications shall be in conformance with NEMA standards and shall be UL approved.
- B. Manufacturers offering products that comply with these specifications include:
 - 1. Arrow Hart.
 - 2. Bryant.
 - 3. GE.
 - 4. Hubbell.
 - 5. Leviton Specmaster.
 - 6. Pass and Seymour.
 - 7. Sierra.
 - 8. Crouse Hinds.
 - 9. Appleton.
 - 10. Or equal.

1.05 WARRANTY

- A. Provide a warranty against defective equipment and workmanship in accordance with the requirements of the General Conditions of the Contract Documents.

PART 2 - PRODUCTS

2.01 SWITCHES

- A. General Purpose: 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. Hazardous Areas: Switches shall consist of a factory assembled and sealed combination general purpose switch in an explosion proof housing. The external operating mechanism shall consist of a wing-type handle having the on-off positions visible from front. The switch shall be rated in accordance with NEC for the area.
- C. Corrosive and Outdoor Areas: Switches shall be 20 Amp pressure switch type with weatherproof/corrosion resistant neoprene plate. Switches shall be mounted in "FS" type copper-free aluminum or PVC mounting boxes.
- D. Ground Fault Interrupter (GFI) Receptacles: Provide duplex specification grade GFI receptacles tripping at 5 milliamps; rated 20 amps, 120 volts, NEMA Configuration 5-20R. Use units meeting NEMA WD 1, fitting standard sized outlet boxes having provision for testing, and ivory in color. Use standard model where ground fault protection is needed. Do not use feed-thru model. Acceptable manufacturers: Square D, General Electric, or equal.
- E. 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.
- F. Device Colors: Brown or black for specific use devices, otherwise as selected by the Engineer.
- G. Plug Caps: Male plug caps for receptacles shall be of the cord grip armored type with heavy phenolic housing of the same manufacturer as the receptacle.
- H. Three Phase Receptacles and Plugs: Receptacles shall be suitable for 480V, 3 phase, 4 wire service with ampere rating as specified. The grounding pole shall be permanently connected to the housing. The grounding pole shall make contact before the line poles are engaged when the plug is connected to the receptacle housing. The plug sleeve shall also make contact with the receptacle housing before the line and load poles make contact. Receptacles shall be provided complete with cast back box, angle adapter, gaskets, a gasketed screw-type, weathertight cap with chain fastener and one plug.

2.02 RECEPTACLES

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- A. General Purpose: Receptacles shall be NEMA WD-1; FS W-C-596, 20 AMP, 125 Volt, specification grade; impact resistant nylon face; back and side wiring provision; grounding screws; duplex.
- B. Hazardous Areas: Receptacles shall be rated in accordance with NEC for the area and shall be factory sealed. Receptacle shall be designed so the plug must be inserted and turned before load is energized. Provide mounting box, sealing chamber and compatible plug.
- C. Corrosive Areas: Receptacles shall be duplex; 20 Amp, NEMA 5-20R. Receptacle and plug shall be corrosion resistance; marine duty; polycarbonate with weatherproof lift cover.

2.03 WALL PLATES

- A. Decorative Cover Plates: Unbreakable nylon, Lexan, or noryl, smooth finish, color to match devices.
- B. Unfinished Area Device Plates: Type 302 stainless steel, 0.030 inch thick minimum, satin finish.
- C. Weatherproof Cover Plate: Gasketed cast metal with hinged, gasketed, spring loaded device covers.

2.04 PLUG STRIP

- A. Plug strip shall be manufactured of sheet steel with the receptacles mounted on front cover. The front cover shall be removable.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Secure devices to outlet boxes without depending on device plates to pull them tight. Install a bonding jumper between all devices and outlet boxes.
- B. Install switches with off position down; and receptacles with grounding pole on bottom.
- C. For cord and plug connected equipment, coordinate receptacle configuration with equipment supplied.
- D. Install device plates on switch, receptacle, and blank outlets. Use jumbo size plates for devices installed in masonry walls.

+++END OF SECTION 16141+++

**SECTION 16321
PAD MOUNTED TRANSFORMERS**

PART 1 GENERAL

1.01 SCOPE

- A. The Contractor shall furnish and install the pad mounted transformer(s) as specified herein and as shown on the contract drawings.

1.02 RELATED SECTIONS

1.03 REFERENCES

- A. The pad-mounted transformer(s) and all components shall be designed, manufactured and tested in accordance with the latest applicable NEMA (NEMA 210), IEEE and ANSI standards (ANSI C57).

1.04 SUBMITTALS – FOR REVIEW/APPROVAL

- A. The following information shall be submitted to the Engineer:
 - 1. Front view elevation or outline drawing and weight
 - 2. Nameplate diagram
 - 3. Conduit entry/exit locations
 - 4. Ratings (on nameplate) including:
 - a. kVA
 - b. Primary and secondary voltage
 - c. Taps
 - d. Basic Impulse level
 - e. Impedance
 - 5. Product data sheets
- B. Where applicable, the following additional information shall be submitted to the Engineer:
 - 1. Busway connection
 - 2. Specified accessories

1.05 SUBMITTALS – FOR CONSTRUCTION

- A. The following information shall be submitted for record purposes:
 - 1. Final as-built drawings and information for items listed in Paragraph 1.04, and shall incorporate all changes made during the manufacturing process
 - 2. Wiring diagrams
 - 3. Production test reports
 - 4. Installation information

5. Seismic certification as specified

1.06 QUALIFICATIONS

- A. The manufacturer of the assembly shall be the manufacturer of the major components within the assembly.
- B. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of five (5) years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.
- C. Provide Seismic qualified equipment as follows:
 1. The equipment and major components shall be suitable for and certified by actual seismic testing to meet all applicable seismic requirements of the latest International Building Code (IBC).
 2. The Project Structural Engineer will provide site specific ground motion criteria for use by the manufacturer to establish SDS values required.
 3. The IP rating of the equipment shall be 1.5
 4. The Structural Engineer for the Site will evaluate the SDS values published on the Manufacturer's website to ascertain that they are "equal to" or "greater than" those required for the Project Site.
 5. The following minimum mounting and installation guidelines shall be met, unless specifically modified by the above referenced standards.
 - a. The Contractor shall provide equipment anchorage details, coordinated with the equipment mounting provision, prepared and stamped by a licensed civil engineer in the state. Mounting recommendations shall be provided by the manufacturer based upon the above criteria to verify the seismic design of the equipment.
 - b. The equipment manufacturer shall certify that the equipment can withstand, that is, function following the seismic event, including both vertical and lateral required response spectra as specified in above codes.
- B. The equipment manufacturer shall document the requirements necessary for proper seismic mounting of the equipment. Seismic qualification shall be considered achieved when the capability of the equipment, meets or exceeds the specified response spectra.

1.07 DELIVERY, STORAGE AND HANDLING

- A. Equipment shall be handled and stored in accordance with manufacturer's instructions. One (1) copy of these instructions shall be included with the equipment at time of shipment.

1.08 OPERATION AND MAINTENANCE MANUALS

- A. Equipment operation and maintenance manuals shall be provided with each assembly shipped and shall include instruction leaflets, instruction bulletins and renewal parts lists where applicable, for the complete assembly and each major component.

1.09 FIELD MEASUREMENTS

- A. Measure primary and secondary voltages and make appropriate tap adjustments.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Eaton
- B. Schneider Electric
- C. General Electric.
- D. Siemens.

