COLLIER COUNTY
NAPLES, FLORIDA

SCRWTP FILTER MEDIA REPLACEMENT, BLEND TANK PASSIVE RELIEF

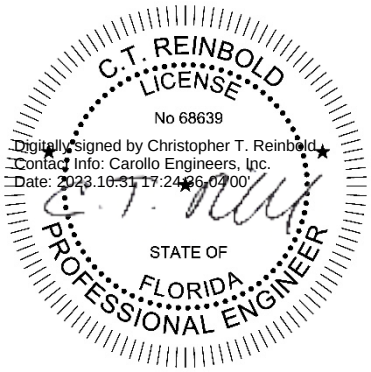
CLIENT PROJECT NO. 70136.1.6, 70136.1.8, 70165.34

CONTRACT & TECHNICAL SPECIFICATIONS

BID SET SUBMITTAL

VOLUME 1 OF 1

OCTOBER 2023



This item has been digitally signed and sealed by C.T. Reinbold on the date adjacent to the seal.

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COLLIER COUNTY

SCRWTP FILTER MEDIA REPLACEMENT, BLEND TANK PASSIVE RELIEF

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SECTION 01_11_00

SUMMARY OF WORK

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Detailed description of the Work.

1.02 THE WORK

A. The Work consists of demolition and construction of the following items. All of which shall be constructed in accordance with the Drawings and Specifications:
   1. Demolish and dispose of existing FRP filter wash throughs, and wash trough support.
   2. Demolish and dispose of existing sub-surface agitators, surface sweep rotational indicators, and associated wash water piping (up to the flange nearest to the wall penetration).
   3. Demolish and dispose of existing clay tile underdrain system. Any anchors remaining shall be cut flush to the existing concrete underdrain slab.
   4. Demolish and dispose of all existing filter media including anthracite, sand, and gravel.
   5. Provide new FRP filter wash troughs and mounting system.
   6. Provide new surface wash spray assemblies, including new rotational indicators and associated surface wash piping.
   7. Provide new HDPE filter underdrain system.
   8. Provide new filter media (12” gravel, 9” sand, 21” anthracite).
   9. Provide new tee connections and protective enclosure for passive overflow relief.

B. The work to be performed under this Contract shall consist of furnishing all tools, equipment, materials, supplies, and manufactured articles and for furnishing all transportation and services, including fuel, power, water, and essential communications, and for the performance of all labor, work, or other operations required for the fulfillment of the Contract in strict accordance with the Contract Documents.

C. Implied and Normally Required Work: It is the intent of these Specifications to provide the County with complete operable systems, subsystems, and other items of Work. Any part or item of Work, which is reasonably implied or normally required to make each installation satisfactorily and completely operable, is deemed to be included in the Work and the Contract Amount. All miscellaneous appurtenances and other items of Work incidental to meeting the intent of these Specifications are included in the Work and the Contract Amount even though these appurtenances may not be specifically called for in these Specifications.

D. Quality of Work: Regard the apparent silence of the Contract Documents as to any detail, or the apparent omission from them of a detailed description concerning any Work to be done and materials to be furnished as meaning that only the best general practice is to prevail and that only materials and workmanship of the best quality are to be used. Interpretation of these specifications will be made upon this basis.

E. Except as specifically noted otherwise, provide and pay for:
   1. Insurance and bonds.
   2. Labor, materials, and equipment.
   3. Tools, equipment, and machinery required for construction.
   4. Utilities required for construction.
   5. Temporary facilities including sheeting and shoring.
   6. Traffic control and dust control measures.
   7. Other facilities and services necessary for proper execution and completion of the Work.

1.03 LOCATION OF PROJECT

A. The Work is located at the South County Regional Water Treatment Plant (SCRWTP) located at 3851 City Gate Boulevard near the City of Naples, Florida, 34117.

1.04 COUNTY ASSIGNED SUBCONTRACTORS

A. There are no County-assigned sub-contractors.

1.05 COUNTY FURNISHED EQUIPMENT

A. Anthracite, silica sand, and graded gravel for Filter No. 3 have been procured by the County and shall be provided for installation by the Contractor.

B. County will:
   1. Arrange for and deliver necessary shop drawings, product data, and samples to Contractor.
   2. Arrange and pay for product delivery to site in accordance with construction schedule.
   3. Deliver supplier's bill of materials to Contractor.
   4. Inspect deliveries jointly with Contractor.
   5. Submit claims for transportation damage.
   6. Arrange for replacement of damaged, defective, or missing items.
   7. Arrange for manufacturer's warranties, bonds, service, and inspections.

C. Contractor's responsibility for County-furnished products:
   1. Designating delivery date for each County-furnished product.
   2. Reviewing shop drawings, product data, and samples.
   3. Submitting notification of discrepancies or anticipated problems.
   4. Receiving and unloading products at site.
   5. Promptly inspecting products jointly with County and recording shortages, and damaged or defective items.
   6. Handling products at site, including uncrating and storage.

7. Protecting products from damage.
8. Installing, including assembly, connections, adjustments, and commissioning in accordance with Contract Documents.
9. Providing operating oils, lubricants, and incidental materials required for complete installation.
10. Repairing or replacing items damaged after receipt until date of Substantial Completion of the Work by County.

D. When County fails to deliver products in accordance with accepted Construction Schedule, adjustments will be made to Contract Times and Contract Price as stipulated in General Conditions.

1.06 ACTIVITIES BY OTHERS

A. Activities by others which may affect performance of work include:
1. County will continuously operate the SCRWTP as a public water supply. As such, there will be ongoing operations and maintenance activities by either County forces or outside contracted firms. Contractor shall not interfere with the work of others in or near the work area.
2. The County will occupy premises during the entire period of construction in order to maintain normal operations. Cooperate with the County's Manager or designee in all construction operations to minimize conflict, and to facilitate County usage.

1.07 QUALIFICATION OF BIDDERS

A. Minimum qualification requirements for General Contractors shall include completion of at least 3 projects in the past ten (10) years, which meet the following criteria:
1. Minimum contract value of $1,000,000.
2. Water or wastewater treatment plant projects. The scope of work for these reference projects shall include either water and/or wastewater filters (including underdrain and surface wash assemblies) in reinforced concrete water retaining structures of at the least the size indicated on the drawings. Contractor project manager and superintendent shall have directly performed filter media replacement projects at a water and/or wastewater facility within the last 8 years.
3. Retrofit, rehabilitation, or improvements completed to an operating water or wastewater facility without unreasonable disruptions to service due to Contractor’s actions or failure to act.
4. Work including water retaining structures, gravity piping systems, site work, structural repair, mechanical, and work of similar type, size, and complexity.
5. Projects completed and operating to the satisfaction of County (to be verified by calling references).
6. Projects completed on time.
7. Projects completed within budget without unreasonable claims or excessive change orders.

B. Any sub-contractors selected by Contractor shall have equivalent experience for the trade in which the work will be performed (exclusive of dollar value noted).

1.08 COORDINATION OF WORK

A. Contractor shall have a preconstruction video made that records the project sites (with the Engineer and County present) including all concrete and asphalt pavements, curb and gutter, fencing to remain, structures to be demolished, and existing structures and facilities that are to be modified.
   1. The original and 2 copies of the DVD shall be turned over to Engineer and County prior to beginning construction activities.
   2. The format of the video file on the DVD shall be 1 file that can be played on a desktop in the windows media player.
   3. The video shall clearly identify existing site and structural conditions prior to construction.

1.09 CONTRACTOR'S USE OF SITE

A. Limit use of site and premises for work and storage to allow for the following:
   1. Coordination of the Work under this Contract with the work of the other Contractors where Work under this Contract encroaches on the Work of other Contractors.
   2. County occupancy and access to operate existing facilities.
   3. Coordination of site use with Engineer.
   4. Responsibility for protection and safekeeping of products under this Contract.
   5. Providing additional off-site storage at no additional cost to the County as needed.

1.10 COUNTY OCCUPANCY

A. The County will occupy premises during the entire period of construction in order to maintain normal operations. Cooperate with the County's Manager or designee in all construction operations and minimize conflict, and to facilitate County's usage.

B. Conduct operations with the least inconvenience to the general public.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01_14_00

WORK RESTRICTIONS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Requirements for sequencing and scheduling the Work affected by existing site and facility, work restrictions, and coordination between construction operations and plant operations.

1.02 SUBMITTALS

A. Baseline Schedule with MOP tasks.

B. Method of Procedure (MOP) Form.

C. Method of Procedure (MOP) Log.

D. Progress Schedule with MOP tasks.

1.03 GENERAL CONSTRAINTS ON WORK AND SCHEDULING OF WORK

A. Perform abandoned pipe Work as specified.

B. Water projects:
   1. The SCRWTP is the County's sole source of drinking water for the local service area.
   2. Conduct Work such that the County's ability to meet its customer's demands for treated drinking water shall not be impaired or reduced in terms of the required quantity or quality of treated water. Do not impair the operational capabilities of essential elements of the treatment process or reduce treatment capacity below levels sufficient to meet demands for water throughout the contract time.
   3. Conduct commissioning activities as specified in Section 01_75_17 - Commissioning in a manner that will not impair capabilities of essential elements of the treatment process or reduce treatment capacity below levels sufficient to meet demands for water throughout the contract time. The quantities of and quality of treated water required are described in this Section.
   4. The status of the treatment plant shall be defined as "operational" when the plant is capable of meeting the County's customer's demands for treated drinking water.

C. Instrumentation and controls process performance testing:
   1. After the Process Operational Period, test PCIS system as specified in Section 01_75_17 - Commissioning.

1.04 SHUTDOWN AND CONSTRUCTION CONSTRAINTS

A. General shutdown constraints:
   1. Execute the Work while the existing facility is in operation.
   2. Some activities may be accomplished without a shutdown.
   3. Apply to activities of construction regardless of process or work area.
   4. Activities that disrupt plant or utilities operations must comply with these shutdown constraints.
   5. Organize work to be completed in a minimum number of shutdowns.
   6. Provide thorough advanced planning, including having required equipment, materials, and labor on hand at time of shutdown.
   7. Where required to minimize treatment process interruptions while complying with specified sequencing constraints, provide temporary pumping, power, lighting, controls, instrumentation, and safety devices.
   8. Final determination of the permitting of shutdowns will be the sole judgment of the County.
   9. County maintains the ability to abort on the day of the scheduled shutdown.

B. Unit process availability work limitations:
   1. Shutdowns and tie-ins or other activities that disrupt plant operations are prohibited unless the following unit process availability conditions exist and unless otherwise approved in writing by the County and Engineer.
      a. The reverse osmosis treatment system is fully operational.
      b. Shutdowns to make tie-ins shall be less than 6 hours.
   2. At a minimum, the following facilities must be in service in order to proceed with a scheduled shutdown.
      a. The reverse osmosis treatment system.
      b. Transfer pumps and blend tank.
      c. Finished water storage tanks.
      d. High service pumps.
      e. All associated chemical storage and feed system necessary to operate the reverse osmosis treatment system including subsequent disinfection.
   3. A full-plant shut down will be required for the passive relief overflow tie-in.
      a. Contractor to coordinate directly with the County and Engineer to develop an acceptable MOP for the passive overflow relief tie-in. See Section 1.09 Work Sequence for additional details.

C. Shutdown activities:
   1. Scheduling:
      a. Perform between the hours as approved by County. Shutdowns shall be planned and executed by the Contractor which shall not exceed 12 hours in duration.
      b. Shutdowns shall not be allowed on Fridays or County holidays.
   2. Unplanned shutdowns due to emergencies are not defined in this Section.

D. Dewatering of existing process:
    1. When the County has turned the process unit over to the Contractor for modification or temporary use, the Contractor is responsible for costs and procedures required to dewater and dispose of liquid in the process units and/or connecting piping.
        a. Drainage and disposal of process unit liquids, solids, etc. into another treatment process unit on the plant site may be allowed if approved in advance by the Engineer and County, and is conducted in accordance with County's requirements.
        b. Costs for dewatering and preparation of surfaces for the Work are Contractor's responsibility.
        c. Contractor shall provide adequate time in schedules for draining and cleanup of tanks and piping.

E. Process area construction constraints:
    1. The following constraints shall be observed while working in and around each of the following process areas.
    2. Material hauling operations:
        1) Contractor shall comply with restrictions regarding Contractor's use of site and premises as specified in Section 01_11_00 - Summary of Work.

1.05 METHOD OF PROCEDURE (MOP)

A. MOP Instructions: See Appendix A.

B. Prepare MOP for the following conditions:
    1. Shutdowns, diversions, and tie-ins to the existing facility.
    2. Process start-up activities.
    3. Power interruption and tie-ins.
    4. Switch over between temporary and permanent facilities, equipment, piping, and electrical and instrumentation systems.
    5. Process constraints requiring interruption of operating processes or utilities.

C. Other Work not specifically listed may require MOPs as determined necessary by the Contractor, County, or Engineer.

D. Submit Baseline Schedule, as specified in Section 01_32_21 - Schedules and Reports.

E. Submit MOP Log at construction progress meetings.

F. No consideration will be given to claims of additional time and cost associated to preparing MOPs required by the County and Engineer to complete this work in a manner that facilitates proper operation of the facility and compliance with meeting the drinking water permit criteria.

G. Where required to minimize treatment process interruptions while complying with specified sequencing constraints, provide temporary pumping, power, lighting, controls, instrumentation, and safety devices.

1.06 COMPLIANCE WITH DRINKING WATER PERMIT

A. The existing facility is operating under the terms of Drinking Water permit issued by the Florida Department of Environmental Protection. This permit specifies the water quality limits that the plant must meet prior to conveyance of finished water. A copy of the existing permit is on file for review at the SCRWTP.

B. Perform work in a manner that will not prevent the existing facility from achieving the finished water quality requirements established by regulations.

C. Bear the cost of penalties imposed on the County for water quality violations caused by actions of the Contractor.

1.07 OPERATIONS AND MAINTENANCE ACCESS

A. Provide safe, continuous access to process control equipment for plant operations personnel.

1.08 UTILITIES

A. Provide advance notice to and utilize services of locating service(s) for location and marking of underground utilities operated by utility agencies other than the County.
   1. Sunshine State One Call, at 1-800-432-4770.
   2. Other locating service retained and paid by Contractor as required for the performance of the work.

B. Maintain electrical, telephone, water, gas, sanitary facilities, and other utilities within existing facilities in service. Provide temporary utilities when necessary.

C. New yard utilities were designed using existing facility drawings.
   1. Field verification of utilities locations performed during design are as noted on the drawings.
   2. Services crossed or located nearby by new yard utilities may require relocation and possible shutdowns.
   3. Pipe alignments as indicated on the Drawings.

1.09 WORK SEQUENCE

A. Contractor shall sequence the work to minimize disruption to the existing operation of facilities, keep plant drives accessible for personnel and fire access and chemical deliveries, and coordinate the following tasks along with all other activities required to complete the work indicated on the Drawings and Specifications:
   1. All features shall be constructed up to the point of connection, but not making the connection, to existing process features.
   2. The number of filters that may be taken out of service for work at any time is described in Section 46_61_11 – Filter Underdrain System.
   3. Perform installation testing, functional testing, and clean water facility testing. All work shall be deemed substantially complete such that the request for clearance to place components into service may be requested from FDEP.
   4. Upon receipt of authorization to place components into service, perform process startup.

5. For any other item indicated in the Contract Documents, but not listed above, Contractor shall sequence construction to minimize impacts to the existing water treatment plant processes.
6. All surfaces that come into contact with potable water, or water being treated to become potable water, or chemicals used to treat the water, shall be disinfected per Section 01_75_18.

B. Work sequence for the passive relief overflow tie in shall additionally include the following:
1. The County will shut down both lime and RO treatment systems
2. The County will operate transfer pumps to the low level cutoff on the shutdown,
3. The Contractor may proceed with draining additional water, cutting into pipe and making any connections.
4. The shutdown shall be limited to a total of 8 hrs.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

ATTACHMENT A - METHOD OF PROCEDURE (MOP)

“METHOD OF PROCEDURE” (MOP)
Instructions and Forms

Definition and Purpose

“Method of Procedure” (MOP) is a detailed document submitted by the Contractor to request process shutdown(s), utility tie-in(s), work in areas that may risk unanticipated outages, or flow diversions to accommodate site construction activities during a project. Such activities may include (but are not limited to) new tie-ins to utilities or structures, mechanical modifications to process piping or equipment, demolition, bulkhead installation, and cleaning processes.

The MOP provides a detailed plan to the County and Engineer that describes specific aspects of the work including purpose, time of execution, and anticipated impacts on treatment processes. The MOP also includes contingency measures and provisions for rapid closure in the event that shutdown or work progress difficulties are encountered. Information from relevant trades associated with the requested shutdown, diversion, or tie-in is also included.

The County should use the information within the MOP to define operational procedures and methods to safely and successfully assist the Contractor.

MOP Process Summary

WHO	STEP	TIMING
Contractor	1. Identify MOPs needed on MOP Log and Baseline Schedule.	No later than 7 days prior to Preconstruction Scheduling Meeting
Contractor, County, Engineer	2. Pre-MOP Meeting.	More than 28 days prior to work
Contractor	3. Submits MOP.	No later than 28 days prior to work
County	4. Reviews MOP.	
County	5. MOP finalized.	No later than 7 days prior to work
Contractor	6. Complete Readiness Checklist.	No later than 5 days prior to work
Contractor	7. Complete Safety Checklist.	Immediately prior to commencing work
Contractor	8. Complete Work.	
Contractor	9. Update MOP Log and Progress Schedules.	Monthly

MOP Process Detail

STEP 1. Identifies MOPs needed on MOP Log and Baseline Schedule.

Contractor submits a preliminary list of anticipated project MOPs on MOP Log. MOPs identified but not limited to those shutdowns, diversions, or tie-ins described in the Contract Documents. Incorporate MOPs as tasks in Baseline Schedule. Date scheduled MOPs to coincide with the appropriate construction activities.

STEP 2. Pre-MOP Meeting.

Contractor requests a Pre-MOP Meeting with the County and Engineer to discuss the nature of the shutdown, diversion, or tie-in, and to gather the information necessary to complete the MOP Form. The pre-MOP meeting may be waived by the County or Engineer if the work is deemed to be minor.

STEP 3. Submits MOP.

Contractor completes the MOP Form and submit 3 copies for approval to the County's Project Manager (OPM).

STEP 4. Reviews MOP.

OPM distributes MOP Form for review by the County's Construction Coordinator, O&M Representative, and Engineer's Project Representative. Review MOP Form for completeness, accuracy, compliance with both the construction schedule, constraints defined in contract documents, and to ensure that the requested work does not negatively impact plant operations or other concurrent project activities. Additional information may be requested to better understand the nature of and method for completing the Work.

STEP 5. MOP finalized.

Once the MOP is agreed to by all parties, the MOP will be finalized by signature. Copies are distributed to the County, Engineer, and Contractor.

STEP 6. Complete Readiness Checklist.

Contractor verifies everything is ready for the work.

STEP 7. Complete Safety Checklist.

Contractor ensures safety.

STEP 8. Complete work.

Contractor complete work.

STEP 9. Update MOP Log and Progress Schedules.

Contractor updates MOP Log weekly and distributes at the regularly scheduled construction progress meetings.

ATTACHMENT B - METHOD OF PROCEDURE (MOP) FORM

METHOD OF PROCEDURE (MOP) FORM

County: _____ **Date:** _____

Contractor: _____ **Carollo Project No.:** _____

Project Name: _____ **Submittal No.:** _____

Submittal Title: _____ **Spec/Dwg. Reference:** _____

MOP #	Task Title *(Provide <10 word title)*:	Submittal Date: *(No later than 28 days prior to work)*

SCHEDULE OF WORK ACTIVITY START: *(Date/Time)* END: (Date/Time)

REQUESTOR:

PRIMARY POINT OF CONTACT: PHONE/PAGER:

SECONDARY POINT OF CONTACT: PHONE/PAGER:

NOTIFY ☐ Control Room, Phone ☐ Security, Phone

BUILDING: LOCATION OF WORK FLOOR/LEVEL:

DESCRIPTION OF WORK: *(Provide sufficient details on process isolation, work sequencing, and safety (i.e., control of significant hazards unique to the work) to demonstrate an understanding of the work and how it will be completed within the constraints, and its impact on the processes and facility.)*

Task Summary: _____

Processes Affected: _____

Trades Affected: _____

WORK PLAN:

Work Sequencing: _____

Process Isolation: _____

Spill Prevention Plan: _____

Contingency Plans: _____

CRITICAL EQUIPMENT/TOOLS: *(pumps and discharge hoses with correct fittings, blind flanges and pipe plugs, no-hub fittings, properly sized electrical service components, generators, portable lighting, chlorine for potable water pipe breaks, etc.)*

☐	Acoustic Ceiling/or Walls Access	☐	Excavation Permit	☐	Lock Out/Tag Out
☐	Chemical Use Approval	☐	Fire Sprinkler Impairment	☐	Life Safety Systems
☐	Confined Space Permit	☐	Flammable Materials	☐	Roof Protocol
☐	Critical Lift Plan	☐	Flush / Discharge	☐	Work After Dark
☐	Energized Electrical Work	☐	High Pressure Test	☐	
☐	Elect. Panel Schedules	☐	Hot Work/Open Flame	☐	

EXISTING SERVICE(S) AT RISK:

☐	Breathing Air	☐	Elect Normal	☐	Process Access	☐	Telephones
☐	Chemical Distribution	☐	Fire Protection	☐	Safety Showers	☐	UPS
☐	City Water	☐	HVAC	☐	SCADA	☐	VAX/DATA
☐	Communication	☐	Inert Gas	☐	Security	☐	
☐	Domestic Drain	☐	Instrument - Air	☐	Solvent Drain	☐	

☐	Elect-Bus Duct	☐	Life Safety System	☐	Specialty Gases	☐	
☐	Elect Emergency	☐	Natural Gas	☐	Storm Drain	☐	
REVIEWER'S INSTRUCTIONS / COMMENTS:							
☐	PREJOB BRIEFING MUST BE COMPLETED PRIOR TO COMMENCING WORK:						

	Full Name (printed)	**Signature**	**Phone**	**Date**
Submitted By				
System Owner				
Reviewer (if needed)				
Reviewer (if needed)				
Reviewer (if needed)				
Reviewer (if needed)				

ATTACHMENT C - READINESS CHECKLIST

READINESS CHECKLIST
(5 days prior to work)

Checklist provided as a guide but is not all inclusive.

1. Confirm all parts and materials are on site: _____
2. Review work plan: _____
3. Review contingency plan: _____

ATTACHMENT D - SAFETY CHECKLIST

SAFETY CHECKLIST
(Just prior to commencing work)

Checklist provided as a guide but is not all inclusive.

1. Location awareness:
   a. Emergency exits: _____
   b. Emergency shower and eyewash: _____
   c. Telephones and phone numbers: _____
   d. Shut-off valve: _____
   e. Electrical disconnects: _____
2. Inspect work area:
   a. Take time to survey the area you are working in. Ensure that what you want to do will work. Do you have enough clearance? Is your footing secure? Do you have adequate lighting and ventilation? Are surrounding utilities out of the way for you to perform your work?
3. SDS (Safety Data Sheets):
   a. Understand the chemicals and substances in the area you are working in by reading the SDS.
4. Lockout/Tagout Procedure:
   a. Lockout/tagout energy sources before beginning work.
   b. Make sure all valves associated with the work are locked out and tagged out on each side of the penetration.
   c. Make sure the lines are depressurized.
5. Overhead work:
   a. Use appropriate personal protective equipment; i.e., safety harness, lifeline, etc.
   b. Select appropriate tie-off points; i.e., structurally adequate, not a pipe or conduit, etc.
   c. Spotter assigned and in position.
   d. Pipe rack access; i.e., check design capacity, protective decking or scaffolding in place, exposed valves or electrical switches identified and protected.
6. Safety equipment:
   a. Shepherd's hook.
   b. ARC flash protection.
   c. Fire extinguisher.
   d. Other: _____.
7. Accidents:
   a. Should accidents occur, do not shut off and do not attempt to correct the situation, unless you are absolutely positive that your action will correct the problem and not adversely affect other people or equipment.
8. Review process start-up documents:
   a. In the event the system is shutdown, the Control Center should have a working knowledge of the process start-up procedures in order to deal effectively with unforeseen events.
9. Evacuation procedures:
   a. Do not obstruct evacuation routes.
   b. Take time to survey the area for evacuation routes.

ATTACHMENT E - METHOD OF PROCEDURE (MOP) LOG

METHOD OF PROCEDURE (MOP) LOG
Sample

MOP Number	Task Title	Date Requested	Date Approved	Date Work Planned	Work Completed (yes/no)
001					
002					
003					

SECTION 01_21_00

ALLOWANCES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Listing of allowance items:
      a. Related responsibilities of Engineer and Contractor, and procedures.

1.02 ALLOWANCE AMOUNTS

A. Contract Allowance - dollar value as indicated on the schedule of bid prices.

1.03 COSTS INCLUDED AND EXCLUDED IN ALLOWANCES

A. Costs included in allowances for furnishing products only:
   1. Net cost of product.
   2. Delivery and unloading at site.
   3. Applicable taxes and fees.

B. Costs included in Contract Price, but not included in allowances for furnishing products only:
   1. Handling at site, including uncrating and storage.
   2. Protection from elements, theft, and damage.
   3. Labor, installation, testing, and finishing.
   4. Other expenses required to complete installation.
   5. Overhead and profit.

C. Costs included in allowances for furnishing and installing products:
   1. Net cost of product.
   2. Delivery and unloading at site.
   3. Applicable taxes.
   4. Handling at site, including uncrating and storage.
   5. Protection from elements and from damage.
   6. Labor, installation, testing, and finishing.
   7. Other expenses required to complete installation.

1.04 DUTIES OF CONTRACTOR IN PROVIDING PRODUCTS BY ALLOWANCE

A. Advise Engineer at least 60 days in advance of purchase date necessary to avoid impacts to Progress Schedule.

B. Obtain proposals from suppliers, including:
   1. Quantity.
   2. Complete description of product and services provided under allowance.
   3. Unit cost.

4. Total amount of purchase.
5. Taxes and delivery charges.

C. On notification of selection, enter into purchase agreement with designated supplier.

D. Arrange for delivery and unloading.

E. Install products in accordance with Contract Documents.

1.05 ADJUSTMENT OF COSTS

A. When actual cost is more or less than amount of allowance, Contract Price will be adjusted by Change Order.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01_29_73

SCHEDULE OF VALUES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Requirements for preparation, format, and submittal of Schedule of Values.

1.02 PREPARATION

A. Prepare Schedule of Values identifying costs of Major Items of Work and other costs.

B. Schedule of Values shall be a listing of all cost loaded, on-site construction activities from the progress schedule, listed in numerical order, showing that the sum total of all cost-loaded activities equal the Contract value.

C. The work shall be divided in a sufficient number of major items to outline the overall project. The Engineer may recommend adding/deleting items in submitted Schedule of Values at his discretion. Recommended division of major items of work as follows:
   1. Mobilization.
   2. Demobilization.
   3. Demolish and dispose of existing sub-surface agitators, surface sweep rotational indicators, and associated wash water piping (up to the flange nearest to the wall penetration) (each filter).
   4. Demolish and dispose of existing clay tile underdrain system (each filter).
   5. Demolish and dispose of all existing filter media including anthracite, sand, and gravel (each filter).
   6. Provide and install new FRP filter wash troughs and mounting system (each filter).
   7. Provide and install new surface wash spray assemblies, including new rotational indicators and associated surface wash piping (each filter).
   8. Provide and installation of new HDPE filter underdrain system.
   9. Install new filter media purchased by County.
   10. Provide and install new filter media (12” gravel, 9” sand, 21” anthracite).
   11. Provide and installation of new tee connections and protective enclosure for passive overflow relief.
   12. Disinfection.
   13. Commissioning.
   14. Record Drawings.

D. Assign prices to Major Items of Work which aggregate the Contract Price. Base prices on costs associated with scheduled activities based on the Project Schedule for each Major Item of Work.

E. When the schedule is changed or revised to include added or deleted work, the Schedule of Values shall also be revised such that the sum total of all cost-loaded activities continuously equal the current Contract value.
   1. Equate the aggregate of these costs to the Lump Sum Contract Price.

F. The scheduled value for mobilization plus demobilization shall not exceed 5 percent of the Contract Price.
   1. Partial payments for mobilization shall be made as follows as a lump sum item:

Construction % Complete	Allowable % of Lump Sum for Mobilization
5	25
10	50
25	75
100	100

1.03 SUBMITTALS

A. Submit Schedule of Values for the Preliminary Schedule as specified in, Section 01_32_21 - Schedules and Reports.

B. Submittal of the Schedule of Values is a condition precedent to the issuance of any payment under this Contract.

C. Submit corrected Schedule of Values within 10 days upon receipt of reviewed Schedule of Values, but no later than 10 days prior to anticipated submittal of first Application for Payment.

D. Upon request, support prices with data that will substantiate their correctness.

E. If activities are added or removed from the Progress Schedule, revise the Schedule of Values and resubmit.

1.04 FORMAT FOR SCHEDULE OF VALUES

A. The format for the schedule of values shall be Contractor’s standard, subject to review and acceptance by County and Engineer.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01_29_77

APPLICATIONS FOR PAYMENT

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Procedures for preparation and submittal of Applications for Payment.

1.02 FORMAT

A. Develop satisfactory spreadsheet-type form generated by downloading cost data from the Progress Schedule.
   1. Submit payment requests and attach spreadsheet with cost data related to Progress Schedule.

B. Fill in information required on form.

C. When Change Orders are executed, add Change Orders at end of listing of scheduled activities:
   1. Identify change order by number and description.
   2. Provide cost of change order in appropriate column.

D. After completing, submit Application for Payment.

E. Engineer will review application for accuracy. When accurate, Engineer will transmit application to County for processing of payment.

F. Execute application with signature of responsible officer of Contractor.

1.03 SUBSTANTIATING DATA

A. Provide Substantiating Data identifying:
   1. Project.
   2. Application number and date.
   3. Detailed list of enclosures.
   4. Stored products log with item number and identification on application, description of specific material, and proof of insurance coverage for offsite stored products.
   5. Submit “certified” payroll, if applicable.
   6. Photos and videos from current pay period.

1.04 SUBMITTALS

A. Submit 4 copies of Application for Payment and Substantiating Data with cover letter.

1.05 PAYMENT REQUESTS

A. Prepare progress payment requests on a monthly basis. Base requests on the breakdowns of costs for each scheduled activity and the percentage of completion for each activity.

B. Indicate total dollar amount of work planned for every month of the project. Equate sum of monthly amounts to Lump Sum Contract Price.

C. Generate Progress Payment request forms by downloading cost data from the schedule information to a spreadsheet type format.

D. Identify each activity on the Progress Schedule that has a cost associated with it, the cost for each activity, the estimated percent complete for each activity, and the value of work completed for both the payment period and job to date.

E. Prepare summary of cost information for each Major Item of Work listed in the Schedule of Values. Identify the value of work completed for both the payment period and job to date.

F. Payment period:
   1. Monthly Application for Payment period shall begin on the 1st day of each month, and end on the last day of each month.
   2. Submit Application for Payment to Engineer no later than the 5th day of each month for work completed the previous month.
   3. Engineer will finalize and submit recommendation for Application for Payment to County by the 15th day of each month to allow time for processing and approval.

G. Track stored material and installed material.

H. Payment shall only be considered for work completed on-site and materials stored (which are not yet incorporated into the Work) provided that it is in full compliance with the Contract Documents.

1.06 COST SUMMARIES

A. Prepare Summary of Cost Information for each Major Item of Work listed in the Schedule of Values. Identify the Value of Work Completed for both the payment period and job to date.

B. Cash flow summary: Prepare cash flow summary, indicating total dollar amount of work planned for each month of the project. Equate sum of monthly amounts to Lump Sum contract price.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01_31_19

PROJECT MEETINGS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Requirements for conducting conferences and meetings for the purposes of addressing issues related to the Work, reviewing and coordinating progress of the Work and other matters of common interest, and includes the following:
   1. Qualifications of Meeting Participants.
   2. Basic Meeting Requirements
   3. Pre-construction Conference.
   4. Progress Meetings.
   5. Pre-Installation Meetings.
   6. Post Construction Meeting.

1.02 QUALIFICATIONS OF MEETING PARTICIPANTS

A. Representatives of entities participating in meetings shall be qualified and authorized to act on behalf of entity each represents.

1.03 BASIC MEETING REQUIREMENTS

A. Attendees:
   1. Meeting leader shall require attendance of parties directly affecting, or affected by, Work being discussed at the meeting.

B. Location:
   1. In location convenient for most invitees.

C. Notification:
   1. Meeting leader shall notify attendees of meeting, including an agenda, a minimum of 7 days prior to meeting.

D. Agenda:
   1. Meeting leader shall prepare copies of agenda for participants and distribute at the meeting.
   2. Minimum requirements:
      a. Meeting purpose:
      b. Review minutes of previous meeting.
      c. Safety and security.
      d. Discuss issues.
      e. Action items.
      f. Next meeting.

E. Meeting minutes:
   1. Meeting leader shall provide draft minutes within 14 days of meeting and send to all attendees for comment within 14 days.
   2. Meeting leader shall incorporate comments from attendees and submit final meeting minutes to attendees within 7 days of receipt of comments.

1.04 PRE-CONSTRUCTION CONFERENCE

A. Engineer leads the meeting.

B. Timing:
   1. Upon issuance of Notice to Proceed, or earlier when mutually agreeable.

C. Required attendees:
   1. Contractor's project manager and superintendent, County, Engineer, representatives of utilities, major subcontractors and others involved in performance of the Work, and others necessary to agenda.

D. Agenda minimum requirements:
   1. Meeting purpose:
      a. To establish working understanding between parties and to discuss Construction Schedule, shop drawing and other submittals, cost breakdown of major lump sum items, processing of submittals and applications for payment, and other subjects pertinent to execution of the Work.
   2. Adequacy of distribution of Contract Documents.
   3. Distribution and discussion of list of major subcontractors and suppliers.
   4. Proposed progress schedules and critical construction sequencing.
   5. Major equipment deliveries and priorities.
   6. Project coordination.
   7. Designation of responsible personnel.
   8. Procedures and processing of:
      a. Field decisions.
      b. Proposal requests.
      c. Submittals - separate ,meeting.
      d. Change Orders.
      e. Request for Information/Interpretations.
      f. Applications for Payment.
      g. Record Documents.
   9. Use of premises:
      a. Office, construction, and storage areas.
      b. County's requirements.
   10. Construction facilities, controls, and construction aids.
   11. Temporary utilities.
   12. Safety and first aid procedures.
   13. Security procedures.
   14. Housekeeping procedures.
   15. Safety and security.
   16. Review proposed photographer submittal.
   17. Action items.
   18. Next meeting.

1.05 PROGRESS MEETINGS

A. Engineer will lead the meeting.

B. Timing:
   1. Hold meetings throughout progress of the Work at maximum weekly intervals.

C. Required attendees:
   1. County, Engineer, Contractor, Contractor's Project Manager, superintendent, quality control manager, project scheduler, major subcontractors and suppliers as appropriate to agenda topics for each meeting.
   2. Additional invitees:
      a. County utility companies when the Work affects their interests, and others necessary to agenda.

D. Agenda minimum requirements:
   1. Meeting purpose:
      a. Provide the status of the Work.
   2. Review minutes of previous meeting.
   3. Safety and security.
   4. Construction schedule summary.
   5. Review of 6 weeks schedule.
      a. Contractor shall provide printed hard copies for each attendee.
   6. Review of off-site fabrication and delivery schedules.
   7. Review of submittals schedule and status of submittals.
   8. Request for information (RFI's) status.
   9. MOP's/shutdown coordination.
   10. Change order management status.
   11. Maintenance of quality standards (QA/QC).
   12. Field observations, problems, and conflicts.
   13. Commissioning.
   14. Partnering recognition status (optional).
   15. General Items.
   16. Action items.
   17. Next meeting.

1.06 PRE-INSTALLATION MEETINGS

A. Contractor leads the meeting.

B. Timing:
   1. When specified in Technical Sections or requested by Engineer, before commencing Work of specific section.

C. Required attendees:
   1. County, Engineer, Contractor, Contractor's Project Manager, General Superintendent, project scheduler, major subcontractors including electrical instrumentation, and suppliers as appropriate to agenda topics for each meeting.

2. Additional invitees:
    a. County utility companies when the Work affects their interests and others necessary to the agenda.

D. Agenda minimum requirements:
    1. Meeting purpose:
        a. Review conditions of installation, preparation and installation procedures.
        b. Review coordination with related work.
    2. Review minutes of previous meeting.
    3. Safety and security.
    4. Action items.
    5. Next meeting.

1.07 POST CONSTRUCTION MEETING

A. Engineer leads the meeting.

B. Required attendees:
    1. Engineer, Contractor, appropriate manufacturers, and installers of major units of constructions, affected subcontractors, and County's operations and maintenance staff.

C. Timing:
    1. About 11 months after date of Substantial Completion.

D. Location:
    1. Meet in County's office or other mutually agreed upon place.

E. Agenda minimum requirements:
    1. Meeting purpose:
        a. Review project for compliance with Contract Documents.
    2. Inspect the Work and draft list of items to be completed or corrected.
    3. Review service and maintenance contracts and take appropriate corrective action when necessary.
    4. Complete or correct defective work and may extend correction period .
    5. Safety and security.
    6. Action items.
    7. Next meeting.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01_32_21

SCHEDULES AND REPORTS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Schedules and reports.

1.02 SUBMITTAL REQUIREMENTS

A. Submit preliminary and baseline schedule.

B. Submit preliminary and baseline schedule of values.

C. Submit preliminary and baseline schedule of submittals.

D. Submit, on a monthly basis, updated schedules as specified.

E. Submit final schedule update as specified.

F. Submit revised schedules and time impact analyses as specified.

G. Submit schedules in the media and number of copies as follows:
   1. Provide each submittal in PDF format and in other formats specified in this Section.
   2. 3 sets of the CPM network and/or bar chart (as specified by the County) on 22-inch by 34-inch sheets.
      a. Color-coding to be specified by the County.
   3. 3 sets of tabular reports listing all activities sorted numerically identifying duration, early start, late start, early finish, late finish, total float, and all predecessor/successor information.
   4. 2 sets of CPM Schedule data electronic files in a native backed-up file (.xer).

1.03 SCHEDULER

A. Designate, in writing and within 5 calendar days after Notice of Award, the person responsible for preparation, maintenance, updating, and revision of all schedules.

B. Scheduler shall have the authority to act on behalf of Contractor.
   1. A minimum of 5 years verifiable experience in preparation of construction schedules for projects of similar value, size, and complexity.
   2. Knowledge of critical path method (CPM) scheduling utilizing Primavera P6 Professional or Asta Powerproject software.

C. County reserves the right to disapprove scheduler when submitted by Contractor if not qualified. County reserves the right to remove scheduler from the project if found to be incompetent.

1.04 SCHEDULING FORMAT

A. Utilize critical path method (CPM) format.

B. Provide a cost and labor loaded schedule.

C. Engineer approval of the format is required.

1.05 SCHEDULING HARDWARE AND SOFTWARE

A. All scheduling software and hardware located on-site.

B. Prepare computerized schedule utilizing the most current version of Oracle Primavera P6 Professional, most current version.

C. Contractor and Engineer must agree on the format.

1.06 PRE-CONSTRUCTION SCHEDULING MEETING

A. As specified in Section 01_31_19 - Project Meetings.

1.07 REVIEW AND ACCEPTANCE OF SCHEDULES

A. Engineer will review Baseline Schedule, Schedule Updates, Schedule Revisions and Time Impact Analyses to ascertain compliance with specified project constraints, compliance with milestone dates, durations and sequence, accurate inter-relationships, and completeness.

B. Engineer and County will issue written comments following completion of review of Baseline Schedule within 21 calendar days after receipt.

C. Written comments on review of Schedule Updates and Schedule Revisions and Time Impact Analyses will be returned to Contractor within 14 calendar days after receipt by Engineer.

D. Revise and resubmit schedule in accordance with Engineer’s comments within 7 calendar days after receipt of such comments or request joint meeting to resolve objections.

E. If Engineer requests a meeting, the Contractor and all major subcontractors must participate in the meeting with Engineer.
   1. Revise and resubmit schedule within 7 calendar days after meeting.

F. Use accepted schedule for planning, organizing, and directing the work and for reporting progress.

G. Engineer’s submittal review response:
   1. When schedule reflects County's and Contractor's agreement of project approach and sequence, schedule will be accepted by County.
   2. Engineer’s submittal review response for schedule submittal will be “Receipt Acknowledged - Filed for Record” including applicable comments.

3. Acceptance of the schedules by the County is for general conformance with the Contract Documents and for County's planning information and does not relieve the Contractor of sole responsibility for planning, coordinating, and executing the Work within the contract completion dates.
    a. Omissions and errors in the accepted schedules shall not excuse performance less than that required by the Contract Documents.
    b. Acceptance by the County in no way constitutes an evaluation or validation of the Contractor's plan, sequence or means, methods, and techniques of construction.

1.08 SCHEDULE UPDATES

A. Any update:
    1. Prepare update using most recent accepted version of schedule including:
        a. Actual start dates of activities that have been started.
        b. Actual finish dates of activities that have been completed.
        c. Percentage of completion of activities that have been started but not finished.
        d. Actual dates on which milestones were achieved.
        e. Update activities by inputting percent complete figures with actual dates.
        f. Use retained logic in preparing Schedule Updates.
        g. When necessary, input remaining durations for activities whose finish dates cannot be calculated accurately with a percent complete figure only.
        h. Revisions to the schedule may be included that have been previously approved as specified in this Section under Revisions to Schedule.

B. Monthly updates:
    1. Submit written narrative report in conjunction with each Schedule Update including descriptions of the following:
        a. Activities added to or deleted from the schedule are to adhere to cost and other resource loading requirements.
            1) Identify added activities in manner distinctly different from original activity designations.
        b. Changes in sequence or estimated duration of activities.
        c. Current or anticipated problems and delays affecting progress, impact of these problems and delays and measures taken to mitigate impact.
        d. Assumptions made and activities affected by incorporating change order work into the schedule.
    2. Submit updated schedule and materials specified under Submittal of Progress Schedules, 5 calendar days before the monthly schedule update meeting.
    3. Since Monthly Schedule Update is the application for progress payment required as specified in Section 01_29_77 - Applications for Payment, submittal and acceptance of the monthly Schedule Update is a condition precedent to the making of any progress payments.

C. Weekly progress meeting:
    1. Update the schedule prior to weekly progress meeting.
        a. Identify overall progress of each Major Item of Work in the Summary Schedule.
        b. If there are significant changes to the schedule, submit a written report at the weekly progress meeting.

2. Should monthly Schedule Update show project completion earlier than current Contract completion date, show early completion time as schedule activity, identified as “Project Float”.
3. Should monthly Schedule Update show project completion later than current Contract completion date, prepare and submit a Schedule Revision in accordance with the Revisions to Schedule.