The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety. Products in compliance with the specification and manufactured by others not named will be considered only if pre-approved by the Engineer ten (10) days prior to bid date.

2.02 RATINGS

- A. The ratings of the transformer shall be as follows or as shown on the drawings:

kVA Rating	As shown on the drawings, ONAN
Impedance	5.75% +/- 7-1/2%
HV	4.16kV Delta
HV BIL	60kV
HV de-energized Taps	.2 - 2-1/2% full capacity above and below normal
LV	480 Volts Wye
LV BIL	30kV

2.03 CONSTRUCTION

- A. The unit shall use biodegradable electrical insulating fluid from high oleic vegetable oil sources filled and shall be in accordance with the latest edition of the NEC. Fluid shall be FR3, Beta Fluid, VG-100 or equivalent high fire point fluid that is Factory Mutual approved.
- B. The transformer shall carry its continuous rating with average winding or temperature rise by resistance that shall not exceed 65 degrees C rise, based on an average ambient of 30 degrees C over 24 hours with a maximum of 40 degrees C.
- C. The transformer shall be designed to meet the sound level standards for liquid transformers as defined in NEMA and ANSI.
- D. High-voltage and low-voltage windings shall be aluminum. Insulation between layers of the windings shall be by thermally set insulating paper or equal.

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- E. The main transformer tank and attached components shall be designed to withstand pressures greater than the required operating design value without permanent deformation. Construction shall consist of carbon steel reinforced with external, internal or sidewall braces. All seams and joints shall be continuously welded.
- F. The assembly shall be individually welded and receive a quality control pressurized check for leaks. The entire tank assembly shall receive a similar leak test before tanking. A final six-hour leak test shall be performed.
- G. The transformer(s) shall be compartmental-type, self-cooled and tamper-resistant for mounting on a pad. The unit shall restrict the entry of water (other than flood water) into the compartments so as not to impair its operation. There shall be no exposed screws, bolts or other fastening devices which are externally removable.
- H. The transformer(s) shall consist of a transformer tank and full-height, bolt-on high- and low-voltage cable terminating compartments located side-by-side separated by a rigid metal barrier. Each compartment shall have separate doors, designed to provide access to the high-voltage compartment only after the low-voltage has been opened. There shall be at least one additional fastening device accessible only after the low-voltage door has been opened, which must be removed to open the high-voltage door. Doors shall be mounted flush with the cabinet frame. The low-voltage door shall have a handle-operated, three-point latching mechanism designed to be secured with a single padlock. A hex-head or penta-head bolt shall be incorporated into the low-voltage door latching mechanism. Both high and low-voltage doors shall be incorporated into the low-voltage door latching mechanism. Both high and low-voltage doors shall be equipped with stainless steel hinges and door stops to secure them in the open position.
- I. Compartment sills, doors and covers shall be removable to facilitate cable pulling and installation. The high-voltage door shall be on the left with the low-voltage door on the right. Compartments shall be designed for cable entry from below.
- J. Transformer(s) shall be supplied with a welded or bolted main tank cover and be of a sealed-tank construction designed to withstand a pressure of 7 psig without permanent distortion. The tank cover shall be designed to shed water and be supplied with a tamper-resistant access handhole sized to allow access to internal bushing and switch connections. Transformers supplied with "less flammable" fluids shall be manufactured to withstand 12 psig without rupture. The transformer shall remain effectively sealed for a top-oil temperature of -5 degrees C to 105 degrees C. When necessary to meet the temperature rise rating specified, cooling panels shall be provided.
- K. The transformer manufacturer shall certify that the transformer is non-PCB containing less than 1 part per million detectable PCBs. Nonflammable transformer liquids including askarel and insulating liquids containing tetrachloroethylene, perchloroethylene, chlorine compounds, or halogenated compounds are not acceptable and shall not be provided.
- L. When high-voltage taps are specified above, full-capacity taps shall be provided with a tap changing mechanism designed for de-energized operation. The tap changer operator shall be located within one of the compartments.

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- M. The coil windings shall be designed to reduce losses and manufactured with the conductor material as specified above. All insulating materials shall be rated for 120 degrees C class.
- N. The core material shall be high-grade, grain-oriented, non-aging silicon core steel with high magnetic permeability, low hysteresis and eddy current losses. Magnetic flux densities are to be kept well below saturation to allow for a minimum of 10 percent overvoltage excitation. The cores shall be properly annealed to reduce stresses induced during the manufacturing processes and reduce core losses.
- O. The core frame shall be designed to provide maximum support of the core and coil assembly. The core frame shall be welded or bolted to ensure maximum short-circuit strength.
- P. The core and coil assembly shall be designed and manufactured to meet the short-circuit requirements of ANSI C57.12.90. The core and coil assembly shall be baked in an oven prior to tanking to “set” the epoxy coating on the insulating paper and remove moisture from the insulation prior to vacuum filling.
- Q. Transformer shall be vacuum-filled with the appropriate fluid as indicated above. The process shall be of sufficient vacuum and duration to ensure that the core and coil assembly is free of moisture prior to filling the tank.

2.04 ACCESSORIES

- A. Transformer features and accessories shall include:
 - 1. Dial-type thermometer
 - 2. Liquid level gauge
 - 3. Pressure-vacuum gauge
 - 4. Drain valve with sample valve
 - 5. Pressure relief valve
 - 6. Non-PCB label
 - 7. Upper fill/filter press connection or valve
 - 8. Additional accessories:
 - a. Alarm and Trip contacts (120VAC, 5 Amp rated dry contacts) for pressure, level, and temperature relays
 - b. Rapid pressure rise relay
 - c. Winding temperature relay
 - d. Gas sampling valve

2.05 PRIMARY CONNECTIONS

- A. Transformer primary connections shall be 200 A deadfront load break or 600 A dead break wells and inserts for cable sizes shown on the drawings.

2.06 OVERVOLTAGE PROTECTION

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- A. DEAD-FRONT BUSHINGS: Externally mounted, Distribution Class M.O.V.E. Dead-front elbow arresters shall be supplied. M.O.V.E. arresters are for installation on 200 A rated dead-front bushing interfaces only.

2.07 FINISH

- A. Transformer units shall include suitable outdoor or indoor paint finish. The paint shall be applied using an electrostatically deposited dry powder system to a minimum of three (3) mils average thickness. Units shall be painted padmount green, Munsell No.7GY3.29/1.5.

PART 3 EXECUTION

3.01 FACTORY TESTING

- A. The following standard factory tests shall be performed on the equipment provided under this section. All tests shall be in accordance with the latest applicable ANSI and NEMA standards.
 - 1. Resistance measurements of all windings on the rated voltage connection
 - 2. Ratio tests on the rated voltage connection and on all tap connections
 - 3. Polarity and phase-relation tests on the rated voltage connections
 - 4. No-load loss at rated voltage on the rated voltage connection
 - 5. Exciting current at rated voltage on the rated voltage connection
 - 6. Impedance and load loss at rated current on the rated voltage connection
 - 7. Applied potential test
 - 8. Induced potential tests
- B. The manufacturer shall provide three (3) certified copies of factory test reports to the Engineer upon request.

3.02 FIELD QUALITY CONTROL

- A. Provide the services of a qualified factory-trained manufacturer's representative to assist the Contractor in installation and startup of the equipment specified under this section for a period of 2 working days. The manufacturer's representative shall provide technical direction and assistance to the Contractor in general assembly of the equipment, connections and adjustments, and testing of the assembly and components contained herein.
- B. The Contractor shall provide three (3) copies of the manufacturer's field startup report.