1.09 REVISIONS TO SCHEDULE

A. Submit Revised Schedule within 5 days:
   1. When delay in completion of any activity or group of activities indicates an overrun of the Contract Time or milestone dates by 20 working days or 5 percent of the remaining duration, whichever is less.
   2. When delays in submittals, deliveries, or work stoppages are encountered making necessary the replanning or rescheduling of activities.
   3. When the schedule does not represent the actual progress of activities.
   4. When any change to the sequence of activities, the completion date for major portions of the Work, or when changes occur which affect the critical path.
   5. When Contract modification necessitates schedule revision, submit schedule analysis of change order work with cost proposal.

B. Create a separate submittal for Schedule Revisions.
   1. Comply with schedule updates as specified in this Section.
   2. Do not submit with Schedule Updates.

C. Schedule Revisions will not be reflected in the schedule until after the revision is accepted by the County.
   1. This includes Schedule Revisions submitted for the purpose of mitigating a Contractor-caused project delay (Recovery Schedule).

1.10 ADJUSTMENT OF CONTRACT TIME OR PRICE

A. Contract Time will be adjusted only for causes specified in Contract Documents.
   1. Non-excusable delay:
      a. Non-excusable delays include actions or inactions of the Contractor, or events for which the Contractor has assumed contractual responsibility (including actions or inactions of subcontractors, suppliers, or material manufacturers at any tier) that would independently delay the completion of the Work beyond the current Contract completion date).
      b. No time extensions will be granted for non-excusable delays.
   2. Excusable delay:
      a. Events which are unforeseeable, outside the control of, and without the fault or negligence of either the County or the Contractor (or any party for whom either is responsible), which would independently delay the completion of the Work beyond the current Contract completion date.
      b. The Contractor may be entitled to a time extension only.
      c. No other damages will be approved.
   3. Compensable delay:
      a. Actions or inactions of the County, or events for which the County has assumed contractual responsibility, which would independently delay the completion of the Work beyond the current Contract completion date.

b. The Contractor may be entitled to a time extension and delay damages.

4. Concurrent delay:
   a. Concurrent delay is any combination of the above 3 types of delay occurring on the same calendar date.
   b. Exception to concurrent delay:
      1) Cases where the combination consists of 2 or more instances of the same type of delay occurring on the same calendar date.
      2) When one cause of delay is County-caused or caused by an event which is beyond the control and without the fault or negligence of either the County or the Contractor and the other Contractor-caused, the Contractor may be entitled only to a time extension and no delay damages.

B. If the Contractor believes that the County has impacted its work, such that the project completion date will be delayed, the Contractor must submit proof demonstrating the delay to the critical path.
   1. This proof, in the form of a Time Impact Analysis, may entitle the Contractor to an adjustment of Contract Time or Contract Price.

C. Time Impact Analysis:
   1. Use the accepted schedule update that is current relative to the time frame of the delay event (change order, third party delay, or other County-caused delay). Represent the delay event in the schedule by:
      a. Inserting new activities associated with the delay event into the schedule.
      b. Revising activity logic.
      c. Revising activity durations.
   2. If the project schedule's critical path and completion date are impacted as a result of adding this delay event to the schedule, a time extension equal to the magnitude of the impact may be warranted.
   3. The Time Impact Analysis submittal must include the following information:
      a. A fragment of the portion of the schedule affected by the delay event.
      b. A narrative explanation of the delay issue and how it impacted the schedule.
      c. A schedule file used to perform the Time Impact Analysis.

D. When a delay to the project as a whole can be avoided by revising preferential sequencing or logic, and the Contractor chooses not to implement the revisions, the Contractor will be entitled to a time extension and no compensation for extended overhead.

E. Indicate clearly that the Contractor has used, in full, all project float available for the Work involved in the request, including any float that may exist between the Contractor's planned completion date and the Contract completion date.
   1. Utilize the latest version of the Schedule Update accepted at the time of the alleged delay, and all other relevant information, to determine the adjustment of the Contract Time.

F. Adjustment of the Contract Times will be granted only when the Contract Float has been fully utilized and only when the revised date of completion of the Work has been pushed beyond the Contract completion date.
   1. Adjustment of the Contract Times will be made only for the number of days that the planned completion of the work has been extended.

G. Actual delays in activities which do not affect the critical path Work or which do not move the Contractor's planned completion date beyond the Contract completion date will not be the basis for an adjustment to the Contract Time.

H. If completion of the project occurs within the specified Contract Time, the Contractor is not entitled to job-site or home office overhead beyond the Contractor's originally planned occupancy of the site.

I. Notify Engineer of a request for Contract Time adjustment.
   1. Submit request as specified in the Contract Documents.
   2. In cases where the Contractor does not submit a request for Contract Time adjustment for a specific change order, delay, or Contractor request within the specified period of time, then it is mutually agreed that the particular change order, delay, or Contractor request has no time impact on the Contract completion date and no time extension is required.

J. The Engineer will, within 30 calendar days after receipt of a Contract Time adjustment, request any supporting evidence, review the facts, and advise the Contractor in writing.
   1. Include the new Progress Schedule data, if accepted by the County, in the next monthly Schedule Update.
   2. When the County has not yet made a final determination as to the adjustment of the Contract Time, and the parties are unable to agree as to the amount of the adjustment to be reflected in the Progress Schedule, reflect that amount of time adjustment in the Progress Schedule as the Engineer may accept as appropriate for such interim purpose.
   3. It is understood and agreed that any such interim acceptance by the Engineer shall not be binding and shall be made only for the purpose of continuing to schedule the Work, until such time as a final determination as to any adjustment of the Contract Time acceptable to the Engineer has been made.
   4. Revise the Progress Schedule prepared thereafter in accordance with the final decision.

1.11 SCHEDULE PREPARATION

A. Preparation and submittal of Progress Schedule represents Contractor's intention to execute the Work within specified time and constraints.

B. All costs associated with schedule requirements are included in the Contract Price.

C. During preparation of the preliminary Progress Schedule, Engineer will facilitate Contractor's efforts by answer questions regarding sequencing issues, scheduling constraints, interface points, and dependency relationships.

D. Prepare schedule utilizing Precedence Diagramming Method (PDM).

E. Prepare schedule utilizing activity durations in terms of working days.
   1. Do not exceed 15 working day duration on activities except concrete curing, submittal review, and equipment fabrication and deliveries.
   2. Where duration of continuous work exceeds 15 working days, subdivide activities by location, stationing, or other sub-element of the Work.
   3. Coordinate holidays to be observed with the County and incorporate them into the schedule as non-working days.

F. Failure to include an activity required for execution of the Work does not excuse Contractor from completing the Work and portions thereof within specified times and at price specified in Contract.
   1. Contract requirements are not waived by failure of Contractor to include required schedule constraints, sequences, or milestones in schedule.
   2. Contract requirements are not waived by County's acceptance of the schedule. In event of conflict between accepted schedule and Contract requirements, terms of Contract govern at all times, unless requirements are waived in writing by the County.

G. Reference schedule to working days with beginning of Contract Time as Day "1".

H. Baseline Schedule and Project Completion:
   1. Should Contractor submit a Baseline Schedule showing project completion more than 20 working days prior to Contract completion date, County may issue Change Order, at no cost to County, revising time of performance of Work and Contract completion date to match Contractor's schedule completion date.
   2. Adjust accordingly any Contract milestone dates.

I. Imposed dates and hidden logic are prohibited.

J. Interim milestone dates, operational constraints:
   1. In event there are interim milestone dates and/or operational constraints set forth in Contract, show them on schedule.
   2. Do not use Zero Total Float constraint or Mandatory Finish Date on such Contract requirements.

K. Contract float is for the mutual benefit of both County and Contractor.
   1. Changes to the project that can be accomplished within this available period of float may be made by County without extending the Contract Time, by utilizing float.
   2. Time extensions will not be granted nor delay damages owed until Work extends beyond currently accepted Contract completion date.
   3. Likewise, Contractor may utilize float to offset delays other than delays caused by County.
   4. Mutual use of float can continue until all available float shown by schedule has been utilized by either County or Contractor, or both. At that time, extensions of the Contract Time will be granted by County for valid County-caused or third party-caused delays which affect the planned completion date and which have been properly documented and demonstrated by Contractor.

5. Non-sequestering of float: Pursuant to float sharing requirements of Contract, schedule submittals can be rejected for, use of float suppression techniques such as preferential sequencing or logic, special lead or lag logic restraints, extended activity durations or imposed dates.

L. Resource loading and leveling:
   1. Input labor data on each schedule activity.
   2. Manpower data consists of the man-hours estimated to perform each task, categorized by trade.
   3. Provide leveled manpower requirements.
      a. Availability of the resources drive activity duration.

M. Cost loading: All schedules:
   1. Only on-site construction activities.
   2. The sum total of all cost loaded activities equal to the current value of the Contract, including change orders, at all times.
   3. County acceptance of the Baseline Schedule creates the Schedule of Values required as specified in Section 01_29_73 - Schedule of Values.
   4. Provide updated Schedule of Values as the monthly Payment Application as specified in Section 01_29_77 - Applications for Payment.
   5. Payments will not be made until updated Schedule of Values is accepted.

N. Schedule logic:
   1. Assembled to show order in which Contractor proposes to carry out Work, indicate restrictions of access, availability of Work areas, and availability and use of manpower, materials, and equipment.
   2. Form basis for assembly of schedule logic on the following criteria:
      a. Which activities must be completed before subsequent activities can be started?
      b. Which activities can be performed concurrently?
      c. Which activities must be started immediately following completed activities?
      d. What major facility, equipment, or manpower restrictions are required for sequencing these activities?

O. Schedule windows for County-furnished, Contractor-installed equipment or materials:
   1. Immediately after Award of Contract, obtain from Engineer anticipated delivery dates of County furnished equipment or materials.
   2. Show these dates in the schedule in same manner indicated by Engineer.

P. Commissioning schedule:
   1. Commissioning activities and milestones (As specified in Section 01_75_17 - Commissioning) shall be an integral part of the overall project schedule.
   2. Commissioning activities and milestones shall be extracted from the main project schedule to provide a separate commissioning schedule that is submitted each time the project schedule is submitted.

1.12 NETWORK DETAILS AND GRAPHICAL OUTPUT

A. Produce a clear, legible, and accurate calendar based, time scaled, and graphical network diagram.
   1. Group activities related to the same physical areas of the Work. Produce the network diagram based upon the early start of all activities.

B. Include for each activity, the description, activity number, estimated duration in working days, total float, and all activity relationship lines.

C. Illustrate order and interdependence of activities and sequence in which Work is planned to be accomplished.
   1. Incorporate the basic concept of the precedence diagram network method to show how the start of 1 activity is dependent upon the start or completion of preceding activities and its completion restricts the start of following activities.

D. Provide schedule showing the critical path for the project.
   1. Critical Path is defined as a sequence of activities that has zero total float.

E. Provide report of Near Critical Path activities for the project, when required by Engineer.
   1. Near Critical Path activities are those with 15 working days or less of float.

F. Delineate the specified contract duration and identify the planned completion of the Work as a milestone.
   1. Show the time period between the planned and Contract completion dates, if any, as an activity identified as project float.

G. Identify system shutdown dates, system tie-in dates, specified interim completion or milestone dates and contract completion date as milestones.

H. Include, in addition to construction activities:
   1. Submission dates and review periods for major equipment submittals, shoring submittals, and indicator pile program:
      a. Shoring reviews: Allow 4-week review period for each shoring submittal.
      b. Pile indicator program: Allow 3-week review period for analysis of program.
   2. Any activity by the County or the Engineer that may affect progress or required completion dates.
   3. Equipment and long-lead material deliveries over 8 weeks.
   4. Approvals required by regulatory agencies or other third parties.

I. Produce network diagram on 22-inch by 34-inch sheets with grid coordinate system on the border of all sheets utilizing alpha and numeric designations.

1.13 WEATHER DAY ALLOWANCE

A. Definition:
   1. Weather conditions that prevent or inhibit the Contractor’s performance of the Work and affect the Critical Path indicated on the Schedule shall be referred to as a Weather Day.

2. A Weather Day is defined as the Contractor being unable to perform at least 4 hours of work on the Critical Path.

B. Allowance:
   1. Include as a separate identifiable activity on the critical path, an activity labeled "Weather Days Allowance".

C. Actual weather day:
   1. Insert a weather delay activity in critical path to reflect actual weather day occurrences when weather days are experienced and accepted by Engineer.
   2. Reduce duration of Weather Days Allowance activity as weather delays are experienced and inserted into the Schedule. Remaining weather days in Weather Day Allowance at completion of project is considered float.
   3. The Contractor shall provide a written notice to the Engineer of the occurrence of a weather day within 2 days after the onset of such weather and shall describe in reasonable detail the type of weather encountered and the Work interfered with or interrupted.
      a. A schedule update will not suffice as a written notice.
      b. The Engineer will determine if the weather day constitutes a use of a portion of the Weather Day Allowance.
      c. After use of all the Weather Day Allowance, the Engineer will determine if the Contractor is entitled to an extension of the Contract Time due to weather conditions.
      d. Weather days are considered excusable delay as defined in this Section.

1.14 PRELIMINARY SCHEDULE

A. Procedure:
   1. Submit proposed Preliminary Schedule within 14 calendar days after Notice to Proceed.
   2. Meet with Engineer within 7 calendar days after receipt of Preliminary Schedule to review and make necessary adjustments.
   3. Submit revised Preliminary Schedule within 5 calendar days after meeting.
   4. Update Preliminary Schedule monthly until the Baseline Schedule is accepted.

B. Format:
   1. Simplified Gannt chart.

C. Activities:
   1. Define activities to be completed in the first 90 calendar days of Work.
   2. Actualize activities performed during the first 90 days into the first monthly schedule update.

1.15 PRELIMINARY SCHEDULE OF VALUES

A. Preliminary Schedule of Values as specified in in Section 01_29_73 - Schedule of Values.

B. Procedure:
   1. Submit proposed Preliminary Schedule of Values within 14 calendar days after Notice to Proceed.

2. Meet with Engineer within 7 calendar days after receipt of Preliminary Schedule of Values to review and make necessary adjustments.
3. Submit revised Preliminary Schedule of Values within 5 calendar days after meeting.

1.16 WORK WITHIN THE FIRST 90 DAYS

A. Proceed with Work after Preliminary Schedule and Preliminary Schedule of Values have been accepted by County.

B. Submittal and acceptance of Preliminary Schedule and Preliminary Schedule of Values is condition precedent to making of progress payments as specified in Section 0129401_29_77 - Applications for Payment and payments for mobilization costs otherwise provided for in the Contract.

1.17 SCHEDULE OF SUBMITTALS

A. Schedule of Submittals shall include submittals required in the Contract Documents but not limited to test plans, training plans, test procedures, operation and maintenance manuals, shop drawings, samples, record documents, and specifically required certificates, warranties, and service agreements.
   1. Data for “Or Equals” or substitutions shall be submitted with the Schedule of Submittals.

B. Preliminary Schedule of Submittals:
   1. Due date: After Preliminary Schedule has been submitted and accepted by County.
   2. Format:
      a. Include submittals anticipated in the first 90 calendar days after award of contract using early start dates.
      b. Indicate week and month anticipated for submittal to Engineer.
      c. Indicate “Priority” submittals where review time can impact Contractor’s schedule.
         1) “Priority” indication will not alter review times specified in Section 01_33_00 - Submittal Procedures.
         2) Engineer will endeavor to provide early review of “Priority” submittals where possible.
      d. List of “Or Equals” or substitutions.
   3. Submittal of Preliminary Schedule of Submittals shall be a condition precedent to County making progress payments during the first 90 calendar days after award of contract.

C. Final Schedule of Submittals:
   1. Due date: 30 days after Baseline Schedule has been submitted and accepted by County.
   2. Format:
      a. Include submittals using early start dates.
      b. Include all submittals, including those required in the Preliminary Schedule of Submittals.
      c. Indicate week and month anticipated for submittal to Engineer.

d. Indicate “Priority” submittals where review time can impact Contractor’s schedule.
    1) “Priority” indication will not alter review times specified in Section 01_33_00 - Submittal Procedures.
    2) Engineer will endeavor to provide early review of “Priority” submittals where possible.
e. Data for “Or Equals” or substitutions.

3. Submittal of Final Schedule of Submittals shall be a condition precedent to County making progress payments after the first 90 calendar days after Notice to Proceed.

D. Provide updated Schedule of Submittals with updated schedules if schedule revisions change listing and timing of submittals.

1.18 BASELINE SCHEDULE AND BASELINE SCHEDULE OF VALUES

A. Due date: No more than 45 calendar days after Notice to Proceed.

B. Format:
1. Schedule: Show sequence and interdependence of all activities required for complete performance of all Work, beginning with date of Notice to Proceed and concluding with date of final completion of Contract.
2. Schedule of Values: As specified in Section 01_29_73 - Schedule of Values.

C. Acceptance of the Baseline Schedule and Baseline Schedule of Values by the County is a condition precedent to making payments as specified in Section 01_29_77 - Applications for Payment after the first 90 calendar days after Notice to Proceed.

1.19 SUMMARY SCHEDULE

A. Due date: At weekly progress meetings and after each Schedule Update or Schedule Revision.

B. Format:
1. Consolidate groups of activities associated with Major Items of Work shown on Baseline Schedule.
2. intended to give an overall indication of the project schedule without a large amount of detail.

1.20 COST FLOW SUMMARY

A. Due date: After Baseline Schedule has been submitted and accepted by the County, submit on a monthly basis as specified in Section 01_29_77 - Applications for Payment.

B. Format:
1. Tabular and graphic report showing anticipated earnings each month of the Contract period.
2. Base tabulation on the summation of the cost-loaded activities each month.
3. Show planned amounts.

4. Show actual earned amounts and anticipated remaining earnings.
5. Spreadsheet format of all schedule activities showing cost and percentage completion during the current month for which payment is sought.

1.21 PROGRESS SCHEDULE AND UPDATED SCHEDULE OF VALUES

A. Due date: Submit on a monthly basis as specified in Section 01_29_77 - Applications for Payment.

B. Format: Schedule of Values: As specified in Section 01_29_73 - Schedule of Values.

1.22 WEEKLY SCHEDULE

A. Due date: At every weekly progress meeting.

B. Format:
1. Contractor and Engineer must agree on the format.
2. 6-Week Schedule showing the activities completed during the previous week and the Contractor's schedule of activities for following 5 weeks.
3. Use the logic and conform to the status of the current progress schedule when producing a Weekly Schedule in CPM schedule or a bar chart format.
    a. In the event that the Weekly Schedule no longer conforms to the current schedule, Contractor may be required to revise the schedule as specified in this Section.
4. The activity designations used in the Weekly Schedule must be consistent with those used in the Baseline Schedule and the monthly Schedule Updates.

1.23 LABOR HISTOGRAM

A. Due date:
1. With progress payments after Baseline Schedule has been submitted and accepted by County.

B. Format:
1. Labor histogram depicting total craft manpower and craft manpower for Contractor's own labor forces and those of each subcontractor.
2. Submit in electronic format.

1.24 EQUIPMENT SCHEDULE

A. Due date: With any progress payment after Baseline Schedule has been submitted and accepted by County if it includes payment for equipment.

B. Format:
1. Tabular report listing each major piece of construction equipment to be used in performing the Work.
2. Include major equipment for Contractor and each subcontractor.
3. Submit electronically in Excel format with 1 paper copy.

C. Progress payments after the first 90 calendar days after Notice to Proceed will not be made until equipment schedule is provided.

1.25 COMMISSIONING SCHEDULE

A. Proposed Commissioning Schedule:
   1. Schedule requirements: As specified in Section 01_75_17 - Commissioning.
   2. Engineer response due within 20 calendar days of receipt.
   3. Contractor responsible for updating schedule and resubmitting within 10 calendar days of receipt of Engineer and County comments.

B. Construction Schedule can include the Commissioning Schedule after Engineer acceptance of the Proposed Commissioning Schedule.
   1. Capable of extracting a stand-alone Commissioning Schedule.
   2. Capable of extracting a stand-alone County Training Schedule.

C. Monthly update requirements:
   1. Highlight percentages of completion, actual start and finish dates, and remaining durations, as applicable.
   2. Include activities not previously included in the previously accepted detail work plan Commissioning Schedule.
   3. Change Order required for any change to contractual dates.
   4. Reviews of these submittals by Engineer will not be construed to constitute acceptance within the time frames, durations, or sequence of work for each added activity.

1.26 FINAL SCHEDULE

A. The final Schedule Update becomes the As-Built Schedule.
   1. The As-Built Schedule reflects the exact manner in which the project was constructed by reflecting actual start and completion dates for all activities accomplished on the project.
   2. Contractor's Project Manager and scheduler sign and certify the As-Built Schedule as being an accurate record of the way the project was actually constructed.

B. Retainage will not be released until final Schedule Update is provided.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01_33_00

SUBMITTAL PROCEDURES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Requirements and procedures for submittals to confirm compliance with Contract Documents.

1.02 DEFINITIONS

A. Certificates: Describe certificates that document affirmations by the Contractor or other entity that the work is in accordance with the Contract Documents.

B. Extra stock materials: Describe extra stock materials to be provided for the County's use in facility operation and maintenance.

C. Maintenance material submittals: Use this article to categorize maintenance materials submittals requiring no Engineer action other than confirmation of receipt under an explanatory heading.

D. Manufacturer's instructions: Instructions, stipulations, directions, and recommendations issued in printed form by the manufacturer of a product addressing handling, installation, erection, and application of the product; manufacturer's instructions are not prepared especially for the Work.

E. Product data: Product data usually consists of manufacturers' printed data sheets or catalog pages illustrating the products to be incorporated into the project.

F. Samples: Samples are full-size actual products intended to illustrate the products to be incorporated into the project. Sample submittals are often necessary for such characteristics as colors, textures, and other appearance issues.

G. Spare parts: Describe spare parts necessary for the County's use in facility operation and maintenance; identify the type and quantity here, but include the actual characteristics of the spare parts in Product as part of the specification of the product.