3.03 MANUFACTURER'S CERTIFICATION

- A. A qualified factory-trained manufacturer's representative shall certify in writing that the equipment has been installed, adjusted and tested in accordance with the manufacturer's recommendations.

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- B. The Contractor shall provide three (3) copies of the manufacturer's representative's certification.

3.04 TRAINING

- A. The contractor shall provide a training session for up to five (5) owner's representatives for 1 normal workday at a job site location determined by the owner.
- B. The training session shall be conducted by a manufacturer's qualified representative. The training program shall consist of the instruction on the operation of the assembly, circuit breakers and major components within the assembly.

3.05 INSTALLATION

- A. The Contractors shall install all equipment per the manufacturer's recommendations and the contract drawings.
- B. All necessary hardware to secure the assembly in place shall be provided by the contractor.

3.06 FIELD ADJUSTMENTS

- A. Adjust taps to deliver appropriate secondary voltage.

3.07 FIELD TESTING

- A. Measure primary and secondary voltages for proper tap settings.
- B. Megger primary and secondary windings
- C. Liquid transformers – Test oil for dielectric strength.

+++ END OF SECTION 16321 +++

SECTION 16429
LOW VOLTAGE SWITCHBOARDS

PART 1- GENERAL

1.01 SCOPE

A. The Contractor shall furnish and install, where indicated, a free-standing, dead-front type low voltage distribution switchboard, utilizing group mounted circuit protective devices as specified herein, and as shown on the contract drawings.

1.02 RELATED SECTIONS

1.03 REFERENCES

A. The low voltage distribution switchboards and all components shall be designed, manufactured and tested in accordance with the latest applicable following standards:

1. NEMA PB-2
2. UL Standard 891

1.04 SUBMITTALS – FOR REVIEW/APPROVAL

A. The following information shall be submitted to the Engineer:

1. Master drawing index
2. Front view elevation
3. Floor plan
4. Top view
5. Single line
6. Schematic diagram
7. Nameplate schedule
8. Component list
9. Conduit entry/exit locations
10. Assembly ratings including:
 - a. Short-circuit rating
 - b. Voltage
 - c. Continuous current
11. Major component ratings including:
 - a. Voltage
 - b. Continuous current
 - c. Interrupting ratings
12. Cable terminal sizes
13. Product data sheets

B. Where applicable, the following additional information shall be submitted to the Engineer:

1. Busway connection
2. Connection details between close-coupled assemblies
3. Composite floor plan of close-coupled assemblies
4. Key interlock scheme drawing and sequence of operations

1.05 SUBMITTALS – FOR CONSTRUCTION

A. The following information shall be submitted for record purposes:

1. Final as-built drawings and information for items listed in Paragraph 1.04, and shall incorporate all changes made during the manufacturing process
2. Wiring diagrams
3. Certified production test reports
4. Installation information
5. Seismic certification and equipment anchorage details as specified

1.06 QUALIFICATIONS

- A. The manufacturer of the assembly shall be the manufacturer of the major components within the assembly.
- B. For the equipment specified herein, the manufacturer shall be ISO 9001 or 9002 certified.
- C. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of five (5) years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

1.07 REGULATORY REQUIREMENTS

- A. The low-voltage switchboard shall be UL labeled.

1.08 DELIVERY, STORAGE AND HANDLING

- A. Equipment shall be handled and stored in accordance with manufacturer's instructions. One (1) copy of these instructions shall be included with the equipment at time of shipment.

1.09 OPERATION AND MAINTENANCE MANUALS

- A. Equipment operation and maintenance manuals shall be provided with each assembly shipped and shall include instruction leaflets, instruction bulletins and renewal parts lists where applicable, for the complete assembly and each major component.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Schneider Electric / Square D
- B. Eaton
- C. General Electric
- D. Or approved equal.

The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety. Products in compliance with the specification and manufactured by others not named will be considered only if pre-approved by the Engineer ten (10) days prior to bid date.

2.02 RATINGS

- A. The assembly shall be rated to withstand mechanical forces exerted during short-circuit conditions when connected directly to a power source having available fault current as shown on the drawings.
- B Voltage rating to be as indicated on the drawings.

2.03 CONSTRUCTION

- A. Switchboard shall consist of the required number of vertical sections bolted together to form a rigid assembly. The sides and rear shall be covered with removable bolt-on covers. All edges of front covers or hinged front panels shall be formed. Provide adequate ventilation within the enclosure.
- B. All sections of the switchboard shall be front and rear aligned with depth as shown on the drawings. All protective devices shall be group mounted. Devices shall be front removable and load connections front accessible enabling switchboard to be mounted against a wall.
- C. The assembly shall be provided with adequate lifting means.
- D. The switchboard shall be suitable for use as service entrance equipment where shown on the drawings and be labeled in accordance with UL requirements.

2.04 BUS

- A. All bus bars shall be silver-plated copper. Main horizontal bus bars shall be mounted with all three phases arranged in the same vertical plane. Bus sizing shall be based on NEMA standard temperature rise criteria of 65 degrees C over a 40 degrees C ambient (outside the enclosure).
- B. Provide a full capacity neutral bus where a neutral bus is indicated on the drawings.
- C. A copper ground bus (minimum 1/4 x 2 inch) shall be furnished firmly secured to each vertical section structure and shall extend the entire length of the switchboard.
- D. All hardware used on conductors shall be high-tensile strength and zinc-plated. All bus joints shall be provided with conical spring-type washers.

2.05 WIRING/TERMINATIONS

- A. Small wiring, necessary fuse blocks and terminal blocks within the switchboard shall be furnished as required. Control components mounted within the assembly, such as fuse blocks, relays, pushbuttons, switches, etc., shall be suitably marked for identification corresponding to appropriate designations on manufacturer's wiring diagrams.
- B. Mechanical-type terminals shall be provided for all line and load terminations suitable for copper or aluminum cable rated for 75 degrees C of the size as indicated on the drawings.
- C. Lugs shall be provided in the incoming line section for connection of the main grounding conductor. Additional lugs for connection of other grounding conductors shall be provided as indicated on the drawings.
- D. All control wire shall be type SIS, bundled and secured with nylon ties. Insulated locking spade terminals shall be provided for all control connections, except where saddle type terminals are provided integral to a device. All current transformer secondary leads shall first be connected to conveniently accessible short-circuit terminal blocks before connecting to any other device. All groups of control wires leaving the switchboard shall be provided with terminal blocks with suitable numbering strips. Provide wire markers at each end of all control wiring.

2.06 MAIN AND FEEDER PROTECTIVE DEVICES, 2000A AND BELOW

- A. Protective devices shall be molded case circuit breakers with inverse time and instantaneous tripping characteristics.
- B. Circuit breakers shall be operated by a toggle-type handle and shall have a quick-make, quick-break over-center switching mechanism that is mechanically trip-free. Automatic tripping of the breaker shall be clearly indicated by the handle position. Contacts shall be nonwelding silver alloy and arc extinction shall be accomplished by means of DE-ION arc chutes. A push-to-trip button on the front of the circuit breaker shall provide a local manual means to exercise the trip mechanism.
- C. Circuit breakers shall have a minimum symmetrical interrupting capacity as indicated on the drawings.
- D. Circuit breakers 400-ampere frame and below shall have thermal-magnetic trip units and inverse time-current characteristics.
- E. Circuit breakers 600-ampere and above shall have microprocessor-based rms sensing trip units with the following characteristics:
 - 1. Microprocessor-based tripping system shall consist of three (3) current sensors, a trip unit and a flux-transfer shunt trip. The trip unit shall use microprocessor-based technology to provide the adjustable time-current protection functions. True rms sensing circuit protection shall be achieved by analyzing the secondary current signals received from the circuit breaker current sensors, and initiating trip signals to the circuit breaker trip actuators when predetermined trip levels and time-delay settings are reached.