H. Shop drawings: Shop drawings are prepared specifically for the project to illustrate details, dimensions, and other data necessary for satisfactory fabrication or construction that are not shown in the contract documents. Shop drawings could include graphic line-type drawings, single-line diagrams, or schedules and lists of products and their application.

I. Submittals: Submittals are samples, product data, shop drawings, and others that demonstrate how Contractor intends to conform with the Contract Documents.

J. Tools: Tools are generally defined as items such as special wrenches, gauges, circuit setters, and other similar devices required for the proper operation or maintenance of a system that would not normally be in the County's tool kit.

1.03 GENERAL INSTRUCTIONS

A. Contractor is responsible to determine and verify field measurements, field construction criteria, materials, dimensions, catalog numbers and similar data, and check and coordinate each item with other applicable approved shop drawings and Contract Document requirements.

B. Provide submittals:
   1. That are specified or reasonably required for construction, operation, and maintenance of the Work.
   2. That demonstrate compliance with the Contract Documents.

C. Where multiple submittals are required, provide a separate submittal for each specification section.
   1. In order to expedite construction, the Contractor may make more than 1 submittal per specification section, but a single submittal may not cover more than 1 specification section:
      a. The only exception to this requirement is when 1 specification section covers the requirements for a component of equipment specified in another section.
      b. For example, circuit breakers are a component of switchgear. The switchgear submittal must also contain data for the associated circuit breakers, even though they are covered in a different specification section.

D. Prepare submittals in the English language. Do not include information in other languages.

E. Present measurements in customary American units (feet, inches, pounds, etc.).

F. Must be clear and legible, and of sufficient size for presentation of information.

G. Page size other than drawings:
   1. Minimum page size will be 8 1/2 inches by 11 inches:
   2. Maximum page size will be 11 inches by 17 inches.

H. Drawing sheet size:
   1. Maximum sheets size: 22-inch by 34-inch.
      a. Minimum plan scale: 1/8-inch equals 1 foot-0 inches.
      b. Minimum font size: 1/8 inch minimum.
   2. 11-inch by 17-inch sheet:
      a. Minimum plan scale: 1/8-inch equals 1 foot-0 inches.
      b. Minimum font size: 1/8 inch minimum.

I. Show dimensions, construction details, wiring diagrams, controls, manufacturers, catalog numbers, and all other pertinent details.

J. Provide submittal information from only 1 manufacturer for a specified product. Submittals with multiple manufacturers for 1 product will be rejected without review.

1.04 SUBMITTAL ORGANIZATION

A. Organize submittals in exactly the same order as the items are referenced, listed, and/or organized in the specification section.

B. For submittals that cover multiple devices used in different areas under the same specification section, the submittal for the individual devices must list the area where the device is used.

C. Bookmarks:
   1. Bookmarks shall match the table of contents.
   2. Bookmark each section (tab) and heading.
   3. Drawings: Bookmark at a minimum, each discipline, area designation, or appropriate division.
   4. At file opening, display all levels of bookmarks as expanded.

D. Where applicable (i.e., except for drawings, figures, etc.) submittal content shall be electronically searchable utilizing the PDF file as submitted.

E. Thumbnails optimized for fast web viewing.

F. Sequentially number pages within the tabbed sections:
   1. Submittals that are not fully indexed and tabbed with sequentially numbered pages, or are otherwise unacceptable, will be returned without review.

G. Attachments:
   1. Specification section: Include with each submittal a copy of the relevant specification section.
      a. Indicate in the left margin, next to each pertinent paragraph, either compliance with a check (√) or deviation with a consecutive number (1, 2, 3).
      b. Provide a list of all numbered deviations with a clear explanation and reason for the deviation.
   2. Drawings: Include with each submittal a copy of the relevant Drawing, including relevant addendum updates.
      a. Indicate either compliance with a check (√) or deviation with a consecutive number (1, 2, 3).
      b. Provide a list of all numbered deviations with a clear explanation and reason for the deviation.
      c. Provide field dimensions and relationship to adjacent or critical features of the Work or materials.

H. Contractor: Prepare submittal information in sufficient detail to show compliance with specified requirements.
   1. Determine and verify quantities, field dimensions, product dimensions, specified design and performance criteria, materials, catalog numbers, and similar data.

2. Coordinate submittal with other submittals and with the requirements of the Contract Documents.
3. Check, verify, and revise submittals as necessary to bring them into conformance with Contract Documents and actual field conditions.

I. Contractor: Prepare "Or Equal" submittal information.
   1. Provide standard submittal requirements.
      a. In addition, provide in sufficient detail to show reason for variance from specified product and impacts.
   2. Provide reason the specified product is not being provided.
   3. Explain the benefits to the County for accepting the "Or Equal".
   4. Itemized comparison of the proposed "Or Equal" with product specified including a list of significant variations:
      a. Design features.
      b. Design dimensions.
      c. Installation requirements.
      d. Operations and maintenance requirements.
      e. Availability of maintenance services and sources of replacement materials.
   5. Reference projects where the product has been successfully used:
      a. Name and address of project.
      b. Year of installation.
      c. Year placed in operation.
      d. Name of product installed.
      e. Point of contact: Name and phone number.
   6. Define impacts:
      a. Impacts to other contracts.
      b. Impacts to other work or products.
   7. Contractor represents the following:
      a. Contractor bears the burden of proof of the equivalency of the proposed "Or Equal".
      b. Proposed "Or Equal" is equal or superior to the specified product.
      c. Contractor will provide the warranties or bonds that would be provided on the specified product on the proposed "Or Equal", unless County requires a Special Warranty.
      d. Contractor will coordinate installation of accepted "Or Equal" into the Work and will be responsible for the costs to make changes as required to the Work.
      e. Contractor waives rights to claim additional costs caused by proposed "Or Equal" which may subsequently become apparent.

J. Contractor: Prepare substitution submittal information.
   1. Provide standard submittal requirements.
      a. In addition, provide in sufficient detail to show reason for variance from specified product and impacts.
   2. Provide reason the specified product is not being provided.
   3. Explain the benefits to the County for accepting the substitution.
   4. Itemized comparison of the proposed substitution with product specified including a list of significant variations:
      a. Design features.
      b. Design dimensions.

c. Installation requirements.
d. Operations and maintenance requirements.
e. Availability of maintenance services and sources of replacement materials.

5. Reference projects where the product has been successfully used:
   a. Name and address of project.
   b. Year of installation.
   c. Year placed in operation.
   d. Name of product installed.
   e. Point of contact: Name and phone number.
6. Define impacts:
   a. Impacts to Contract Price.
      1) Required license fees or royalties.
      2) Do not include costs under separate contracts.
      3) Do not include Engineer's costs for redesign or revision of Contract Documents.
   b. Impacts to Contract Time.
   c. Impacts to Contract Scope.
   d. Impacts to other contracts.
   e. Impacts to other work or products.
7. Contractor represents the following:
   a. Contractor shall pay associated costs for Engineer to evaluate the substitution.
   b. Contractor bears the burden of proof of the equivalency of the proposed substitution.
   c. Proposed substitution does not change the design intent and will have equal performance to the specified product.
   d. Proposed substitution is equal or superior to the specified product.
   e. Contractor will provide the warranties or bonds that would be provided on the specified product on the proposed substitution, unless County requires a Special Warranty.
   f. Contractor will coordinate installation of accepted substitution into the Work and will be responsible for the costs to make changes as required to the Work.
   g. Contractor waives rights to claim additional costs caused by proposed substitution which may subsequently become apparent.

1.05 SUBMITTAL IDENTIFICATION NUMBERING

A. Number each submittal using the format defined below:

	Spec Section Number	**Dash**	**Initial Submittal - Sequential Number**	**Decimal Point**	**Subsequent Submittal Revisions Sequential Number**
Example 1 Description	*Cast-In-Place Concrete*		*8th initial submittal*		
	00_30_30	-	0008		

Example 2 Description	*Cast-In-Place Concrete*		*8th initial submittal*		*First revision to the 8th initial submittal*
	00_30_30	-	0008	.	1

1.06 SUBMITTALS IN ELECTRONIC MEDIA FORMAT

A. General: Provide all information in PC-compatible format using Windows® operating system as utilized by the County and Engineer.

B. Text: Provide text documents and manufacturer's literature in Portable Document Format (PDF).

C. Graphics: Provide graphic submittals (drawings, diagrams, figures, etc.) utilizing Portable Document Format (PDF).

1.07 SUBMITTAL PROCEDURE

A. Engineer: Review submittal and provide response:
   1. Review description:
      a. Engineer will be entitled to rely upon the accuracy or completeness of designs, calculations, or certifications made by licensed professionals accompanying a particular submittal whether or not a stamp or seal is required by Contract Documents or Laws and Regulations.
      b. Engineer's review of submittals shall not release Contractor from Contractor's responsibility for performance of requirements of Contract Documents. Neither shall Engineer's review release Contractor from fulfilling purpose of installation nor from Contractor's liability to replace defective work.
      c. Engineer's review of shop drawings, samples, or test procedures will be only for conformance with design concepts and for compliance with information given in Contract Documents.
      d. Engineer's review does not extend to:
         1) Accuracy of dimensions, quantities, or performance of equipment and systems designed by Contractor.
         2) Contractor's means, methods, techniques, sequences, or procedures except when specified, indicated on the Drawings, or required by Contract Documents.
         3) Safety precautions or programs related to safety which shall remain the sole responsibility of the Contractor.
      e. Engineer can Approve or Not Approve any exception at their sole discretion.
   2. Review timeframe:
      a. Except as may be provided in technical specifications, a submittal will be returned within 30 days.
      b. When a submittal cannot be returned within the specified period, Engineer will, within a reasonable time after receipt of the submittal, give notice of the date by which that submittal will be returned.

c. Engineer's acceptance of progress schedule containing submittal review times less than those specified or agreed to in writing by Engineer will not constitute Engineer's acceptance of review times.
d. Critical submittals:
1) Contractor will notify Engineer in writing that timely review of a submittal is critical to the progress of Work.

3. Schedule delays:
a. No adjustment of Contract Times or Contract Price will be allowed due to Engineer's review of submittals, unless all of the following criteria are met:
1) Engineer has failed to review and return first submission within the agreed upon time frame.
2) Contractor demonstrates that delay in progress of Work is directly attributable to Engineer's failure to return submittal within time indicated and accepted by Engineer.

4. Review response will be returned to Contractor with one of the following dispositions:
a. Approved:
1) No Exceptions:
a) There are no notations or comments on the submittal and the Contractor may release the equipment for production.
2) Make Corrections Noted - See Comments:
a) The Contractor may proceed with the Work, however, all notations and comments must be incorporated into the final product.
b) Resubmittal not required.
3) Make Corrections Noted - Confirm:
a) The Contractor may proceed with the Work, however, all notations and comments must be incorporated into the final product.
b) Submit confirmation specifically addressing each notation or comment to the Engineer within 15 calendar days of the date of the Engineer's transmittal requiring the confirmation.
b. Not approved:
1) Correct and resubmit:
a) Contractor may not proceed with the Work described in the submittal.
b) Contractor assumes responsibility for proceeding without approval.
c) Resubmittal of complete submittal package is required within 30 calendar days of the date of the Engineer's submittal review response.
2) Rejected - See Remarks:
a) Contractor may not proceed with the Work described in the submittal.
b) The submittal does not meet the intent of the Contract Documents. Resubmittal of complete submittal package is required with materials, equipment, methods, etc. that meet the requirements of the Contract Documents.

c. Receipt acknowledged - Filed for record:
    1) This is used in acknowledging receipt of informational submittals that address means and methods of construction such as schedules and work plans, conformance test reports, health and safety plans, etc.
d. Receipt acknowledged with comments - Resubmit:
    1) This is used in acknowledging receipt of informational submittals that address means and methods of construction such as schedules and work plans, conformance test reports, health and safety plans, etc. Feedback regarding missing information, conflicting information, or other information that makes it incomplete can be made with comments.

B. Contractor: Prepare resubmittal, if applicable:
    1. Clearly identify each correction or change made.
    2. Include a response in writing to each of the Engineer's comments or questions for submittal packages that are resubmitted in the order that the comments or questions were presented from the 1st and subsequent submittals and numbered consistent with the Engineer's numbering.
        a. Acceptable responses to Engineer's comments are listed below:
            1) "Incorporated" Engineer's comment or change is accepted and appropriate changes are made.
            2) "Response" Engineer's comment not incorporated. Explain why comment is not accepted or requested change is not made. Explain how requirement will be satisfied in lieu of comment or change requested by Engineer.
        b. Reviews and resubmittals:
            1) Contractor shall provide resubmittals which include responses to all submittal review comments separately and at a level of detail commensurate with each comment.
            2) Contractor responses shall indicate how the Contractor resolved the issue pertaining to each review comment
                a) Responses such as "acknowledged" or "noted" are not acceptable.
            3) Resubmittals which do not comply with this requirement may be rejected and returned without review.
            4) Contractor shall be allowed no extensions of any kind to any part of their contract due to the rejection of non-compliant submittals.
            5) Submittal review comments not addressed by the Contractor in resubmittals shall continue to apply whether restated or not in subsequent reviews until adequately addressed by the Contractor to the satisfaction of the reviewing and approving authority.
        c. Any resubmittal that does not contain responses to the Engineer's previous comments shall be returned for Revision and Resubmittal. No further review by the Engineer will be performed until a response for previous comments has been received.
    3. Resubmittal timeframe:
        a. Contractor shall provide resubmittal within 15 days.
        b. When a resubmittal cannot be returned within the specified period, Contractor shall notify Engineer in writing.

4. Review costs:
    a. Costs incurred by County as a result of additional reviews of a particular submittal after the second time it has been reviewed shall be borne by Contractor.
    b. Reimbursement to County will be made by deducting such costs from Contractor's subsequent progress payments.

1.08 PRODUCT DATA

A. Edit submittals so that the submittal specifically applies to only the product furnished.

B. Neatly cross out all extraneous text, options, models, etc. that do not apply to the product being furnished, so that the information remaining is only applicable to the product being furnished.

C. Details:
1. Supplier name and address.
2. Subcontractor name and address.

D. Include:
1. Catalog cuts.
2. Bulletins.
3. Brochures.
4. Manufacturer’s Certificate of Compliance: Signed by product manufacturer along with supporting reference data, affidavits, and tests, as appropriate.
5. Manufacturer’s printed recommendations for installation of equipment.
6. Quality photocopies of applicable pages from manufacturer’s documents.

E. Test reports including the following information:
1. Test description.
2. List of equipment used.
3. Name of the person conducting the test.
4. Date and time the test was conducted.
5. Ambient temperature and weather conditions.
6. All raw data collected.
7. Calculated results.
8. Clear statement if the test passed or failed the requirements stated in Contract Documents.
9. Signature of the person responsible for the test.

F. Certificates:
1. As specified in technical sections.
2. For products that will be in contact with potable water, submit evidence from a nationally recognized laboratory that the products comply with the requirements of the NSF 61 standard.

1.09 SHOP DRAWINGS

A. Contractor to field verify elevation, coordinates, and pipe material for pipe tie-in to pipeline or structure prior to the preparation of shop drawings.

B. Indicate project designated equipment tag numbers for submittal of devices, equipment, and assemblies.

C. Details:
   1. Fabrication drawings: Drawn to scale and dimensioned.
   2. Front, side, and, rear elevations, and top and bottom views, showing all dimensions.
   3. Locations of conduit entrances and access plates.
   4. Component layout and identification.
   5. Weight.
   6. Finish.
   7. Temperature limitations, as applicable.
   8. Nameplate information.

D. Minor or incidental products and equipment schedules:
   1. Details:
      a. Shop Drawings of minor or incidental fabricated products will not be required, unless requested.
      b. Submit tabulated lists of minor or incidental products showing the names of the manufacturers and catalog numbers, with Product Data and Samples as required to determine acceptability.

1.10 SAMPLES

A. Details:
   1. Submit labeled samples.
   2. Samples will not be returned.
   3. Provide number of sample submittals as below:
      a. Total: 2 minimum.
         1) County: 1.
         2) Engineer: 1.

B. Contractor: None.Field samples:
   1. As specified in technical sections.

1.11 DESIGN CALCULATIONS

A. Defined in technical sections:
   1. Calculations must bear the original seal and signature of a Professional Engineer licensed in the state of Florida and who provided responsible charge for the design.

1.12 SCHEDULES

A. Progress schedules: As specified in Section 01_32_21 - Schedules and Reports.
   1. Each schedule submittal specified in these Contract Documents shall be submitted as a native backed-up file (.xer) of the scheduling program as specified in Section 01_32_21 - Schedules and Reports.
   2. The schedule and all required reports shall also be submitted as a PDF file.
   3. Schedule of values: As specified in Section 01_29_73 - Schedule of Values.

4. Schedule of submittals: As specified in Section 01_32_21 - Schedules and Reports.

A. Progress reports and quantity charts:
   1. As specified in Section 01_32_21 - Schedules and Reports.

1.13 REQUESTS FOR SUBSTITUTIONS (RFS)

A. As specified in Section 01_60_00 - Product Requirements.

1.14 REQUESTS FOR INFORMATION (RFI)

A. As specified.

1.15 CONTRACTOR'S PROFESSIONAL ENGINEER (P.E.) CERTIFICATION FORM

A. Submit a completed Contractor's P.E. Certification Form, provided in this Section, to comply with technical sections requirement for a professional engineer's certification from an engineer licensed in the state of Florida where required by applicable rule or law.

1.16 CLOSEOUT SUBMITTALS

A. Provide closeout submittals as specified in Section 01_77_00 - Closeout Procedures.

B. Operation and Maintenance Manuals: final documents shall be submitted as specified in Section 01_78_24 - Operation and Maintenance Manuals.

C. Extra materials, spare parts, etc.: Submittal forms shall indicate when actual materials are submitted.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

ATTACHMENT A - CONTRACTOR SUBMITTAL TRANSMITTAL FORM

CONTRACTOR SUBMITTAL TRANSMITTAL FORM

County:	Click here to enter text.	**Date:**	MM/DD/YYYY
Contractor:	Click here to enter text.	**Project No.:**	XXXXX.XX
Project Name:	Click here to enter text.	**Submittal Number:**	000
Submittal Title:	Click here to enter text.		
To:	Click here to enter text.		
From:	Click here to enter text.	Click here to enter text.	
	Click here to enter text.	Click here to enter text.	

Specification No. and Subject of Submittal / Equipment Supplier			
Spec ##:	Spec ##.	**Subject:**	Click here to enter text.
Authored By:	Click here to enter text.	**Date Submitted:**	XX/XX/XXXX

Submittal Certification		
Check Either (A) or (B):		
☐	(A)	We have verified that the equipment or material contained in this submittal meets all the requirements specified in the project manual or shown on the contract drawings with no exceptions.
☐	(B)	We have verified that the equipment or material contained in this submittal meets all the requirements specified in the project manual or shown on the contract drawings except for the deviations listed.
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.		
General Contractor's Reviewer's Signature:		
Printed Name:		
In the event, Contractor believes the Submittal response does or will cause a change to the requirements of the Contract, Contractor shall immediately give written notice stating that Contractor considers the response to be a Change Order.		
Firm: Click here to enter text.	**Signature:**	**Date Returned:** XX/XX/XXXX

PM/CM Office Use	
Date Received GC to PM/CM:	
Date Received PM/CM to Reviewer:	
Date Received Reviewer to PM/CM:	
Date Sent PM/CM to GC:	

ATTACHMENT B – CONTRACTOR'S P.E. CERTIFICATION FORM

DOCUMENT 01_33_00
CONTRACTOR'S P.E. CERTIFICATION FORM

County:	Click here to enter text.	**Date:**	MM/DD/YYYY.
Contractor:	Click here to enter text.	**Registration State:**	Click here to enter text.
Project Name:	Click here to enter text.	**Project No.:**	00000.00.
Responsibilities:	Click here to enter text.		
Spec Section:	Click here to enter text.		

Statement of Certification

The undersigned hereby certifies that he/she is a professional engineer registered in the State of and that he/she has been employed by

The undersigned further certifies that he/she has performed the said design 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 calculation and drawings used in, and resulting from, the design.

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

Click here to enter text.

(Name of County, or County's representative within 7 days of receiving a written request by the County.)

Prof. Engineer Signature: _____ **Date:** _____

Printed Name: _____ **Company Name:** _____

Contractor's Signature: _____ **Date:** _____

Printed Name: _____

SECTION 01_41_00

REGULATORY REQUIREMENTS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Regulatory authorities and codes.

1.02 AUTHORITIES HAVING JURISDICTION (AHJ)

A. Also referred to as the permitting agency.

B. National Fire Protection Association (NFPA):
   1. NFPA 70: National Electrical Code, current edition.
   2. 6th Edition Florida Fire Prevention Code (NFPA 1-Uniform Fire Code-2015 edition, NFPA 101-Life Safety Code-2015 edition).

C. Florida Building Commission (FBC), with local amendments:
   a. Florida Building Code: Building – 2020.
   b. Florida Building Code: Energy – 2020.
   c. Florida Building Code: Existing Building – 2020.
   d. Florida Building Code: Fuel Gas – 2020.
   e. Florida Building Code: Mechanical – 2020.
   f. Florida Building Code: Plumbing – 2020.

D. Florida Building Code: Test Protocols for High Velocity Hurricane Zone – 2020.

1.03 APPLICABLE CODES

A. Design requirements:
   1. Building code:
      a. Florida Building Code: Building.
      b. Florida Building Code: Existing Building.
      c. Florida Building Code: Test Protocols for High Velocity Hurricane Zones.
   2. Electrical code:
      a. NFPA 70: National Electric Code.
   3. Energy conservation code:
      a. Florida Building Code: Energy.
   4. Fire code:
      a. 7th Edition Florida Fire Prevention Code, with local amendments.
   5. Mechanical codes:
      a. Florida Building Code: Mechanical.
      b. Florida Building Code: Fuel Gas.
   6. Plumbing code:
      a. Florida Building Code: Plumbing.

B. Local Requirements:
   1. Contractor shall be responsible for complying with the Collier County Water-Sewer District Utilities Standards Manual (CCWSDUS) applicable specifications, details, and guidelines. In case of discrepancy among the Contract Documents and the CCWSDUS documents, the most restrictive requirements shall govern. In the event that any conflicts cannot be resolved by reference to this provision, then County shall resolve the conflict in any manner which is acceptable to County and which comports with the overall intent of the Contract Documents.

C. Florida Department of Environmental Protection Drinking Water Section
   1. Section 62-550 of the Florida Administrative Code.
   2. Section 62-555 of the Florida Administrative Code.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01_45_00

QUALITY CONTROL

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Quality control and control of installation.
   2. Tolerances.
   3. References.
   4. Mock-up requirements.
   5. Authority and duties of County's representative or inspector.
   6. Sampling and testing.
   7. Testing and inspection services.
   8. Contractor's responsibilities.

1.02 QUALITY CONTROL AND CONTROL OF INSTALLATION

A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce Work of specified quality.

B. Comply with manufacturers' instructions, including each step in sequence.

C. When manufacturers' instructions conflict with Contract Documents, request clarification from Engineer before proceeding.

D. Comply with specified standards as minimum quality for the Work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.

E. Perform Work by persons qualified to produce required and specified quality.

F. Verify field measurements are as indicated on Shop Drawings or as instructed by manufacturer.

G. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, or disfigurement.

H. When specified, products will be tested and inspected either at point of origin or at Work site:
   1. Notify Engineer in writing well in advance of when products will be ready for testing and inspection at point of origin.
   2. Do not construe that satisfactory tests and inspections at point of origin is final acceptance of products. Satisfactory tests or inspections at point of origin do not preclude retesting or re-inspection at Work site.

I. Do not ship products which require testing and inspection at point of origin prior to testing and inspection.

1.03 TOLERANCES

A. Monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate.

B. Comply with manufacturers' tolerances. When Manufacturers' tolerances conflict with Contract Documents, request clarification from Engineer before proceeding.

C. Adjust products to appropriate dimensions; position before securing products in place.

1.04 REFERENCES

A. ASTM International (ASTM):
   1. E329 - Standard for Agencies Engaged in Construction Inspection, Testing or Special Inspection.

B. National Institute of Standards and Technology (NIST).

1.05 PRODUCT REQUIREMENTS

A. For products or workmanship specified by association, trade, or other consensus standards, comply with requirements of standard, except when more rigid requirements are specified or are required by applicable codes.

B. Conform to reference standard by date of issue current on date of Contract Documents, except where specific date is established by code.

C. Obtain copies of standards where required by product specification sections.

D. When specified reference standards conflict with Contract Documents, request clarification from Engineer before proceeding.

1.06 MOCK-UP REQUIREMENTS

A. Tests will be performed under provisions identified in this Section and identified in respective product specification sections.

B. Assemble and erect specified items with specified attachment and anchorage devices, flashings, seals, and finishes.

C. Accepted mock-ups shall be comparison standard for remaining Work.

D. Where mock-up has been accepted by Engineer and is specified in product specification sections to be removed; remove mock-up and clear area when directed to do so by Engineer.

1.07 AUTHORITY AND DUTIES OF COUNTY'S REPRESENTATIVE OR INSPECTOR

A. County’s Project Representative employed or retained by County is authorized to inspect the Work.

B. Inspections may extend to entire or part of the Work and to preparation, fabrication, and manufacture of products for the Work.

C. Deficiencies or defects in the Work which have been observed will be called to Contractor's attention.

D. Inspector will not:
   1. Alter or waive provisions of Contract Documents.
   2. Inspect Contractor's means, methods, techniques, sequences, or procedures for construction.
   3. Accept portions of the Work, issue instructions contrary to intent of Contract Documents, or act as foreman for Contractor. Supervise, control, or direct Contractor's safety precautions or programs; or inspect for safety conditions on Work site, or of persons thereon, whether Contractor's employees or others.

E. Inspector will:
   1. Conduct on-site observations of the Work in progress to assist Engineer in determining when the Work is, in general, proceeding in accordance with Contract Documents.
   2. Report to Engineer whenever Inspector believes that Work is faulty, defective, does not conform to Contract Documents, or has been damaged; or whenever there is defective material or equipment; or whenever Inspector believes the Work should be uncovered for observation or requires special procedures.

1.08 SAMPLING AND TESTING

A. General:
   1. Prior to delivery and incorporation in the Work, submit listing of sources of materials, when specified in sections where materials are specified.
   2. When specified in sections where products are specified:
      a. Submit sufficient quantities of representative samples of character and quality required of materials to be used in the Work for testing or examination.
      b. Test materials in accordance with standards of national technical organizations.

B. Sampling:
   1. Furnish specimens of materials when requested.
   2. Do not use materials which are required to be tested until testing indicates satisfactory compliance with specified requirements.
   3. Specimens of materials will be taken for testing whenever necessary to determine quality of material.
   4. Assist Engineer in preparation of test specimens at site of work, such as soil samples and concrete test cylinders.

1.09 TESTING AND INSPECTION SERVICES

A. Contractor will employ and pay for specified services of an independent firm to perform Contractor quality control testing as required in the technical specifications for various work and materials.

B. County will employ and pay for specified services of an “County’s independent testing firm” certified to perform testing and inspection as required in the technical specifications for various work and materials or stipulated in Section 01_45_24 - Regulatory Quality Assurance to confirm Contractor’s compliance with Contract Documents.

C. The County’s independent testing firm will perform tests, inspections and other services specified in individual specification sections and as required by County and requested by the Engineer.

D. The qualifications of laboratory that will perform the testing, contracted by the County or by the Contractor, shall be as follows:
   1. Has authorization to operate in the state where the project is located.
   2. Meets “Recommended Requirements for Independent Laboratory Qualification,” published by American Council of Independent Laboratories.
   3. Meets requirements of ASTM E329.
   4. Laboratory Staff: Maintain full time specialist on staff to review services.
   5. Testing Equipment: Calibrated at reasonable intervals with devices of accuracy traceable to NIST or accepted values of natural physical constants.
   6. Will submit copy of report of inspection of facilities made by Materials Reference Laboratory of NIST during most recent tour of inspection, with memorandum of remedies of deficiencies reported by inspection.

E. Testing, inspections, and source quality control may occur on or off project site. Perform off-site testing inspections and source quality control as required by Engineer or County.

F. Contractor shall cooperate with County’s independent testing firm, furnish samples of materials, design mix, equipment, tools, storage, safe access, and assistance by incidental labor as requested.
   1. Notify Engineer and County’s independent testing firm 48 hours prior to expected time for operations requiring testing.
   2. Make arrangements with County’s independent testing firm and pay for additional samples and tests required for Contractor’s use.

G. Limitations of authority of testing Laboratory: County’s independent testing firm or Laboratory is not authorized to:
   1. Agency or laboratory may not release, revoke, alter, or enlarge on requirements of Contract Documents.
   2. Agency or laboratory may not approve or accept any portion of the Work.
   3. Agency or laboratory may not assume duties of Contractor.
   4. Agency or laboratory has no authority to stop the Work.

H. Testing and employment of an County’s independent testing firm or laboratory shall not relieve Contractor of obligation to perform Work in accordance with requirements of Contract Documents.

I. Re-testing or re-inspection required because of non-conformance to specified requirements shall be performed by same County’s independent testing firm on instructions by Engineer. Payment for re-testing or re-inspection will be charged to Contractor by deducting testing charges from Contract Sum/Price.

J. The County's independent testing firm responsibilities will include:
   1. Test samples of mixes submitted by Contractor.
   2. Provide qualified personnel at site. Cooperate with Engineer and Contractor in performance of services.
   3. Perform specified sampling and testing of products in accordance with specified standards.
   4. Ascertain compliance of materials and mixes with requirements of Contract Documents.
   5. Promptly notify Engineer and Contractor of observed irregularities or non-conformance of Work or products.
   6. Perform additional tests required by Engineer.
   7. Attend preconstruction meetings and progress meetings when requested.

K. County's independent testing firm individual test reports:
   1. After each test, County's independent testing firm will promptly submit electronically report to Engineer and to Contractor.
   2. Test reports shall include at least the following information:
      a. Date issued.
      b. Project title and number.
      c. Name of inspector.
      d. Date and time of sampling or inspection.
      e. Identification of product and specifications section.
      f. Location in Project.
      g. Type of inspection or test.
      h. Date of test.
      i. Certified test results stamped and signed by a registered Engineer in the state where the project is located.
      j. Summary of conformance with Contract Documents.
      k. When requested by Engineer, the County's independent testing firm will provide interpretation of test results.

L. County's independent testing firm will provide monthly report of certification to identify all work performed for special inspections and other contract requirements on this project. The following certified monthly report at a minimum will include but not limited to:
   1. Results of testing.
   2. Testing logs.
   3. Outstanding deficiencies.
   4. Various statistical data.
   5. Testing curves (up to 4 types) as required by the Engineer.

1.10 CONTRACTOR'S RESPONSIBILITIES

A. Cooperate with County's independent testing firm or laboratory personnel and provide access to construction and manufacturing operations.

B. Secure and deliver to County's independent testing firm or laboratory adequate quantities of representative samples of materials proposed to be used and which require testing.

C. Provide to County's independent testing firm or laboratory and Engineer preliminary mix design proposed to be used for concrete, and other materials mixes which require control by testing laboratory.

D. Submit product test reports electronically.

E. Furnish incidental labor and facilities:
   1. To provide access to construction to be tested.
   2. To obtain and handle samples at Work site or at source of product to be tested.
   3. To facilitate inspections and tests.
   4. For storage and curing of test samples.

F. Notify County's independent testing firm or laboratory 48 hours in advance of when observations, inspections and testing is needed for laboratory to schedule and perform in accordance with their notice of response time.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01_60_00

PRODUCT REQUIREMENTS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Requirements for tangible materials, raw or manufactured, that become part of the project.

1.02 REFERENCES

A. International Organization for Standardization (ISO):
   1. 9001 - Quality Management Systems - Requirements.

B. NSF International (NSF).
   1. 61 - Drinking Water System Components - Health Effects.
   2. 372 - Drinking Water System Components – Lead Content.

C. Underwriters Laboratories, Inc. (UL).

D. American National Standards Institute (ANSI).

1.03 TERMINOLOGY

A. The words and terms listed below, are not defined terms that require initial capital letters, but, when used in this Section have the indicated meaning.
   1. Calculations:
      a. Documentation of the process of transforming the design and prescriptive criteria into a design meeting the performance criteria.
   2. Certificates:
      a. An official document that attests a fact is in accordance with the Contract Documents.
   3. Manufacturer's instructions:
      a. Stipulations, directions, and/or recommendations issued by the manufacturer of the product addressing handling, installation, erection, and/or application of the product.
   4. Products:
      a. Raw materials, finished goods, equipment, systems, and shop fabrications that will become part of the Work.
   5. Product data:
      a. Public information about the product which is found in the manufacturer's catalogs or on their web site including catalog pages, data sheets, bulletins, layout drawings, exploded views, and brochures.
   6. Samples:
      a. As defined in the General Conditions and Supplementary Conditions.

b. Full-size actual products or pieces of products intended to illustrate the products to be incorporated into the project. Sample submittals are often necessary for such characteristics as colors, textures, and other appearance issues.

7. Schedules:
   a. Product parts and materials lists.
8. Shop Drawings:
   a. As defined in the General Conditions and Supplementary Conditions.
   b. Shop Drawings are prepared specifically for the project to illustrate details, dimensions, and other data necessary for satisfactory fabrication or construction that are not shown completely in the Drawings.
   c. Shop Drawings could include graphic line-type drawings and single-line diagrams.
9. Spare parts and materials:
   a. Duplicate parts necessary to replace a damaged or worn part of the product.
   b. Consumables such as operating fluids.
10. Special tools:
    a. Special wrenches, gauges, circuit setters, and other similar devices required for the proper operation or maintenance of a system that would not normally be in the County's tool kit and that have been specifically made for use on a product for assembly, disassembly, repair, or maintenance.
11. Submittals:
    a. As defined in the General Conditions and Supplementary Conditions.
    b. Samples, product data, Shop Drawings, and others that demonstrate how Contractor intends to conform to the Contract Documents.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Provide products as Engineer has approved by the Submittal process or by other written documents.

B. Provide products by same manufacturer when units are of similar nature, unless otherwise specified.

C. Provide like parts of duplicate units that are interchangeable.

D. Provide equipment or product that has not been in service prior to delivery, except as required by tests.

E. Provide products produced by manufacturers regularly engaged in the production of these products.

F. Provide products that bear approvals and labels as specified such as Factory Mutual (FM), Underwriters Laboratory (UL), or National Sanitation Foundation (NSF International).

G. All products that come into contact with drinking water, or water being treated to become drinking water, shall conform to NSF-61 or other acceptable standard per FAC 62-555.

2.02 MATERIAL

A. Dissimilar metals:
   1. Separate contacting surfaces with dielectric material.
   2. Neoprene, bituminous impregnated felt, heavy bituminous coatings, nonmetallic separators or washers, or other materials as specified.

B. Edge grinding:
   1. Sharp projections of cut or sheared edges of ferrous metals which are not to be welded shall be ground to a radius required to ensure satisfactory paint adherence.

C. Use anti-galling compound on threads of stainless steel fasteners during factory assembly.

D. Provide anti-galling compound with stainless steel fasteners shipped for field assembly.

E. Aluminum in contact with concrete or masonry: Apply epoxy mastic.

F. Pipes:
   1. Provide new pipe manufactured for the project, not from manufacturer's inventory, under the following conditions:
      a. Pipes 24-inch diameter and larger.
      b. Except steel pipes 6-inch diameter and larger.
   2. Prove pipe manufactured more than 6 months prior to delivery if the pipe material or its coating is subject to ultraviolet (UV) degradation.
   3. Provide ductile iron pipe with cement-mortar lining manufactured more than 6 months prior to delivery to the project.
   4. Mark each length of pipe in accordance with applicable standards.

2.03 PRODUCT SELECTION

A. When products are specified without named manufacturers, provide products that meet or exceed the Specifications.

B. When products are specified with names of manufacturers but no model numbers or catalog designations, provide products by one of named manufacturers that meet or exceed specifications.

C. When products are specified with names of manufacturers and model numbers or catalog designations, provide products with model numbers or catalog designations by one of the named manufacturers.

D. When products are specified with names of manufacturers, but with brand or trade names, model numbers, or catalog designations by one manufacturer only, provide:
    1. Products specified by brand or trade name, model number, or catalog designation.
    2. Products by another named manufacturers proven, in accordance with requirements for an “or equal”, including Engineer’s approval, to meet or exceed quality, appearance and performance of specified brand or trade name, model number, or catalog designation.

E. When products are specified with only one manufacturer followed by “or Equal,” provide:
    1. Products meeting or exceeding Specifications by specified manufacturer.
    2. Engineer deemed “or equal” evidenced by an approved Shop Drawing or other written communication.

F. When products are specified by naming 2 or more manufacturers with 1 manufacturer as a “Basis of Design”:
    1. Any of the named manufacturers can be submitted.
    2. If the product submitted is not by the named “Basis of Design” product and requires a change in the scope (dimensions, configuration, physical properties, etc.), schedule (longer lead time), or budget, the Contractor must submit a substitution request.

2.04 SPARE PARTS, MAINTENANCE PRODUCTS, AND SPECIAL TOOLS

A. Provide spare parts and maintenance products as required by Technical Sections.
    1. Submit completed Attachment A - Spare Parts, Maintenance Products, and Special Tools Inventory List.

B. Provide one set of special tools required to install or service the equipment.

C. Box, tag, and clearly mark items.

D. Contractor is responsible for spare parts, maintenance products, and special tools until acceptance by County.

PART 3 EXECUTION

3.01 SHIPMENT

A. Requirements prior to shipment of equipment:
    1. Engineer approved Submittals or other written documentation.
    2. Engineer approved Manufacturer’s Certificate of Source Testing as specified in the Technical Sections.
    3. Draft operations and maintenance manuals, as specified in Section 01_78_24 - Operation and Maintenance Manuals as specified in the Technical Sections.

B. Transport products by methods that avoid product damage.

C. Deliver products in undamaged condition in manufacturer's unopened containers or packaging.

3.02 DELIVERY AND HANDLING

A. Handle equipment in accordance with manufacturer's instructions.

B. Deliver products in undamaged condition in manufacturer's unopened containers or packaging.

C. Provide construction equipment and personnel to handle products by methods in accordance with manufacturer’s instructions.

D. Upon delivery, promptly inspect shipments:
   1. Verify compliance with Contract Documents, correct quantities, and undamaged condition of products.
   2. Acceptance of shipment does not constitute final acceptance of equipment.

E. Spare parts, maintenance products, special tools.
   1. Immediately store in accordance with the manufacturer's instructions.
   2. Store spare parts, maintenance products, and special tools in enclosed, weather-proof, and lighted facility during the construction period.
      a. Protect parts subject to deterioration, such as ferrous metal items and electrical components with appropriate lubricants, desiccants, or hermetic sealing.
   3. With County's written request for advanced delivery of spare parts, maintenance products, and special tools.
      a. Deliver requested items and deduct them from the inventory list.
      b. Provide transmittal documentation.
   4. Store large items individually:
      a. Weight: Greater than 50 pounds.
      b. Size: Greater than 24 inches wide by 18 inches high by 36 inches long.
      c. Clearly labeled:
         1) Equipment tag number.
         2) Equipment manufacturer.
         3) Subassembly component, if appropriate.
         4) Store smaller items in spare parts box:
      d. Weight: Less than 50 pounds.
      e. Size: Less than 24 inches wide by 18 inches high by 36 inches long.
      f. Clearly labeled:
         1) Equipment tag number.
         2) Equipment manufacturer.
         3) Subassembly component, if appropriate.
         4) Spare parts and special tools box:
      g. Box material: Waterproof, corrosion resistant.
      h. Hinged cover:
         1) Locking hasp.
      i. Spare parts inventory list taped to underside of cover.
      j. Clearly labeled:
         1) The words “Spare Parts and/or Special Tools”.
         2) Equipment tag number.

3) Equipment manufacturer.
4) Subassembly component, if appropriate.

3.03 STORAGE AND PROTECTION DURING STORAGE

A. Storage of equipment to be in accordance with the manufacturer's instructions.
1. Including connection of motor heaters, lubrication, manually rotating shafts, etc.
2. The Contractor shall furnish a copy of the manufacturer's instructions for storage to the Engineer prior to storage of equipment and materials.

B. Immediately store and protect products until installed in Work.

C. Furnish covered, weather-protected storage structures providing a clean, dry, noncorrosive environment for mechanical equipment, valves, architectural items, electrical and instrumentation equipment and special equipment to be incorporated into this project.

D. Store products with seals and legible labels intact.

E. Protect painted or coated surfaces against impact, abrasion, discoloration, and damage.

F. Storage of spare parts, maintenance products, special tools.
1. Immediately store in accordance with the manufacturer's instructions.
2. Store spare parts, maintenance products, and special tools in enclosed, weather-proof, and lighted facility during the construction period.
3. Protect parts subject to deterioration, such as ferrous metal items and electrical components with appropriate lubricants, desiccants, or hermetic sealing.
4. Store large items individually:
   a. Weight: Greater than 50 pounds.
   b. Size: Greater than 24 inches wide by 18 inches high by 36 inches long.
   c. Clearly labeled:
      1) Equipment tag number.
      2) Equipment manufacturer.
      3) Subassembly component, if appropriate.
5. Store smaller items in spare parts boxes:
   a. Weight: Less than 50 pounds.
   b. Size: Less than 24 inches wide by 18 inches high by 36 inches long.
   c. Clearly labeled:
      1) Equipment tag number.
      2) Equipment manufacturer.
      3) Subassembly component, if appropriate.
6. Spare parts and special tools box:
   a. Box material: Waterproof, corrosion resistant.
   b. Hinged cover with locking hasp:
   c. Inventory list taped to underside of cover.
      1) Clearly labeled:
      2) The words "Spare Parts and/or Special Tools".
      3) Equipment tag number.
      4) Equipment manufacturer.
      5) Subassembly component, if appropriate.

G. Exterior storage of fabricated products:
   1. Place on aboveground supports that allow for drainage.
   2. Cover products subject to deterioration with impervious sheet covering.
   3. Provide ventilation to prevent condensation under covering.

H. Store moisture sensitive products in watertight enclosures.

I. Store loose granular materials on solid surfaces in well-drained area.
   1. Prevent materials mixing with foreign matter.
   2. Provide access for inspection.

J. Provide an equipment log and stored products log with monthly pay applications.
   1. Data includes as a minimum: The storage location, equipment or product identification, date stored, date of inspection/maintenance, date removed from storage, copy of manufacturer's recommended storage guidelines, description of inspection/maintenance activities performed, and signature of party performing inspection/maintenance.

K. When needed and approved by the Engineer, offsite storage location shall be within 20 miles of the project site.
   1. Provide proof of insurance coverage for products stored offsite.

L. Payment will not be made for equipment and materials improperly stored or stored without providing Engineer with the manufacturer's instructions for storage.

3.04 INSTALLATION

A. Inspect equipment or product prior to product installation.

B. Repaint or recoat damaged painted or coated surfaces.

C. Use anti-galling compound on stainless steel threads used for field assembly.

3.05 PROTECTION AFTER INSTALLATION

A. Provide substantial coverings as necessary to protect installed products from damage from traffic and subsequent construction operations.
   1. Remove covering when no longer needed.
   2. Replace corroded, damaged, or deteriorated equipment, product, or parts before acceptance of the project.