2. An adjustable trip setting dial mounted on the front of the trip unit shall establish the continuous trip ratings of each circuit breaker.
3. System coordination shall be provided by the following microprocessor-based time-current curve shaping adjustments:
 - a. Adjustable long-time setting (set by adjusting the trip setting dial)
 - b. Adjustable short-time setting and delay with selective curve shaping
 - c. Adjustable instantaneous setting
 - d. Adjustable ground fault setting and delay, where indicated on the drawings
4. The microprocessor-based trip unit shall have both powered and unpowered thermal memory to provide protection against cumulative overheating should a number of overload conditions occur in quick succession.

2.07 ACCESSORIES

- A. Provide shunt trips, bell alarms and auxiliary switches/contacts as shown on the contract drawings.

2.08 MISCELLANEOUS DEVICES

- A. Key interlocks shall be provided as indicated on the drawings.
- B. Control power transformers with primary and secondary protection shall be provided, as indicated on the drawings, or as required for proper operation of the equipment.

2.09 METERING

- A. Metering section shall include a Microprocessor-Based power meter capable of measuring as a minimum Volts, Amps, kW and Power Factor. All meter parameters shall be available for transferring to the Plant SCADA system through an integral EtherNet port via EtherNet TCP/IP protocol. Any deviations in the proposed protocol shall be coordinated with SCADA system integrator.

2.10 ENCLOSURES

- A. NEMA 1 Enclosure unless listed otherwise on Electrical Drawings.

2.11 NAMEPLATES

- A. Engraved nameplates, mounted on the face of the assembly, shall be furnished for all main and feeder circuits as indicated on the drawings. Nameplates shall be laminated plastic, black characters on white background. Characters shall be 3/16-inch high, minimum. Nameplates shall give item designation and circuit number as well as frame ampere size and appropriate trip rating. Furnish master nameplate giving switchboard designation, voltage ampere rating, short-circuit rating, manufacturer's name, general order number, and item number.
- B. Control components mounted within the assembly, such as fuse blocks, relays, pushbuttons, switches, etc., shall be suitably marked for identification corresponding to appropriate designations on manufacturer's wiring diagrams.

2.12 FINISH

- A. All exterior and interior steel surfaces of the switchboard shall be properly cleaned and provided with a rust-inhibiting phosphatized coating. Color and finish of the switchboard shall be ANSI 61 light gray.

2.13 SURGE PROTECTIVE DEVICE

- A. Provide integral surge protective devices with short circuit rating as shown on Electrical Drawings.

2.14 AUTOMATIC THROWOVER SYSTEM

A. Main-Main Automatic Throw over System

- 1. Main-Main Standard functions shall include the following:
 - a. Automatic Transfer to Alternate Source, Manual Return to Normal Source for Main-Main
 - b. Open Transition with control program interlocking to prevent paralleling
 - c. Bypass of Retransfer delay if alternate source fails
 - d. Electrically Interlocked
 - e. Manual Circuit Breaker Close Buttons Inhibited
 - f. Time Delay on Transfer
 - g. Time Delay on Retransfer, Open Transition
 - h. Source Stabilization Before Retransfer
 - i. Undervoltage sensing on both sources (27 Device), adjustable with LED indication
 - j. Phase Sequence reverse phase sensing on both sources (47 Device), 2 cycles with local LED indication
 - k. Phase Loss (47 Device), Adjustable with local LED indication
 - l. Phase Imbalance (47 Device), Adjustable with local LED indication
 - m. Auto/Manual Switch with Removable Key and light indication
 - 1. White Light for Auto
 - 2. Blue Light for Manual
 - n. Control Power Transfer between sources
 - o. Open (Green)/Close (Red) Lighted Pushbuttons for Manual Operation of the Circuit Breakers
 - p. Test switch for simulating loss of either source
 - q. Circuit Breaker electrical trip lockout with amber light indication
 - r. Uninterruptable Power Supply for 120Vac Control Power
 - s. UPS Bypass relay
 - t. White lights for sources available
 - u. Operator Interface Panel
 - v. Wire labels for control wiring
 - w. Fused control circuits with individual blown fuse indication
- 2. Optional functions shall include the following:
 - a. Automatic return from Alternate Source for Main-Main
 - b. Remote alarm contact (system inoperative), 5A @120Vac

- c. Preferred source selector
- d. Pilot Lights test switch
- 3. Documentation shall include the following:
 - a. Wiring diagram of each assembly in system
 - b. System schematic diagram
 - c. Input/output listing
 - d. Sequence of operation
 - e. Test procedures
- 4. The manufacturer shall provide a qualified service representative for one day to start up the automatic throw over system.

PART 3 - EXECUTION

3.01 FACTORY TESTING

- A. The following standard factory tests shall be performed on the equipment provided under this section. All tests shall be in accordance with the latest version of ANSI and NEMA standards.
 - 1. The switchboard shall be completely assembled, wired, adjusted, and tested at the factory. After assembly, the complete switchboard will be tested for operation under simulated service conditions to ensure the accuracy of the wiring and the functioning of all equipment. The main circuits shall be given a dielectric test of 2200 volt for one (1) minute between live parts and ground, and between opposite polarities. The wiring and control circuits shall be given a dielectric test of 1500 volt for one (1) minute between live parts and ground.
- B. The manufacturer shall provide three (3) certified copies of factory test reports.

3.02 INSTALLATION

- A. The Contractors shall install all equipment per the manufacturer's instructions, contract drawings and National Electrical Code.
- B. The assembly shall be provided with adequate lifting means and shall be capable of being moved into installation position and bolted directly to the floor without the use of floor sills provided the floor is level to 1/8 inch per 3-foot distance in any direction. All necessary hardware to secure the assembly in place shall be provided by the Contractor.
- C. Install Switchboard on a 4-inch housekeeping pad and secure to sills imbedded in the concrete with 1/2-inch threaded bolts and nuts.
- D. Touch up paint scratches and vacuum to remove construction debris and dirt. Install all doors, wireway covers etc., and plug any unused device holes.
- E. Properly set and level channel sills.
- F. Furnish complete, clear, and concise instructions for installation, operation, and maintenance of the equipment.

3.03 FIELD ADJUSTMENTS

- A. The Contractor shall perform field adjustments of the protective devices as required to place the equipment in final operating condition. The settings shall be in accordance with the approved short-circuit study, protective device evaluation study and protective device coordination study.
- B. Necessary field settings of devices, adjustments and minor modifications to equipment to accomplish conformance with an approved short circuit and protective device coordination study shall be carried out by the Contractor at no additional cost to the owner.

3.04 TESTS

- A. Set all breakers parameters based on the Power Study recommendations.
- B. Megger each bus, phase-to-phase and phase-to-ground.

+++END SECTION 16429+++

**SECTION 16470
LIGHTING AND POWER DISTRIBUTION PANELBOARDS**

PART 1 – GENERAL

1.01 DESCRIPTION

- A. Three phase, four wire 208Y/120 or 480Y/277 volt, dead front, circuit breaker type panelboard with current rating of 600amperes or less.
- B. Single phase, three wire 120/240 volt, dead front, circuit breaker type panelboards with current rating of 400 amperes or less.

1.02 REFERENCES

- A. This section contains references to the following documents. 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. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.
- B. 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). 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. 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
IEEE	Institute of Electrical and Electronic Engineers
NEMA	National Electrical Manufacturing Association
NFPA 70	National Electrical Code (NEC)
UL 50	Cabinets and Boxes
UL 67	Underwriters Laboratories, Electric Panelboards
UL 489	Molded-Case Circuit Breakers and Circuit Breaker Enclosures
UL 1449	Surge Suppression Devices

PART 2 – PRODUCTS

2.01 MANUFACTURERS

- A. The Owner and Construction Manager believe the following candidate manufacturers are capable of producing equipment and/or products that will satisfy the requirements of this Section. This statement, however, shall not be construed as an endorsement of a particular manufacturer's products, nor shall it be construed that named manufacturers' standard equipment or products will comply with the requirements of this Section. Candidate manufacturers include:
1. Eaton / Cutler-Hammer: PRL1a and PRL3a
 2. General Electric: AQ and AD
 3. Siemens: S1, SE, and S3
 4. Square D: NQOD and NF
 5. Or Engineer Approved equal.

2.02 ARRANGEMENT AND CONSTRUCTION

- A. The front of the panel shall have concealed trim clamps and hinges. The locks shall be flush with cylinder tumbler-type with spring-loaded door pulls. The fronts shall not be removable with doors in the locked position. Panelboard locks shall be keyed alike.
- B. Gutter space shall be provided on all sides of the breaker assembly to neatly connect and arrange incoming wiring.
- C. Panelboard shall be composed of individually mounted circuit breakers designed to be removable without disturbing other breakers.
- D. A directory holder with clear plastic plate and metal frame shall be mounted on the inside of the door.

2.03 BUS

- A. Bus shall be tin-plated copper and shall have current ratings as shown on the panelboard schedules, sized in accordance with UL 67. Ratings shall be determined by temperature rise test.
- B. The minimum bus size shall be 100 amperes. Panel fault withstand rating shall be not less than the interrupting rating of the smallest circuit breaker in the panel. Series rating is prohibited.
- C. Panelboards shall be provided with a separate ground bus and, where specified, with a full capacity neutral bus. The neutral bus shall be mounted on insulated stand-offs.

2.04 CIRCUIT BREAKERS

- A. Circuit breakers shall be molded-case type provided for the current ratings and pole configurations specified on the panelboard schedule. Circuit breakers shall be bolt-on type. Circuit breakers shall be listed in accordance with UL 489 for the service specified. Load terminals of circuit breakers shall be solderless connectors.
- B. Circuit breakers rated 120/208 volt and 120/240 volt alternating current shall have a minimum interrupting current rating of 18,000 amperes symmetrical at 240 volt AC.
- C. Circuit breakers rated 277/480 volt alternating current shall have a minimum interrupting current rating of 25,000 amperes symmetrical at 480 volt or as specified on the panelboard schedule.
- D. Provide circuit breakers with special features such as ground fault interrupting (GFI), heating air conditioning and refrigeration (HACR) rating, or locking capability as shown on the Drawings or Schedules.

2.05 FINISH

- A. Panelboard cabinet shall be fabricated from hot-dip galvanized steel in accordance with UL 50. Panelboard fronts shall have a gray, baked enamel finish.

2.06 NAMEPLATES

- A. Nameplates shall be provided in accordance with the requirements of Section 16000.

2.07 PRODUCT DATA

- A. The following information shall be provided in accordance with the General Conditions:
 - 1. Manufacturer's certification that bus bracing is capable of withstanding the specified short circuit condition.
 - 2. Operation and maintenance information as specified in Section 01730.
 - 3. Quantity and rating of circuit breakers provided with each panelboard.

PART 3 – EXECUTION

3.01 GENERAL

- A. The Contractor shall type in the circuit description on the circuit directory as shown on the final record drawings or panelboard schedule.
- B. Provide “Circuit Directory and Circuit Identification” in accordance with NEC 408.4. Each circuit shall be of sufficient detail to allow each circuit to be distinguished from other

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circuits. Circuit identification shall include load location and provide equipment or instrument Tag Number and Tag Description, where shown on the drawings.

3.02 TESTING

- A. Panelboards shall be tested for proper operation and function.

+++END OF SECTION 16470+++

SECTION 16500

LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Solid-state luminaires that use LED technology.
 - 2. Lighting fixture supports.
 - 3. Exterior light poles, foundations and supports.

1.3 DEFINITIONS

- A. CCT: Correlated color temperature.
- B. CRI: Color Rendering Index.
- C. Fixture: See "Luminaire."
- D. IP: International Protection or Ingress Protection Rating.
- E. LED: Light-emitting diode.
- F. Lumen: Measured output of lamp and luminaire, or both.
- G. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Arrange in order of luminaire designation.
 - 2. Include data on features, accessories, and finishes.
 - 3. Include physical description and dimensions of luminaires and housing.

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4. Include physical description and dimensions of poles, foundations and supports.
 5. Include emergency lighting units, including batteries and chargers.
 6. Include life, output (lumens, CCT, and CRI), and energy efficiency data.
 7. Photometric data and adjustment factors based on laboratory tests
 - a. Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.
 - b. Testing Agency Certified Data: For indicated luminaires, photometric data certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.
- B. Shop Drawings: For nonstandard or custom luminaires.
1. Include plans, elevations, sections, and mounting and attachment details.
 2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 3. Include diagrams for power, signal, and control wiring.
- C. Samples: For each luminaire and for each color and texture with standard factory-applied finish.
- D. Samples for Initial Selection: For each type of luminaire with custom factory-applied finishes.
1. Include Samples of luminaires and accessories involving color and finish selection.
- E. Samples for Verification: For each type of luminaire.
1. Include Samples of luminaires and accessories to verify finish selection.
- F. Product Schedule: For luminaires and lamps, use same designations indicated on Drawings.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Site lighting plan(s), Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Lighting luminaires.
 2. Suspended ceiling components.
 3. Partitions and millwork that penetrate the ceiling or extend to within 12 inches (300 mm) of the plane of the luminaires.
 4. Structural members to which equipment and luminaires will be attached.

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5. Initial access modules for acoustical tile, including size and locations.
6. Items penetrating finished ceiling, including the following:
 - a. Other luminaires.
 - b. Air outlets and inlets.
 - c. Speakers.
 - d. Sprinklers.
 - e. Access panels.
 - f. Ceiling-mounted projectors.
7. Moldings.
8. Pole and arm assemblies for exterior site lighting.
9. Foundations and supports for poles.

B. Qualification Data: For testing laboratory providing photometric data for luminaires.

C. Seismic Qualification Certificates: For luminaires, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

D. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

E. Product Certificates: For each type of luminaire.

F. Product Test Reports: For each luminaire.

G. Sample warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For luminaires and lighting systems to include in operation and maintenance manuals.

1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

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1. Lamps: Ten for every 100 of each type and rating installed. Furnish at least one of each type.
2. Diffusers and Lenses: One for every 100 of each type and rating installed. Furnish at least one of each type.
3. Globes and Guards: One for every 20 of each type and rating installed. Furnish at least one of each type.