B. Update equipment log with monthly pay applications.
   1. Data includes as a minimum: Description of maintenance activities performed in accordance with the manufacturer's recommendation and industry standards and signature of party performing maintenance.

END OF SECTION

ATTACHMENT A - SPARE PARTS, MAINTENANCE PRODUCTS, AND SPECIAL TOOLS INVENTORY LIST

SPARE PARTS, MAINTENANCE PRODUCTS, AND SPECIAL TOOLS INVENTORY LIST

County: _____ **Date:** _____

Contractor: _____ **Project No.:** _____

Project Name: _____

Inventory List				
Spec Number: _____		Spec Title _____		
Equipment Tag No.: _____		Equipment Manufacturer: _____		
Quantity	**Subassembly Component**	**Description**	**Manufacturer's Part Number**	**Storage Location**

SECTION 01_71_23

FIELD ENGINEERING

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Field engineering to establish lines and grades for the Work.

1.02 SUBMITTALS

A. Submit as specified in Section 01_33_00 - Submittal Procedures.

B. Qualifications of the professional land surveyor or licensed civil engineer with the authority to provide land surveying in Florida that will be performing the field engineering.

C. Pre-Excavation Report.

1.03 PRE-EXCAVATION REPORT

A. Prior to the start of the Work, create a report confirming the verification of the following data:
   1. Site elevation.
   2. Existing structures including but not limited to buildings, manholes (sanitary, storm, electrical, and other), drainage inlets:
      a. Location coordinates.
      b. Top of wall elevation and coordinates.
      c. Floor elevations.
      d. Invert elevations.
   3. Existing utilities as specified in Section 02280(33_05_01) - Subsurface Utility Engineering.
   4. Proposed building corners, tank, and equipment locations.
   5. Verify existing electrical, instrumentation, and phone utilities.

B. Incorporate information from Pre-Excavation Report into the record drawings.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 SURVEY REFERENCE POINTS

A. Basic reference line, a beginning point on basic reference line, points with referenced coordinates, and a benchmark will be provided by County.

B. From these reference points, establish other control and reference points as required to properly lay out the Work.

C. Locate and protect control points prior to starting site work, and preserve permanent reference points during construction:
   1. Make no changes or relocations without prior written notice.
   2. Replace Project control point, when lost or destroyed, in accordance with original survey control.

D. Set monuments for principal control points and protect them from being disturbed and displaced:
   1. Re-establish disturbed monuments.
   2. When disturbed, postpone parts of the Work that are governed by disturbed monuments until such monuments are re-established.

3.02 PROJECT SITE SURVEY REQUIREMENTS

A. Establish minimum of 2 permanent benchmarks on site referenced to data established by survey control points.

B. Record permanent benchmark locations with horizontal and vertical data on Project Record Documents.

C. Perform verifications and checking in accordance with industry standard surveying practice.

D. Maintain complete, accurate log of control points and survey.

E. Affix civil engineer's or professional land surveyor's signature and license number to Record Drawings to certify accuracy of information shown.

3.03 CONSTRUCTION STAKES, LINES, AND GRADES

A. Execute the Work in accordance with the lines and grades indicated.

B. Make distances and measurements on horizontal planes, except elevations and structural dimensions.

3.04 QUALITY CONTROL

A. Accuracy of stakes, alignments, and grades may be checked randomly by Engineer:
   1. Notice of when checking will be conducted will be given.
   2. When notice of checking is given, postpone parts of the Work affected by stakes, alignments, or grades to be checked until checked.
   3. Engineer's check does not substitute or complement required field quality control procedures.

3.05 RECORD DOCUMENTS

A. Prepare and submit Record Documents as specified in Section 01_77_00 - Closeout Procedures.

B. Provide certified site survey including constructed features, benchmarks, and appurtenances sealed and signed by professional land surveyor or duty authorized licensed civil engineer.
   1. Submit to permitting agency, as required.

END OF SECTION

SECTION 01_75_17

COMMISSIONING

TABLE OF CONTENTS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Commissioning.

1.02 DEFINITIONS

A. Commissioning: The process of planning for, testing of, and start-up of systems, subsystems, equipment, components, and devices of the Work to demonstrate, through documented verification, that the Work has successfully met the Contract Documents. It includes training the County's staff on operation and maintenance of the installed Work.

B. Commissioning Phases: The activities of commissioning are grouped into the phases defined in the following table.
   1. Table 1 - Commissioning Phases.

TABLE 1 - COMMISSIONING PHASES		
Planning Phase	**Testing and Training Phase**	**Start-Up Phase**
Draft Test Plans	Source Testing • Documentation	Start-Up • Documentation • County Training
	Installation Verification • Documentation • County Training	
	Functional Testing • Documentation • County Training	

   2. Attachment A provides Commissioning Flowcharts.

C. Component: A part of a system that does not have an electrical connection or internal electronics. Examples: Piping and pressure gauges.

D. Device: A part of a system that has electrical connections or internal electronics. Examples: level transmitter or pressure transmitter.

E. Electrical Energization Plan: A plan to manage how and when power is applied to electrical equipment.

F. Equipment: A factory or field assembled apparatus that performs an identifiable function. Examples: pumps, motors, VFDs, MCCs.

G. Functional Testing: Testing performed on a completed subsystem or system to demonstrate that the system meets the specified requirements. Example systems: backwash system, dewatering system.

H. Installation Verification: Testing to demonstrate that equipment or system and associated components or devices have been properly installed. Example equipment: pumps, meters, and blowers with associated piping.

I. Manufacturer's Certificate of Functional Compliance: The form completed by the manufacturer to confirm that testing of the installed equipment or system has been performed and the results conform to the specified performance. The form is provided in Attachment D provided at the end of this Section.

J. Manufacturer's Certificate of Installation Verification: The form completed by the manufacturer to confirm that the equipment or system is installed in conformance with the Contract. The form is provided in Attachment C at the end of this Section.

K. Manufacturer's Certificate of Source Testing: The form completed by the manufacturer to confirm that the specified source tests have been performed and the results conform to the specified requirements. The form is provided in Attachment B at the end of this Section.

L. County Training: The County's staff is trained by the Contractor, with assistance from manufacturer, to operate and maintain the completed Work. This is sometimes referred to as Vendor Specific Training.

M. Process Stream: A series of liquid or solids flow processes that are designed to improve the water quality to meet regulatory permit requirements.

N. Source Testing: Test equipment or products for performance at point of manufacture or assembly for the requirements specified in the Contract Documents. Also referred to as factory testing and factory acceptance testing (FAT).

O. Start-Up Phase: The phase when Start-Up occurs.

P. Start-Up: Operating the Work with process water to verify the Work meets the Contract Documents.

Q. Subsystem: A grouping of equipment, components, and devices that is a part of a larger system and that perform a single definable function. Examples: sand filters, filter backwash.

R. System: A grouping of equipment, components, and devices that perform a single definable function. If a system is a part of a larger system, it is referred to as a subsystem Examples: Flocculation and sedimentation, filtration.

S. System Testing: Testing of a completed system for an extended time period. Examples: Headworks, filtration.

T. Water Management Plan: A plan to manage the test water used for commissioning from source to disposal. The test water may be clean water, potable water, non-potable water, or process water (e.g., raw water, plant water, sludge). The plan demonstrates how water will be produced, conveyed, treated, disposed of as directed by the plant manager, and/or recycled.

1.03 SUBMITTALS

A. Project commissioning:
   1. Commissioning Coordinator's qualifications.
      a. Submit to Engineer no later than 30 days after Notice to Proceed.
      b. Describe previous similar experience on similar projects with a list of references including phone numbers.
      c. Provide names and qualifications of commissioning assistants, if applicable.
   2. Schedules:
      a. Commissioning Schedule containing all commissioning activities.
      b. County Training Schedule.
   3. Test Plans:
      a. Submit draft Test Plan outlined in the Planning Phase, unless specified otherwise.
         1) Engineer approval of draft Test Plans required for successful completion of Planning Phase.
      b. Submit final Test Plan a maximum of 60 calendar days prior to testing.
      c. Engineer approval of final Test Plan required prior to start of testing.
   4. Test Reports:
      a. Submit draft Test Reports outline in the Planning Phase, unless specified otherwise.
         1) Engineer approval of draft Test Reports outline required for successful completion of Planning Phase.
      b. Submit final Test Report a maximum of 30 calendar days after testing.

B. Technical Sections commissioning:
   1. Manufacturer's representative's qualifications.
      a. Submit to Engineer no later than 30 days in advance of required services.
      b. Representative's name, phone, and e-mail address:
         1) May use 2 representatives: 1 for field testing and 1 for County Training.
         2) Provide resume stating instructor's technical expertise and instructional technology skills and experience.
   2. Test Plans:
      a. Submit draft Test Plan outlined in the Planning Phase, unless specified otherwise.
         1) Engineer approval of draft Test Plans required for successful completion of Planning Phase.
      b. Submit final Test Plan a maximum of 60 calendar days prior to testing.
      c. Engineer approval of final Test Plan required prior to start of testing.
   3. Test Reports:
      a. Submit draft Test Reports outline in the Planning Phase, unless specified otherwise.
         1) Engineer approval of draft Test Reports outline required for successful completion of Planning Phase.
      b. Submit final Test Report a maximum of 30 calendar days after testing.
   4. Manufacturer's representatives field notes and data.
   5. County Training:
      a. Prior to the training session:
         1) Training instructor qualifications.

2) Training course materials: Due 30 calendar days prior to initial training session.
    a) If County requires, Continuing Education Units (CEUs), submit training materials to state regulatory agency in sufficient time to obtain approval for training prior to the training.
    b) Drafts of training agenda, lesson plan, presentation, handouts, and list of audio-visual aids.
    c) Format: 1 electronic copy and 3 hard copies organized in notebooks.

b. Post training session:
    1) Training course materials: Due 14 calendar days after class completion.
        a) Recordings.
        b) Class attendance sheet.
        c) Final version of training agenda, final lesson plan, presentation, handouts, and audio-visual aids.
        d) Format: 1 electronic copy and 3 hard copies organized in notebooks.
    2) Provide materials for all sessions of the class in a single transmittal.
    3) If the County requires training CEUs, issue training CEU certificates approved by the state regulatory agency to County's staff who successfully completed the training.

1.04 COMMISSIONING COORDINATOR (CC)

A. Responsibilities include the following:
    1. Become thoroughly familiar with Contract commissioning requirements.
    2. Provide the primary interface with Engineer and County for Commissioning efforts.
    3. Lead Commissioning efforts - all phases and tasks.
    4. Coordinate training efforts.
    5. Meetings:
        a. CC is responsible for setting commissioning coordination meeting dates and times, as well as preparing the agendas and meeting minutes.
        b. CC shall conduct commissioning progress meetings throughout construction, to plan, scope, coordinate, and schedule future activities, resolve problems, etc.
        c. Frequency: Monthly minimum. Increase frequency as needed based on complexity and quantity of commissioning activities.

B. CC on-site:
    1. Testing and Training Phase: Full-time.
    2. Start-Up Phase: Full-time.

1.05 MANUFACTURER'S REPRESENTATIVES

A. Qualifications: as specified below and in the Technical Sections:
   1. For Installation and Functional Testing:
      a. Factory trained and experienced in the technical applications, installation, operation, and maintenance of respective equipment/system with full authority by the equipment/system manufacturer to issue the certifications required of the manufacturer.
   2. Training instructor qualifications:
      a. Provide resume stating instructor's technical preparation and instructional technology skills and experience.
      b. If CEUs are required, the operator training instructors must comply with state regulatory.
      c. Knowledgeable in the equipment/system for which they are training.
      d. Experienced in conducting classes.
      e. Sales representatives are not qualified instructors unless they possess the detailed operating and maintenance knowledge required for proper class instruction.
   3. Representatives to be approved by County and Engineer.
   4. No substitute representatives without written approval by County and Engineer.

B. Duties:
   1. Determine if additional time and/or trips (beyond those specified in the Technical Sections) is required to perform the specified services.
   2. Coordinate services in accordance with the Contractor's project schedule up to and including making multiple trips to project site when there are separate milestones associated with installation of each occurrence of manufacturer's equipment.
   3. Perform on-site services as specified in the Technical Sections:
   4. Provide daily copies of manufacturer's representatives field notes and data to Contractor.

1.06 PLANNING PHASE

A. Overview of Planning Phase:
   1. Define approach and timing for commissioning.
   2. Obtain Engineer approval of draft Test Plans.

B. Test Plans.
   1. Define approach and timing for:
      a. Testing and Training Phases.
         1) Major systems, with separate plans for each system.
      b. Start-Up Phase.
   2. Source Test (Factory Acceptance Test) and Functional Test Plans:
      a. As specified in this Section and other Technical Sections.
      b. Based on approved shop drawings.
      c. Prepared by Contractor.
      d. Include the following items for each test:
         1) Purpose of the test.

2) Identification of each item of equipment/system to be tested, including system designation, location, tag number, control loop identifier, etc.
3) Description of the pass/fail criteria that will be used.
4) Listing of pertinent reference documents (Contract and industry standards or sections applicable to the testing).
a) Credentials of test personnel.
5) Test equipment:
a) Include Product Data for the test equipment.
b) Appropriate calibration records.
(1) Drawings or photographs of test stands and/or test apparatus.
6) Duration: Determine test durations with County's input.
7) Detailed step-by-step test procedures.
a) The level of detail shall be sufficient for the witness to follow the steps.

e. Define for Functional Testing:
1) Required temporary systems (pumps, piping, etc.).
2) Shutdown requirements for existing systems.

f. Furnish labor, power, tools, equipment, instruments, and services required for and incidental to testing activities.

3. Test forms minimum requirements:
a. Name of product to be tested.
b. Test date.
c. Names of persons conducting the test.
d. Names of persons witnessing the test, where applicable.
e. Test data.
f. Applicable project requirements as specified in the Technical Sections.
g. Check offs for each completed test or test step.
h. Place for signature of person conducting tests and for the witnessing person, as applicable.

4. County responsibilities:
a. Schedule County's staff within the constraints of their workloads.
1) Those who will participate in this test have existing full-time work assignments, and testing is an additional assigned work task, therefore, scheduling is imperative.
2) County staff work schedules regularly shift, as treatment facilities are typically operated on an around-the-clock basis.
3) Maximum hours per week: 4.
4) Days available: Monday through Friday.
5) Scheduling coordination:
6) CC is responsible for the following:
a) Coordinate schedule with the County's personnel and manufacturer's representatives (instructors).

C. Test Reports:
1. Minimum requirements:
a. Title.
b. Abstract.
c. Equipment.
d. Procedures.

e. Results.
    1) Complete disclosure of the calculation methodologies.
f. Conclusions.
g. Signature by an authorized party.
h. Appendices.
    1) Completed test forms signed by witnesses.

2. Water Management Plan:
    a. Requirements:
        1) Demonstrate how water will be produced, conveyed, treated, recycled, and or disposed until testing verifies specified requirements.
3. Commissioning Schedule:
    a. Content:
        1) Comply with Attachment G - Functional Testing Requirements and provide activities organized by system and subsystem.
        2) Include:
            a) Source testing when required.
            b) Functional testing.
            c) County Training.
        3) Comply with Attachment F - Commissioning Roles and Responsibilities Matrix.
    b. Procedures:
        1) Submit commissioning schedule as specified in Section 01_32_21 - Schedules and Reports.

1.07 TESTING AND TRAINING PHASE

A. Overview of Testing and Training Phase:
1. General:
    a. Contractor tests the Work to verify it meets the Contract requirements.
    b. Contractor trains the County to operate and maintain the Work.
2. Contractor responsibilities:
    a. Furnish labor, tools, equipment, instruments, and services required for and incidental to completing commissioning activities in accordance with the approved Commissioning Plans.
3. County responsibilities:
    a. Furnish labor, and services required for and incidental to completing commissioning activities in accordance with the approved Commissioning Plans.
    b. County provided services, equipment, and/or materials to be as specified in Section 01_11_00 - Summary of Work.

B. Source Testing:
1. As specified in the Technical Section.
2. Source Test Plan:
    a. Engineer approval of Source Test Plan required prior to testing.
3. Witnessed in person:
    a. As specified in the Technical Section.

b. Contractor is responsible for trip costs associated with County's and Engineer's representatives.
    1) Transportation:
        a) Travel 1 day on commercial airline to site including air flight costs and $1,600 allowance per person per day.
        b) Travel 1 day on commercial airline from site including air flight costs and $1,600 allowance per person per day.
        c) Rental car from hotel to and from the test site.
    2) Hotel/Meals:
        a) Hotel with an American Automobile Association 4 star rating or equivalent for single occupancy room per person per day.
        b) Meal allowance of $60 per person per day.

4. Virtual witness testing:
    a. As specified in the Technical Sections.
    b. Contractor is responsible for costs associated with virtual witness.
    c. Provide the following:
        1) An agenda detailing start time of each major phase in the procedure defined in the approved Test Plan.
        2) A dedicated operator (separate from the test technician) to operate the camera, provide commentary throughout test, and inspect devices at the request of the attendees.
    d. Online meeting platform: ZOOM, Microsoft Teams, or equivalent.
    e. Share video through a high-definition camera.
    f. Establish methods to communicate, convey, and record information clearly even in environments with loud background noise.
        1) Electronic feed for screen sharing of the control panel, HMI, or other screens used throughout testing.
        2) Provide recording of virtual sharing within 1 day after testing.
    g. Test run of virtual sharing a minimum of 1 week prior to the test:
        1) Use current record documents in PDF format.
        2) Provide recording of virtual sharing within 1 day after the test run.
        3) Engineer approval of test run virtual sharing is required before source testing.
5. If the Source Test is not ready on the scheduled date or if the Source Test fails:
    a. Contractor is responsible for associated costs:
        1) First test costs that are non-refundable, if applicable.
        2) Repeat test costs:
            a) Trip costs, if applicable.
        3) Virtual witness costs, if applicable.
            a) Witness labor costs:
                (1) Travel time and witness time are included, if applicable.
                (2) The greater of $200 per hour or $1,600 per day.
6. Source testing is complete after successful testing, submittal of test report, and Manufacturer's Certificate of Source Testing.
7. Engineer approval of Source Testing Report is required.

C. Installation Verification:
    1. Overview:
        a. Verifying the installation of equipment to be in accordance with Manufacturer's Instructions.

2. Prerequisite:
    a. Engineer approval of Source Testing Report.
3. Perform checks:
    a. Structural anchorage check.
    b. Electrical energization check.
        1) As specified in the flowchart shown in Attachment A.
    c. Health and safety check.
4. Submit Manufacturer's Certificate of Installation Verification.
5. Engineer approval of Manufacturer's Certificate of Installation Verification is required.

D. Functional Testing:
1. Overview:
    a. Testing the function of a system or subsystem.
2. Prerequisites:
    a. Engineer approval of Manufacturer's Certificate of Installation Verification .
    b. Engineer approval of Functional Test Plan required prior to testing.
    c. Draft Operations and Maintenance Manual as specified in Section 01_78_24 - Operations and Maintenance Manual.
    d. Completed pipe, valve, and gate labeling of system or subsystem.
3. Witnessed.
4. Discipline checks:
    a. Verify support systems function properly, such as seal water, pipes, valves, etc.
    b. As specified in the individual Technical Sections.
5. Consecutive Day Test:
    a. Operate the Work as specified in Attachment G - Functional Testing Requirements and as specified in the individual Technical Sections.
        1) Successful completion of subsystem testing required prior to system testing.
    b. Failure response time:
        1) Be equipped and ready to provide emergency repairs, adjustments, and corrections to comply with the "Significant Interruption Duration" requirements as specified in Attachment G - Functional Testing Requirements.
    c. Duration:
        1) As specified in Attachment G - Functional Testing Requirements.
        2) Restart the consecutive day test when the system performance failures exceed the "Significant Interruption Duration" time period specified in Attachment G - Functional Testing Requirements.
            a) Individual equipment/system failures that are corrected within the "Significant Interruption Duration" time specified in Attachment G - Functional Testing Requirements shall not require the consecutive day test to be restarted unless the failure recurs.
            b) Engineer has the authority to reject the consecutive day test if individual equipment/system failures are repetitive.
6. Instrumentation and controls tests.
    a. Loop Validation Tests.

b. Complete End-to-End Testing (CEET):
1) Signal are tested from the field device through the PLC program, the network, and all the way to the operator's HMI graphic screens.

7. Restore to condition prior to testing.
8. Submit Manufacturer's Certificate of Functional Compliance.
9. Engineer approval of Manufacturer's Certificate of Functional Compliance is required.

E. Documentation:
1. Provide records generated during Commissioning Phase of Project including but not limited to:
a. Training documentation.
b. Manufacturer's Certificate of Source Testing.
c. Manufacturer's Certificate of Installation Verification.
d. Manufacturer's Certificate of Functionality Compliance.
e. Daily logs of equipment/system testing identifying tests conducted and outcome.
f. Test forms and documentation.
g. Functional Testing results.
h. Logs of time spent by manufacturer's representatives performing services on the job site.
i. Equipment lubrication records.
j. Electrical phase, voltage, and amperage measurements.
k. Insulation resistance measurements.
l. Bearing temperature measurements.
m. Data sheets of control loop testing including testing and calibration of instrumentation devices and setpoints.
n. Provide: 1 electronic copy in format and 3 hard copies organized in notebooks.
o. Store the data within 24 hours of the test or document creation in the project system.
p. Due date: Within 14 calendar days of Substantial Completion.
2. Engineer approval of documentation is required.