1.8 QUALITY ASSURANCE

- A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7, accredited under the NVLAP for Energy Efficient Lighting Products, and complying with the applicable IES testing standards.
- B. Provide luminaires from a single manufacturer for each luminaire type.
- C. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.
- D. Mockups: For interior lighting luminaires in room or module mockups, complete with power and control connections.
 1. Obtain Engineer's approval of luminaires in mockups before starting installations.
 2. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Engineer specifically approves such deviations in writing.
 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.
- B. Provide manufacturer's standard provisions for protecting pole finishes during transport, storage, and installation. Do not store poles on ground. Store poles so they are at least 12 inches (305 mm) above ground level and growing vegetation. Do not remove factory-applied pole wrappings until just before installing pole.

1.10 WARRANTY

- A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.
- B. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Luminaires shall withstand the effects of earthquake motions determined according to ASCE/SEI 7
- B. Seismic Performance: Luminaires and lamps shall be labeled vibration and shock resistant.
 - 1. The term "withstand" means "the luminaire will remain in place without separation of any parts when subjected to the seismic forces."

2.2 LUMINAIRE REQUIREMENTS

- 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. NRTL Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by an NRTL.
- C. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.
- D. Recessed Fixtures: Comply with NEMA LE 4.
- E. Bulb shape complying with ANSI C79.1.
- F. Lamp base complying with ANSI C81.61 or IEC 60061-1.
- G. CRI of 80 CCT (4100 K) minimum.
- H. Rated lamp life of 50,000 hours.
- I. Lamps dimmable from 100 percent to 0 percent of maximum light output.
- J. Internal driver.

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- K. Nominal Operating Voltage: 120 V ac.
 - 1. Lens Thickness: At least 0.125 inch (3.175 mm) minimum unless otherwise indicated.
- L. Housings:
 - 1. Extruded-aluminum housing and heat sink.
 - 2. Anodized finish.

2.3 CYLINDER

- A. SEE LIGHTING FIXTURE SCHEDULE
- B. Minimum lumens per fixture schedule. Minimum allowable efficacy of 80 lumens per watt.
- C. With integral mounting provisions.

2.4 DOWNLIGHT

- A. SEE LIGHTING FIXTURE SCHEDULE
- B. Minimum lumens per fixture schedule. Minimum allowable efficacy of 80 lumens per watt.
- C. Universal mounting bracket.
- D. Integral junction box with conduit fittings.

2.5 HIGHBAY, LINEAR

- A. SEE LIGHTING FIXTURE SCHEDULE
- B. Minimum lumens per fixture schedule. Minimum allowable efficacy of 80 lumens per watt.

2.6 HIGHBAY, NONLINEAR

- A. SEE LIGHTING FIXTURE SCHEDULE
- B. Minimum lumens. Minimum allowable efficacy of 80 lumens per watt.
- C. Universal mounting bracket.

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- D. Integral junction box with conduit fittings.

2.7 LINEAR INDUSTRIAL

- A. SEE LIGHTING FIXTURE SCHEDULE
- B. Minimum lumens per fixture schedule. Minimum allowable efficacy of 80 lumens per watt.
- C. Housing and heat sink rated to the following:
 - 1. Class 1, Division 2 Group(s) (A) (B) (C) and (D).
 - 2. NEMA 4X.
 - 3. IP 54.
 - 4. IP 66.
 - 5. Marine and wet locations.
 - 6. CSA C22.2 No 137.

2.8 LOWBAY

- A. SEE LIGHTING FIXTURE SCHEDULE
- B. Minimum lumens per fixture schedule. Minimum allowable efficacy of 80 lumens per watt.
- C. Universal mounting bracket.

2.9 RECESSED LINEAR

- A. SEE LIGHTING FIXTURE SCHEDULE
- B. Minimum lumens per fixture schedule. Minimum allowable efficacy of 85 lumens per watt.
- C. Integral junction box with conduit fittings.

2.10 STRIP LIGHT

- A. SEE LIGHTING FIXTURE SCHEDULE
- B. Minimum lumens per fixture schedule. Minimum allowable efficacy of 80 lumens per watt.
- C. Integral junction box with conduit fittings.

2.11 SURFACE MOUNT, LINEAR

- A. SEE LIGHTING FIXTURE SCHEDULE
- B. Minimum lumens per fixture schedule. Minimum allowable efficacy of 80 lumens per watt.
- C. Integral junction box with conduit fittings.

2.12 SURFACE MOUNT, NONLINEAR

- A. SEE LIGHTING FIXTURE SCHEDULE
- B. Minimum lumens per fixture schedule. Minimum allowable efficacy of 80 lumens per watt.
- C. Integral junction box with conduit fittings.

2.13 SUSPENDED, LINEAR

- A. SEE LIGHTING FIXTURE SCHEDULE
- B. Minimum lumens per fixture schedule. Minimum allowable efficacy of 85 lumens per watt.

2.14 SUSPENDED, NONLINEAR

- A. SEE LIGHTING FIXTURE SCHEDULE
- B. Minimum lumens per fixture schedule. Minimum allowable efficacy of 85 lumens per watt.
- C. Integral junction box with conduit fittings.

2.15 POLE-MOUNT, SITE AREA

- A. SEE LIGHTING FIXTURE SCHEDULE
- B. Minimum lumens per fixture schedule. Minimum allowable efficacy of 85 lumens per watt.

2.16 MATERIALS

A. Metal Parts:

1. Free of burrs and sharp corners and edges.
2. Sheet metal components shall be steel unless otherwise indicated.
3. Form and support to prevent warping and sagging.

B. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

C. Diffusers and Globes:

1. Tempered Fresnel glass, prismatic glass, diffuse glass, clear glass, prismatic acrylic, clear, UV-stabilized acrylic
2. Acrylic Diffusers: One hundred percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
3. Glass: Annealed crystal glass unless otherwise indicated.
4. Lens Thickness: At least 0.125 inch (3.175 mm) minimum unless otherwise indicated.

D. Housings:

1. Extruded-aluminum housing and heat sink.
2. Anodized finish.

E. Poles:

1. Poles shall be as shown on the drawings, and as specified. Finish shall be as specified on the drawings.
2. The pole and arm assembly shall be designed to meet the wind loading conditions at project site, with an additional 30% gust factor and supporting luminaire(s) and accessories such as shields, banner arms, and banners that have the effective projected areas indicated.
3. Poles shall be embedded, or anchor-bolt type (Aluminum or Steel, per ASTM requirements) designed for use with underground supply conductors. Poles shall be seamless extruded or spun seamless type.
4. Poles shall contain handhole(s) having a minimum clear opening of 2.5 x 5 inches (65 x 125 mm). Handhole covers shall be secured by stainless steel captive screws.
5. Poles shall include a steel-grounding stud (opposite handhole openings), designed to prevent electrolysis when used with copper wire.
6. Provide a base cover that matches the pole in material and color to conceal the mounting hardware pole-base welds and anchor bolts.

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7. Hardware and Accessories: All necessary hardware and specified accessories shall be the product of the pole manufacturer.
- F. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Locate labels where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
 1. Label shall include the following lamp characteristics:
 - a. "USE ONLY" and include specific lamp type.
 - b. Lamp diameter, shape, size, wattage, and coating.
 - c. CCT and CRI for all luminaires.