F. County Training:
1. Train County's staff on the operation and maintenance of the equipment/system.
2. Train on each topic of the approved Operation and Maintenance Manual.
a. Include classroom instruction and field demonstration with all necessary tools and test equipment.
3. Training tailored to the skills and job classifications of the staff attending the classes (e.g., plant superintendent, treatment plant operator, maintenance technician, electrician, etc.).
4. Training outcomes:
a. County's staff can safely operate, maintain, and repair the equipment/systems provided as recommended by the manufacturer.
5. Training plan:
a. CC shall meet with Engineer and County's designated training coordinator to develop list of personnel to be trained and to establish expected training outcomes and objectives at least 60 calendar days prior to commissioning of equipment/system.

b. Coordinate and arrange for manufacturer's representatives to provide both classroom-based learning and field (hands-on) training, based on training module content and stated learning objectives.
c. Conduct classroom training at location designated by County.
d. Scope and sequence:
1) Plan and schedule training in the correct sequence to provide prerequisite knowledge and skills to trainees.
a) Describe recommended procedures to check/test equipment/system following a corrective maintenance repair.
2) If multiple classes are needed to meet the training objectives, they shall be included in the training plan.

6. County Training Schedule:
a. Schedule County's staff training within the constraints of their workloads.
1) Those who will participate in this training have existing full-time work assignments, and training is an additional assigned work task, therefore, scheduling is imperative.
2) County staff work schedules regularly shift, as treatment facilities are typically operated on an around-the-clock basis.
b. Training scheduling coordination:
1) CC is responsible for the following:
a) Coordinate schedule for training periods with the County's personnel and manufacturer's representatives (instructors).
2) Complete County Training no sooner than 15 calendar days prior to Functional Testing of each system.
c. Class logistics:
1) Delivery time minimum: 2 hours.
2) Delivery time maximum: 4 hours.
3) Class agenda:
a) Refreshment break: One 10-minute break.
b) Meal break: One 45-minute break, unless otherwise specified.
c) Schedule refreshment breaks and meal breaks to meet the class needs and County work rules.
4) Schedule specific sessions:
a) Minimum of 30 days in advance to allow County staffing arrangements to take place.
b) At the times requested by the County, within the period 7 a.m. to 7 p.m. Monday through Friday.
(1) Times scheduled will be at County's discretion.
c) County approval and confirmation required for session schedules.
d) Provide minimum of 2 sessions for each class unless otherwise noted.
(1) The purpose of having multiple sessions on each class is to accommodate the attendance of as many County personnel working different shifts as possible.
e) A maximum of 1 session per day for each class.
d. Number of students:
1) Engineer will confirm the headcount 1 week prior to the class, so that the instructor can provide the correct number of training aids for students.

7. Submittals:
    a. Submit Training Plan Schedule 30 calendar days before the first scheduled training session, including but not limited to lesson plans, participant materials, instructor's resumes, and training delivery schedules.
    b. Submit training documentation including the following:
        1) Training plan:
            a) Training modules.
            b) Scope and sequence statement.
            c) Contact information for manufacturer's instructors including name, phone, and e-mail address.
            d) Instructor qualifications.
        2) Training program schedule:
            a) Format: Bar chart:
                (1) Include in the Project Progress Schedule.
            b) Contents:
                (1) Training modules and classes.
8. Lesson plans:
    a. Divide training into discrete modules appropriate for the equipment and trades.
    b. State performance-based learning objectives in terms of what the trainees will be able to do at the end of the lesson.
    c. Define student conditions of performance and criteria for evaluating instructional success.
    d. Minimum requirements:
        1) Hands-on demonstrations planned for the instructions.
        2) Cross-reference training aids.
        3) Planned training strategies such as whiteboard work, instructor questions, and discussion points or other planned classroom or field strategies.
        4) Attach handouts cross-referenced by section or topic in the lesson plan.
        5) Indicate duration of outlined training segments.
    e. Provide instruction lesson plans for each trade:
        1) Detailed component description:
            a) Identify each component function and describe in detail.
            b) Identify equipment's mechanical, electrical, and electronic components and features.
            c) Where applicable, group relative components into subsystems.
            d) Identify and describe in detail equipment safety features, permissive and controls interlocks.
        2) Equipment operation:
            a) Describe equipment's operating (process) function and system theory.
            b) Describe equipment's fundamental operating principles and dynamics.
            c) Identify support equipment associated with the operation of subject equipment.
            d) Detail the relationship of each piece of equipment or component to the subsystems, systems, and process.

e) Cite hazards associated with the operations, exposure to chemicals associated with the component, or the waste stream handled by the component.
f) Specify appropriate safety precautions, equipment, and procedures to eliminate, reduce, or overcome hazards.

3) Define Preventative Maintenance (PM) inspection procedures required on equipment in operation, spot potential trouble symptoms (anticipate breakdowns), and forecast maintenance requirements (predictive maintenance).
a) Review preventive maintenance frequency and task analysis table.

4) Define equipment Corrective Maintenance (CM) troubleshooting:
a) Describe recommended equipment preparation requirements as they relate to specific craft problems.
b) Identify and describe the use of any special tools required for maintenance of the equipment as they relate to specific craft problems.
c) Provide component specific troubleshooting checklists as they relate to specific craft problems.
d) Describe component removal/installation and disassembly/assembly procedures for specific craft repairs.
e) Perform at least 2 hands-on demonstrations of common corrective maintenance repairs.

5) Describe recommended measuring instruments and procedures, and provide instruction on interpreting alignment measurements, as appropriate.

9. Training instruction format:
a. The training for operations and maintenance personnel shall be provided as 1 entity.
b. Instructors shall apply adult education best practices, emphasizing learner participation and activity.
c. Lecturing should be less than 30 percent of class time.
d. Training delivery may include problem solving, question/answer, hands-on instruction, practice, evaluation/feedback tools, and lecture to support training objectives.
e. Conduct hands-on instruction according to the following descriptions:
1) Present hands-on demonstrations of at least the following tasks:
a) Proper start-up, shutdown, and normal and alternative operating strategies.
b) Common corrective maintenance repairs for each group.
c) Recommended procedures to check/test equipment/system following a corrective maintenance repair.
d) Preventative maintenance points.
e) Calibration, if applicable.

2) Use tools and equipment provided by manufacturer to conduct the demonstrations.
a) Submit requests for supplemental assistance and facilities with the Contractor’s proposed lesson plans.

3) Contractor remains responsible for equipment disassembly or assembly during hands-on training situations involving equipment disassembly or assembly by County’s personnel.

f. Training aids:
    1) Instructors shall provide needed audio-visual devices such equipment (televisions, video recorder/player, computer, projectors, screens, easels, etc.), models, charts, etc. for each class.
    2) Instructor to confirm with Engineer in advance of each class that the classroom will be appropriate for the types of audiovisual equipment to be employed.

10. Training sessions:
    a. Provide training sessions for equipment/system as specified in the individual equipment/system section.
    b. Include the following information in the agenda:
        1) Instructor name.
        2) Listing of subjects to be discussed.
        3) Time estimated for each subject.
        4) Allocation of time for County staff to ask questions and discuss the subject matter.
        5) List of documentation to be used or provided to support training.
    c. County may request that particular subjects be emphasized, and the agenda be adjusted to accommodate these requests.
    d. Digitally record audio and video of each training session.
        1) Include classroom and field instruction with question and answering periods.
        2) Engineer approval required for producer of video materials from one of the following options:
            a) Qualified, professional video production company or individual.
        3) Record in digital format and recording shall become property of the County with exclusive rights.
            a) No video recording agreements will be entered into by the County.
        4) Media:
            a) Video quality shall be 720p HD or greater in MPG, AVCHD, AVI, or MP4 format.
            b) Digital color video format.
            c) Provide audio portion of the composite CD sufficiently free from electrical interference and background noise to provide complete intelligibility of oral report.
            d) Identification: On each copy provide a label with the following information:
                (1) Name of training.
                (2) Date video was recorded.
            e) Display continuous running time.
            f) At start of each video recording, record training class name, date, instructor’s name.
            g) Provide audio quality that is not degraded during the recording of the field sessions due to background noise, space, distance or other factors.
        5) The Contractor shall provide a written release from all claims to the recorded training material produced, if required.
    e. Distribute copies of the agenda to each student at the beginning of each training class.
    f. Trainees will keep training materials and documentation after the session.

g. Distribute Training Evaluation Form following each training session.
    1) Training Evaluation Form is included in this Section.
    2) Return completed Training Evaluation Forms to County's designated training coordinator immediately after session is completed.
    3) Revise training sessions judged "Unsatisfactory" by a majority of attendees.
        a) Conduct training sessions again until a satisfactory rating is achieved.

11. Engineer approval of County Training is required.

1.08 START-UP PHASE

A. Overview of Start-Up Phase:
1. General:
    a. Confirm reliability requirements.
    b. Confirm regulatory compliance.

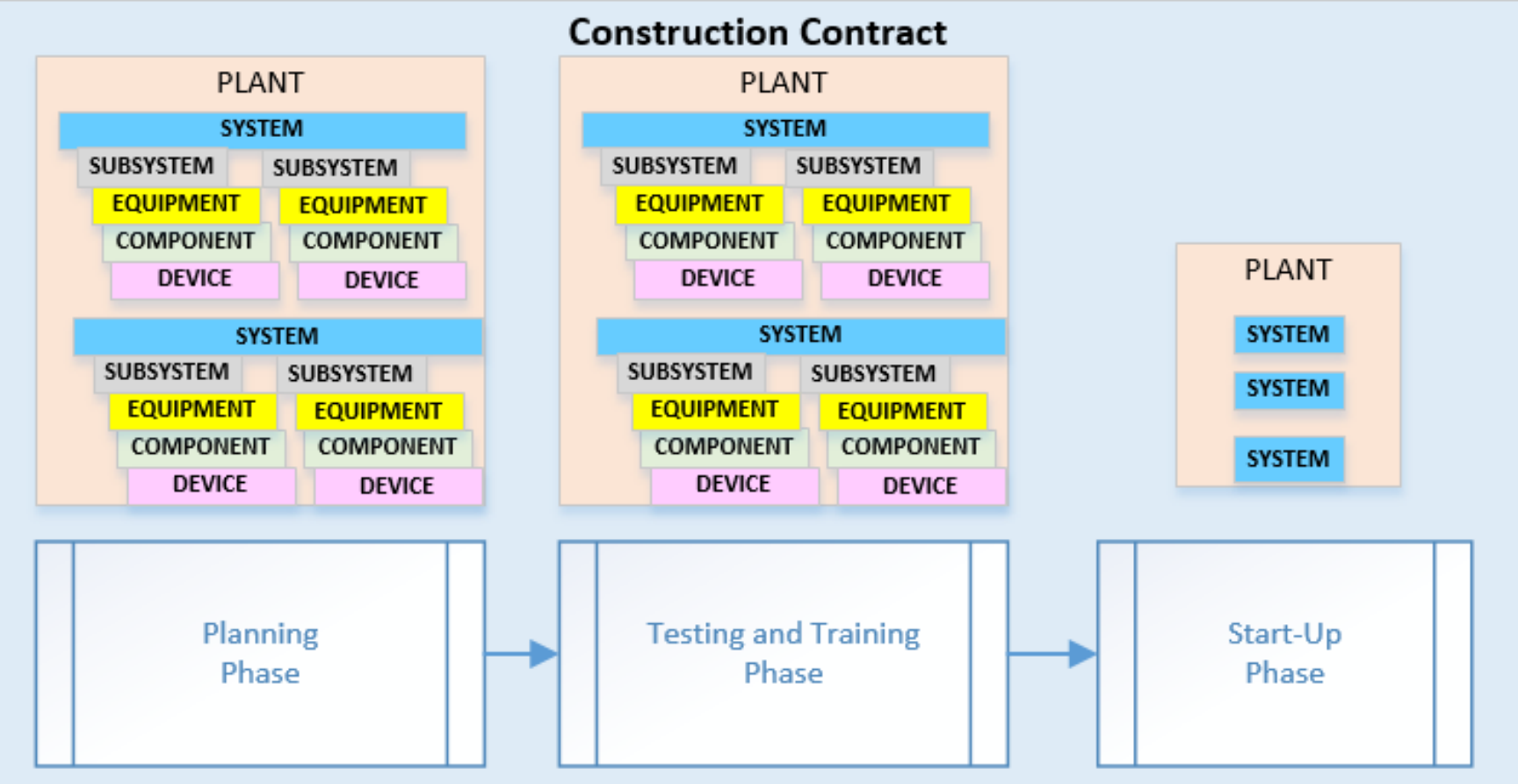
B. Start-Up Period:
1. Contractor responsibilities:
    a. Support County to operate the Work.
2. County responsibilities:
    a. County to operate the Work.
    b. County-provided services, equipment, and/or materials to be as specified in Section 01_11_00 - Summary of Work.
    c. Furnish labor, tools, equipment, instruments, and services required for and incidental to completing commissioning activities in accordance with the approved Commissioning Plans.
3. Prerequisites:
    a. Engineer approval of Testing and Training Phase.
4. Witnessed.
5. Duration: 7 days.
6. Engineer approval of Start-Up Period is required to achieve substantial completion.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