2.17 METAL FINISHES

- A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

2.18 LUMINAIRE FIXTURE SUPPORT COMPONENTS

- A. Comply with requirements in Section 15.... "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.
- B. Single-Stem Hangers: 1/2-inch (13-mm) steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.
- C. Wires: ASTM A 641/A 641 M, Class 3, soft temper, zinc-coated steel, 12-gage (2.68 mm).
- D. Rod Hangers: 3/16-inch (5-mm) minimum diameter, cadmium-plated, threaded steel rod.
- E. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

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- B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before fixture installation. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 TEMPORARY LIGHTING

- A. If approved by the Engineer, use selected permanent luminaires for temporary lighting. When construction is sufficiently complete, clean luminaires used for temporary lighting and install new lamps.

3.3 INSTALLATION

- A. Install lighting in accordance with the NEC, as shown on the drawings, and in accordance with manufacturer's recommendations.
- B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.
- C. Install lamps in each luminaire.
- D. Supports:
 - 1. Sized and rated for luminaire weight.
 - 2. Able to maintain luminaire position after cleaning and relamping.
 - 3. Provide support for luminaire without causing deflection of ceiling or wall.
 - 4. Luminaire mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and vertical force of 400 percent of luminaire weight.
- E. Flush-Mounted Luminaire Support:
 - 1. Secured to outlet box.
 - 2. Attached to ceiling structural members at four points equally spaced around circumference of luminaire.
 - 3. Trim ring flush with finished surface.
- F. Wall-Mounted Luminaire Support:
 - 1. Attached to structural members in walls; to a minimum 20-gauge backing plate (attached to wall structural members); or attached using through-bolts and backing plates on either side of wall(s).
 - 2. Do not attach luminaires directly to gypsum board.
- G. Ceiling-Mounted Luminaire Support:

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1. Ceiling mount with two 5/32-inch (4 mm) diameter aircraft cable supports adjustable to 120 inches (6 m) in length.
2. Ceiling mount or four-point pendant mount with 5/32-inch (4 mm) diameter aircraft cable supports adjustable to 120 inches (6 m) in length.
3. Ceiling mount with hook mount.

H. Suspended Luminaire Support:

1. Pendants and Rods: Where longer than 48 inches (1200 mm), brace to limit swinging.
2. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.
3. Continuous Rows of Luminaires: Use tubing or stem for wiring at one point and tubing or rod wire support for suspension for each unit length of luminaire chassis, including one at each end.
4. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.

I. Ceiling-Grid-Mounted Luminaires:

1. Secure to any required outlet box.
2. Secure luminaire to the luminaire opening using approved fasteners in a minimum of four locations, spaced near corners of luminaire.
3. Use approved devices and support components to connect luminaire to ceiling grid and building structure in a minimum of four locations, spaced near corners of luminaire.

J. Pole Foundations:

1. Excavate only as necessary to provide sufficient working clearance for installation of forms and proper use of tamper to the full depth of the excavation. Prevent surface water from flowing into the excavation. Thoroughly compact backfill with compacting arranged to prevent pressure between conductor, jacket, or sheath, and the end of conduit.
2. Set anchor bolts according to anchor-bolt templates furnished by the pole manufacturer.
3. Install poles as necessary to provide a permanent vertical position with the bracket arm in proper position for luminaire location.
4. After the poles have been installed, shimmed, and plumbed, grout the spaces between the pole bases and the concrete base with non-shrink concrete grout material. Provide a plastic or copper tube, of not less than 9 mm (0.375-inch) inside diameter through the

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grout, tight to the top of the concrete base to prevent moisture weeping from the interior of the pole.

- K. Comply with requirements in Section 16... "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.
- L. Ground noncurrent-carrying parts of equipment, including metal poles, luminaires, mounting arms, brackets, and metallic enclosures, as specified in Section 16... "Grounding and Bonding... exterior lighting and metal poles".

3.4 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 16050 "Electrical Identification".

3.5 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
 - 2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.
- B. Luminaire will be considered defective if it does not pass operation tests and inspections.
- C. Prepare test and inspection reports.

3.6 STARTUP SERVICE

- A. Comply with requirements for startup specified in Section 15... "Addressable-Fixture Lighting Controls."
- B. Comply with requirements for startup specified in Section 15..."Relay-Based Lighting Controls."

3.7 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting the direction of aim of luminaires to suit occupied conditions. Make up to two visits to project site during other-than-normal hours for this purpose. Some of this work may be required during hours of darkness.

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1. During adjustment visits, inspect all luminaires. Replace lamps or luminaires that are defective.
2. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
3. Adjust the aim of luminaires in the presence of the Engineer.

END OF SECTION 16500

**SECTION 16999
ACCEPTANCE TESTING AND CALIBRATION**

PART 1 - GENERAL

1.01 SCOPE

- A. This Section includes the field testing, inspection and adjusting of all material and equipment installed. Other Electrical Sections covering individual types of equipment may have additional testing requirements.

1.02 QUALITY ASSURANCE

- A. Reference Standards: Comply with all Federal and State laws or ordinances, as well as all applicable codes, standards, regulations and/or regulatory agency requirements including the partial listing below:
 - 1. NEC, National Electrical Code.
 - 2. NEMA, National Electrical Manufacturers Association
 - 5. ASTM, American Society for Testing Materials.
 - 4. IEEE, Institute of Electrical and Electronics Engineers.
 - 5. NETA, National Electrical Testing Association.
 - 6. ANSI, American National Standards Institute.
 - 7. IPCEA, Insulated Power Cable Engineers Association.
 - 8. OSHA, Occupational Safety and Health Act.
- B. Items not passing test will be rejected and shall be repaired or replaced with acceptable new items. The repaired and replacement items shall be tested.

PART 2 - PRODUCTS Not Applicable.

PART 3 - EXECUTION

3.01 GENERAL

- A. Inspect, test and calibrate in accord with manufacturer's instructions supplemented by this Specification.
- B. Institute and maintain rigorous precautions for all test procedures. Maintain telephone or voice radio contact between the potential source location and energized remote locations during any potential testing operations.
- C. Contractor shall utilize the services of a testing firm, approved by the Engineer, which is regularly engaged in the testing of electrical equipment, devices,

installations and systems to conduct all of the testing specified in this Section. The testing firm shall meet the qualification criteria set forth in NETA acceptance testing specification.

3.02 POWER CIRCUIT BREAKERS

- A. Preparatory Work: Prior to testing, remove each breaker from its compartment. Clean, lubricate, inspect and adjust each breaker in accord with manufacturer's published maintenance instructions. Inspect contacts, arc quenchers, primary and secondary disconnects, current sensors, small wiring and trip devices. Examine contacts for condition, clearance, pressure and wipe.
- B. Tests and Data: Determine and record the following data:
1. Breaker identification, including City's designation, manufacturer's ratings, serial number, trip device type, ranges and time bands.
 2. Test each breaker electrically for proper tripping characteristics by passing 60 Hz. sinusoidal low voltage current through each pole, one at a time, with test current injection at the primary disconnects. Adjust trip devices for required pickup characteristics. Perform tests at operating trip device settings as specified. Include this information in the report plus the record of the settings "as left" after calibration.
 3. Apply sufficient current to actuate each mode of trip device, i.e., long time pickup, long time delay band, short time pickup, short time delay band, instantaneous pickup, ground pickup and ground delay band as applicable. Test current and elapsed time at tripping. For each pole, state whether or not breaker tripping is within the manufacturer's tolerances.
 4. Perform insulation resistance test on each breaker. With contacts closed, apply 1000 volts DC for each 600 V and under and 250 V DC up to 5 KV and make readings after one-minute energization between each pair of poles and from each pole to the breaker frame.
- C. Molded Case Circuit Breakers and Motor Circuit Protectors. Test automatic molded case circuit breakers for acceptance. Quantity to be tested is indicated below.
1. Thermomagnetic Trips. (Breakers Only). Test breakers having thermomagnetic trips in a temperature controlled environment maintained at 40⁰ C plus or minus 3⁰ C. A temperature stabilization period of 15 minutes is required prior to testing the inverse-time automatic tripping characteristics. Test each pole of each breaker at 90% and 200% of its continuous current rating. Replace any breaker or trip device which trips within 10 minutes at

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90%, or which fails to trip at 200% within the time indicated in the following table:

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Rated Continuous Current, Amperes	Max. Tripping Time, Minutes	Breakers tested per Panel or Switchboard
15 - 40	2	10% (not less than 2)
50	4	20% (not less than 1)
60 - 100	6	50% (not less than 1)
125 - 225	8	100%
250 - 400	10	100%
500 - 600	12	100%
700 - 800	14	100%
1000	16	100%
1200	18	100%

2. Instantaneous Trips. Test each pole of each breaker and motor circuit protector for automatic instantaneous tripping with slowly rising current. Replace any breaker or trip device which fails to operate within the following values:

Non Adjustable Trips - plus or minus 20% of fixed setting.

Adjustable Trips - plus or minus 10% of the high setting of the rms values of the instantaneous tripping current.

3. Motor Circuit Protectors after testing shall be placed in service at the minimum position which permits motor starting based on motor nameplate data following MCP manufacturer's instructions.

3.03 MOTORS AND MOTOR CONTROLS

- A. Inspect and test motors and motor wiring, power and control for proper connection, circuit continuity, wire identification, insulation resistance and proper functioning or operation. Test insulation resistance from line to line and from each line to ground with a test instrument. Make tests prior to energizing circuits. Test motors for correct rotation. Test proper operation of starters and control devices. Record the nameplate data of motors for the selection of the proper overload relay heater size.
- B. Test and inspect power distribution equipment for damage, defects and for proper functioning of all electrical and mechanical components. Test line and load bus, connections and conductors and test circuit breakers for proper electrical and mechanical operation.
- C. Place motor circuit protectors in service at the minimum position which permits motor starting, based on motor nameplate data and following MCP manufacturer's instructions.

3.04 LIQUID FILLED TRANSFORMERS

- A. Inspect for physical damage, cracked insulators, leaks and tightness of connections. Verify proper auxiliary device operation. Verify proper liquid level in all tanks and bushings. Perform specific inspections and mechanical tests as recommended by manufacturer. Verify proper equipment grounding.
- B. Perform insulation-resistance tests, winding-to-winding, and windings-to-ground. Perform a turns-ratio test between windings at all tap positions. Sample insulating liquid in accordance with ASTM D-923. Sample shall be laboratory tested for, acid neutralization number, specific gravity, interfacial tension and color.
- C. Perform all other tests not specified here, but required to conform to the requirements of NETA.

3.05 MEDIUM VOLTAGE MOTOR STARTERS

- A. Inspect for physical, electrical and mechanical conditions. Check for proper anchorage, required area clearances and physical damage. Verify that fuse sizes and types correspond to Drawings. Verify that instrument transformer ratios correspond to Drawings. Check all bus and cable connections and bolt tightness. test all electrical and mechanical interlock systems for proper operation. verify proper barrier and shutter installation and operation. Inspect contactors for mechanical operation. Inspect and adjust contact gap, wipe, alignment, pressure, etc., per manufacturer's requirements. Compare overload protection rating with motor to verify proper size. Set adjustable devices per protective device coordination study.
- B. Perform ration and polarity tests on all current and voltage transformers. Perform insulation-resistance tests on each bus section, phase-to-phase, and phase-to-ground. Perform insulation-resistance test at 1000 volt DC on control wiring. Perform insulation-resistance tests on contactor, phase-to-ground across the open contacts. Perform bottle integrity test on each pole for vacuum contactors.
- C. Perform all other tests not specified here, but required to conform to the requirements of NETA.

3.06 SPECIAL SYSTEMS

- A. Exercise care in the testing of electrical systems so as not to damage special, electronic or instrumented circuits. Do not undertake to check or test special electronic or instrumented circuits beyond the manufacturer's instructions included with the equipment and performed for equipment installation. Test the continuity

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only for alarm, instrumentation, or similar special wiring systems prior to the final equipment connections.

3.07 INSULATION TESTS

- A. Furnish the necessary test equipment and labor to test the insulation of electrical equipment and circuits before they are energized. Use a 1000 volt "Megger" or other approved instrument, to test the insulation resistance of circuits insulated for 600 volts, associated motors and transformers, low-voltage motor control centers and low voltage switchboard.
- B. Insulation Tests: Include, but are not limited to, the following:
1. Transformers: Test primary to ground, secondary to ground and primary to secondary.
 2. Services: Test phase to phase and each phase to ground.
 3. Cables: Test phase to phase and each phase to ground.
 4. Perform continuity test to ensure proper cable connection.
 5. Motors: Test winding to ground.
 6. Load Side of 600 Volt Circuits: Test each phase to ground and phase to phase.
 7. Minimum Acceptable Megger Readings (Megohms at 20 C) for 600 volt class equipment:

Transformers	Megohms
Primary to ground	20
Primary to Secondary	20
Secondary to Ground	5
Services - Motor Starters and Buses	20
Motors	1
Load side of 600 volt circuits less motor	20

- C. Control power transformers, potential transformers and other devices connected phase to phase or phase to ground and any devices not designed to withstand the test voltages must be disconnected when testing insulation resistance in switchboard, motor control centers and other apparatus.

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- D. Keep written record of tests performed on forms approved for the purpose and turned over to Engineer upon request, or at the termination of the Work. Identify each circuit or piece of apparatus tested, the date of the test, the temperature at the time of testing, the instrument used, the test voltage applied, the resistance values found and the name of the person in charge of and witnessing the test.

3.08 FINAL INSPECTION AND TEST

- A. Upon completion of the various phases of the project, or at convenient times during progress of the Work, check and/or test as herein specified all equipment and wire installed.
- B. Upon receipt of written notice that the work has been completed, including tests herein specified, Engineer's representative will give the entire work a thorough inspection. Any defects or omissions noted shall be corrected before acceptance of the work.
- C. The inspections and tests to be made by the Contractor shall include, but are not limited to, the following:
 - 1. Visually inspect wires and cable connections including internal wiring of switchgear, transformers and other equipment.
 - 2. Verify continuity of power and control conductors.
 - 3. Make insulation tests as herein specified.
 - 4. Check control circuits for short circuits and extraneous grounds.
 - 5. Check equipment for proper mechanical adjustment and freedom of operation and removal of shipping blocks and/or stops.
 - 6. Check closing, tripping, supervision and alarm functions of the controlled equipment.
 - 7. Operate motor controllers, contactors, etc., from their control devices.
 - 8. Check operation of alarm circuits.
 - 9. Check motors for proper rotation and motor currents measured under load conditions. Any motor found to be operating incorrectly shall be inspected to determine the cause and the condition shall be corrected to the satisfaction of Engineer. Furnish a record of these tests to Engineer.

END OF SECTION 16999