ATTACHMENT A - COMMISSIONING FLOWCHARTS


Construction Contract
PLANT
SYSTEM
SUBSYSTEM
SUBSYSTEM
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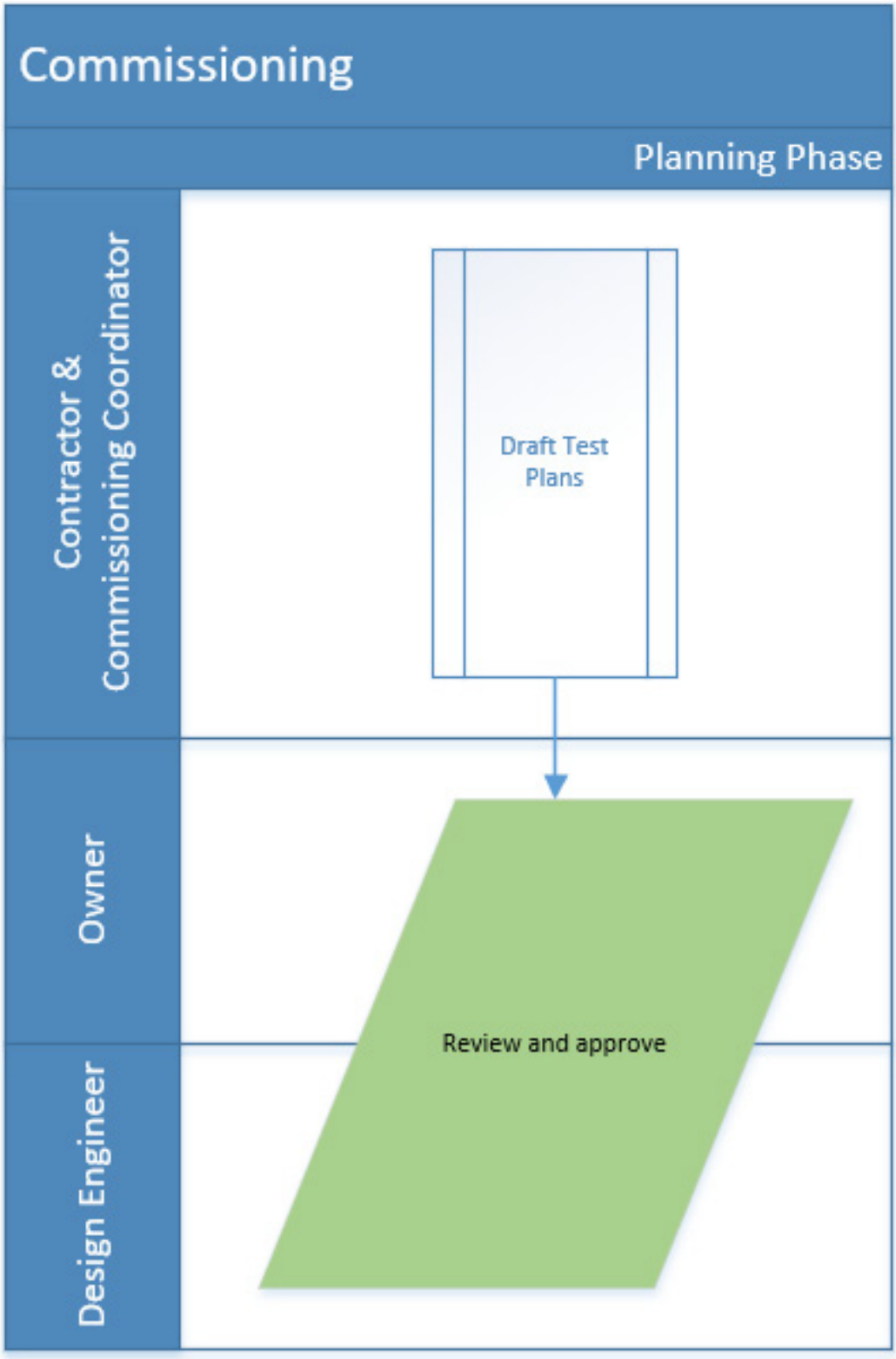
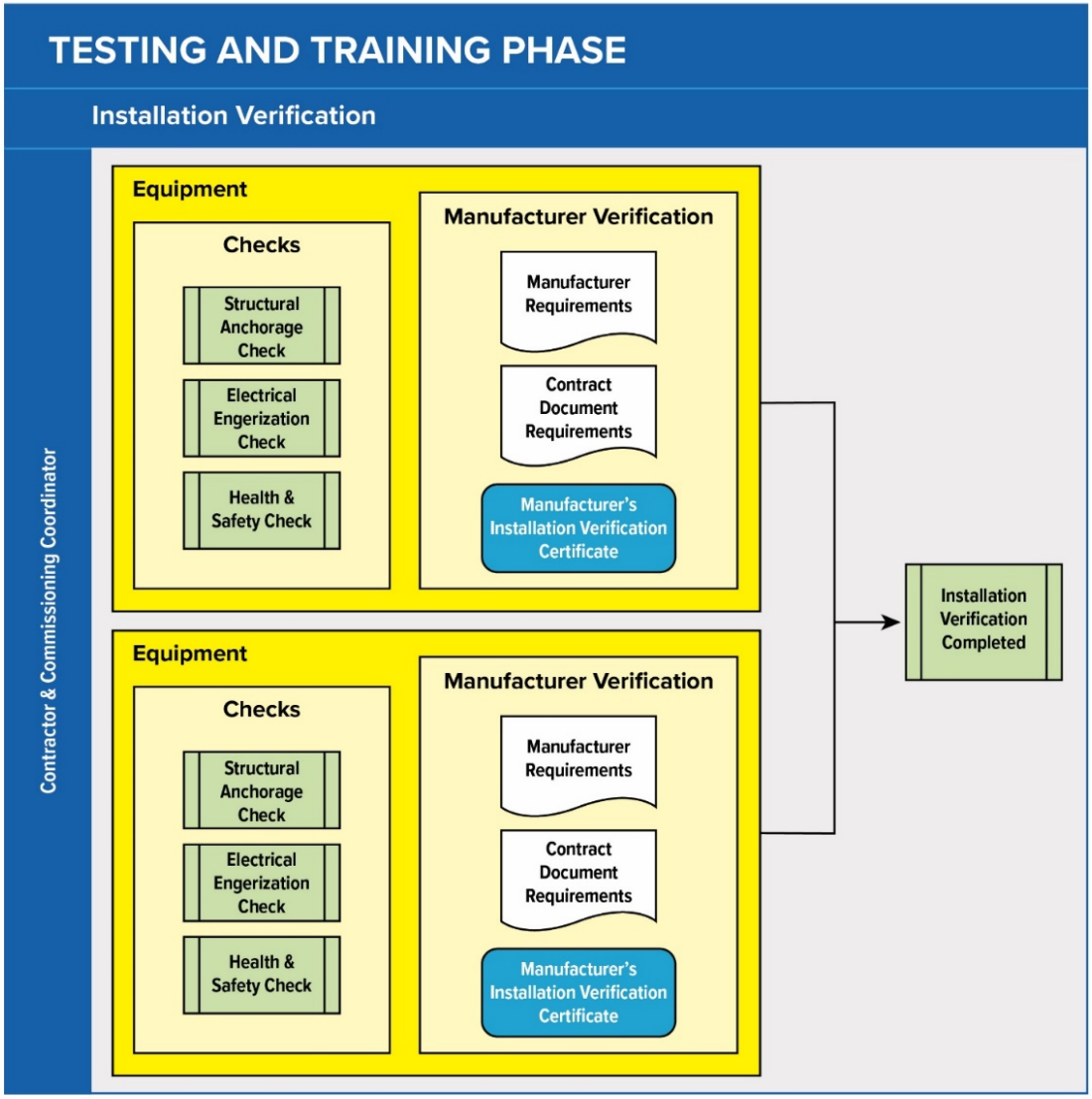
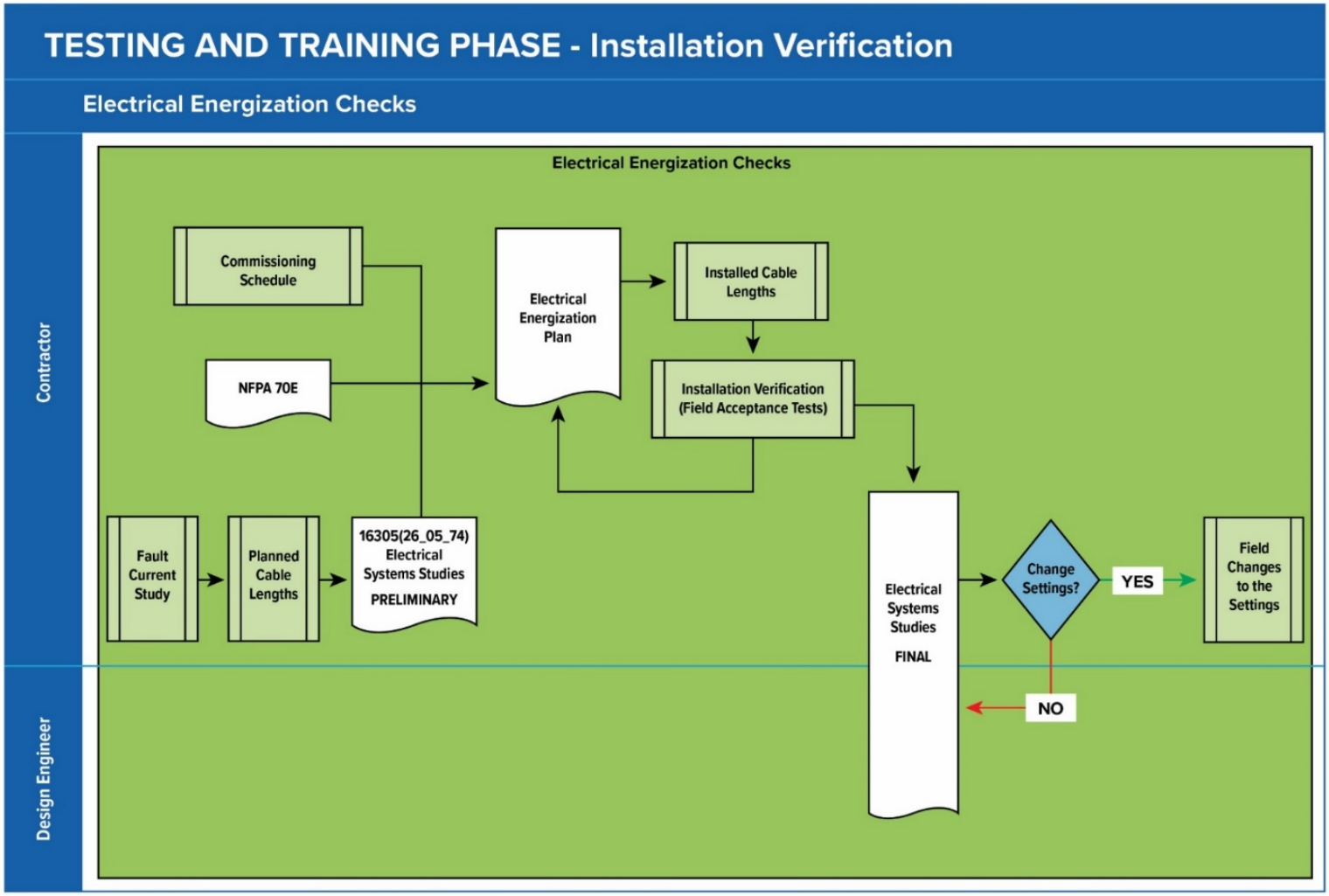
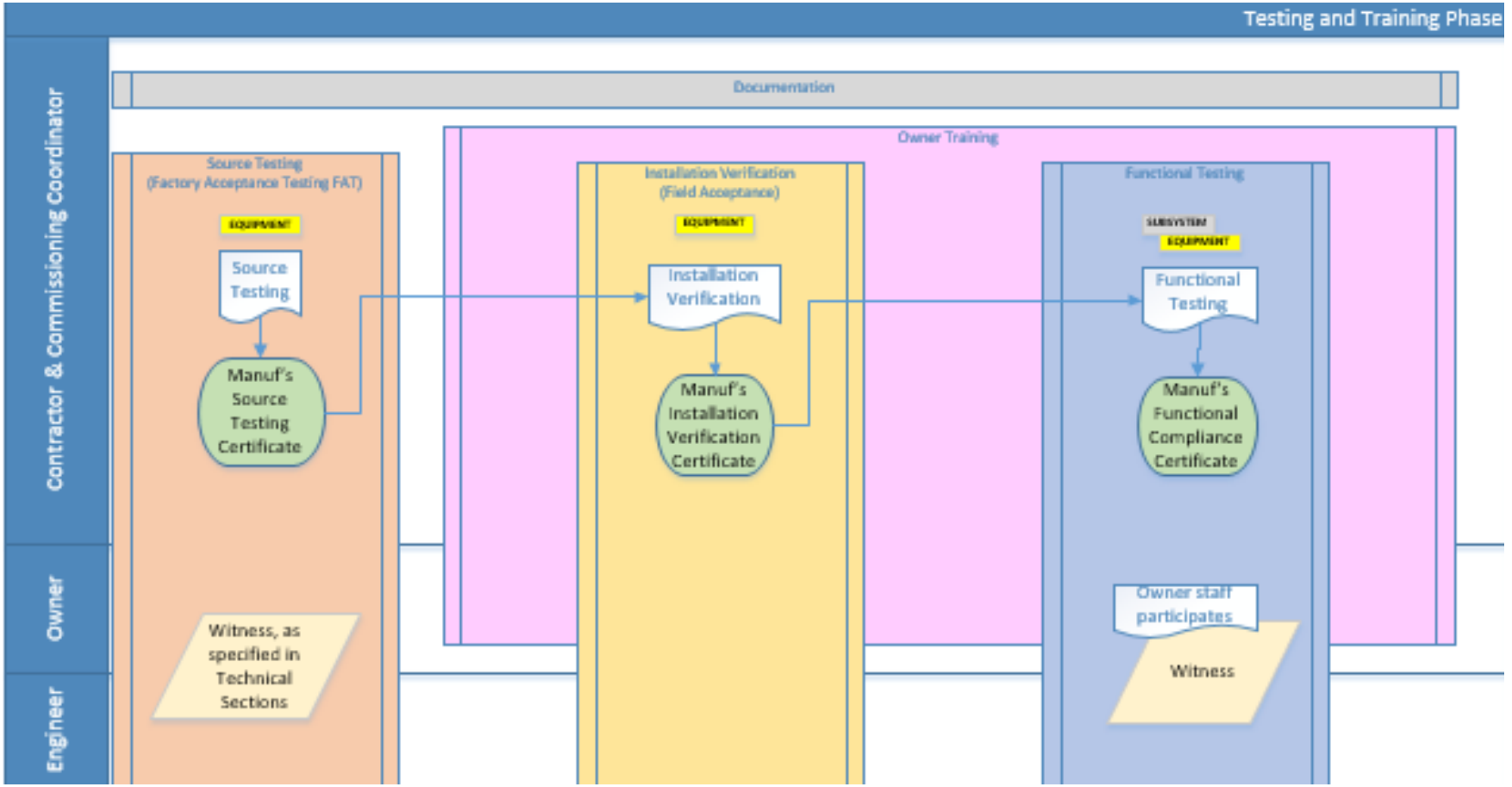
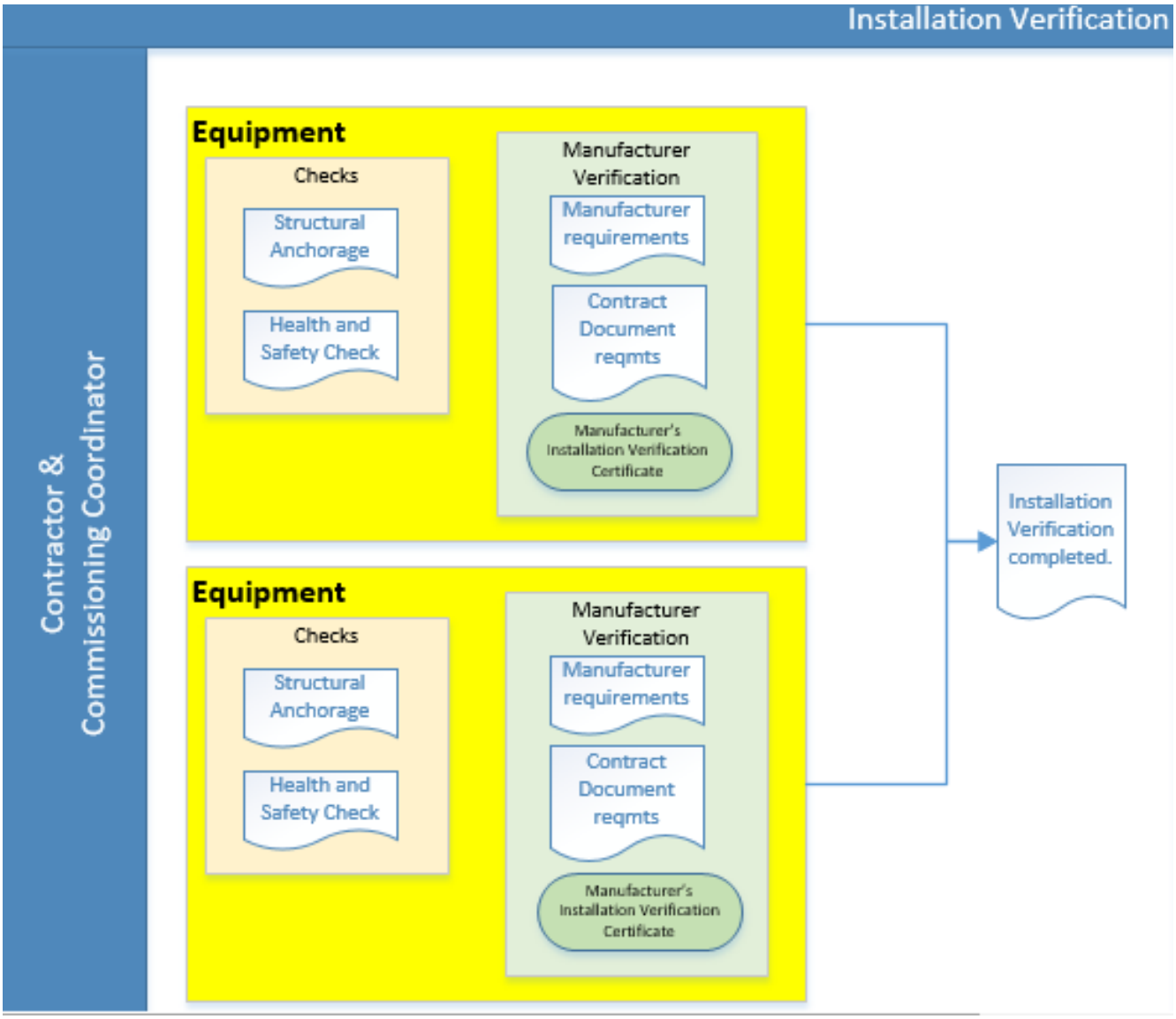
Planning Phase
Testing and Training Phase
Start-Up Phase

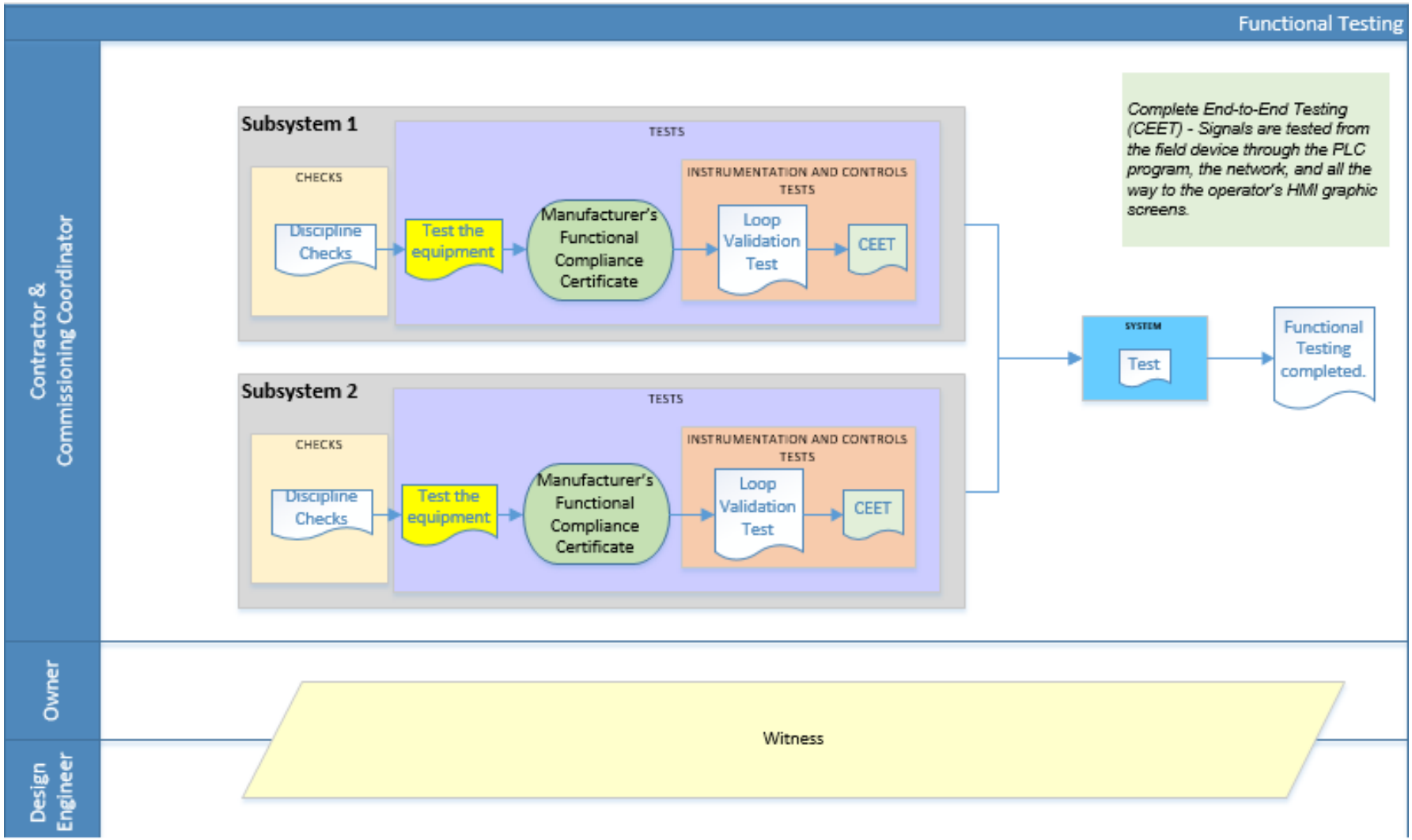

Commissioning
Planning Phase
Contractor & Commissioning Coordinator
Draft Test Plans
Owner
Review and approve
Design Engineer

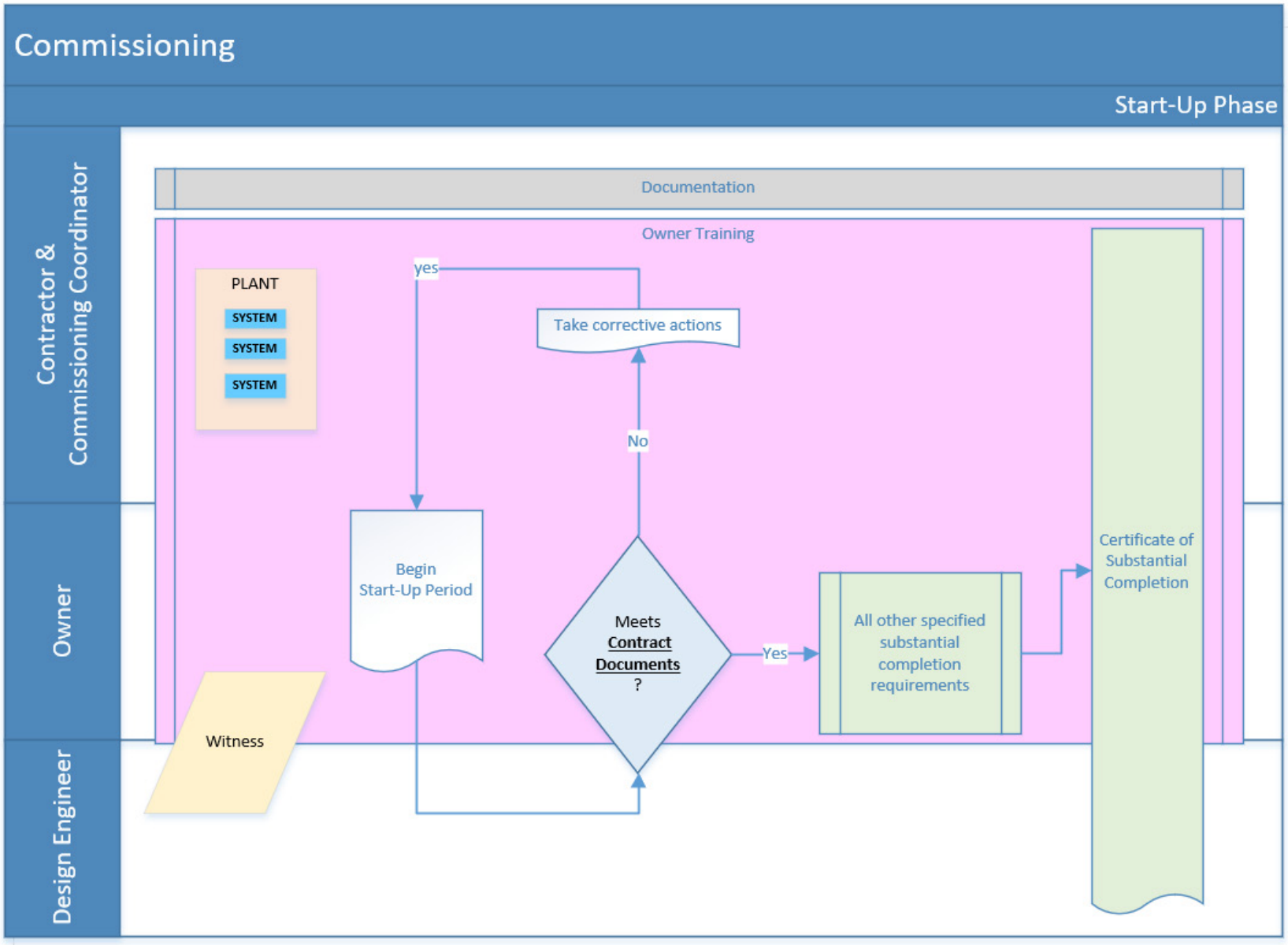

TESTING AND TRAINING PHASE
Installation Verification
Contractor & Commissioning Coordinator
Equipment
Checks
Structural Anchorage Check
Electrical Engerization Check
Health & Safety Check
Manufacturer Verification
Manufacturer Requirements
Contract Document Requirements
Manufacturer's Installation Verification Certificate
Equipment
Checks
Structural Anchorage Check
Electrical Engerization Check
Health & Safety Check
Manufacturer Verification
Manufacturer Requirements
Contract Document Requirements
Manufacturer's Installation Verification Certificate
Installation Verification Completed


TESTING AND TRAINING PHASE - Installation Verification
Electrical Energization Checks
Contractor
Design Engineer
Electrical Energization Checks
Commissioning Schedule
NFPA 70E
Electrical Energization Plan
Installed Cable Lengths
Installation Verification (Field Acceptance Tests)
Fault Current Study
Planned Cable Lengths
16305(26_05_74) Electrical Systems Studies
PRELIMINARY
Electrical Systems Studies
FINAL
Change Settings?
YES
NO
Field Changes to the Settings


Testing and Training Phase
Contractor & Commissioning Coordinator
Owner
Engineer
Documentation
Source Testing
(Factory Acceptance Testing FAT)
EQUIPMENT
Source Testing
Manuf's Source Testing Certificate
Witness, as specified in Technical Sections
Owner Training
Installation Verification
(Field Acceptance)
EQUIPMENT
Installation Verification
Manuf's Installation Verification Certificate
Functional Testing
SUBSYSTEM
EQUIPMENT
Functional Testing
Manuf's Functional Compliance Certificate
Owner staff participates
Witness


Installation Verification
Contractor & Commissioning Coordinator
Equipment
Checks
Structural Anchorage
Health and Safety Check
Manufacturer Verification
Manufacturer requirements
Contract Document reqmts
Manufacturer's Installation Verification Certificate
Equipment
Checks
Structural Anchorage
Health and Safety Check
Manufacturer Verification
Manufacturer requirements
Contract Document reqmts
Manufacturer's Installation Verification Certificate
Installation Verification completed.


Functional Testing
Contractor & Commissioning Coordinator
Owner
Design Engineer
Subsystem 1
CHECKS
Discipline Checks
TESTS
Test the equipment
Manufacturer's Functional Compliance Certificate
INSTRUMENTATION AND CONTROLS TESTS
Loop Validation Test
CEET
Subsystem 2
CHECKS
Discipline Checks
TESTS
Test the equipment
Manufacturer's Functional Compliance Certificate
INSTRUMENTATION AND CONTROLS TESTS
Loop Validation Test
CEET
Complete End-to-End Testing (CEET) - Signals are tested from the field device through the PLC program, the network, and all the way to the operator's HMI graphic screens.
SYSTEM
Test
Functional Testing completed.
Witness


Commissioning
Start-Up Phase
Contractor & Commissioning Coordinator
Owner
Design Engineer
Documentation
Owner Training
PLANT
SYSTEM
SYSTEM
SYSTEM
yes
Take corrective actions
No
Begin Start-Up Period
Meets Contract Documents ?
Yes
All other specified substantial completion requirements
Certificate of Substantial Completion
Witness

ATTACHMENT B - MANUFACTURER'S CERTIFICATE OF SOURCE TESTING

MANUFACTURER'S CERTIFICATE OF SOURCE TESTING

COUNTY _____ EQPT/SYSTEM _____

PROJECT NAME _____ EQPT TAG NO. _____

PROJECT NO. _____ EQPT SERIAL NO. _____

SPECIFICATION NO. _____

SPECIFICATION TITLE _____

Comments: _____

_____

_____

_____

_____

I hereby certify Source Testing has been performed on the above-referenced equipment/system as defined in the Contract, and results conform to the Contract Document requirements. Testing data is attached.

Date of Execution: _____, 20____

Manufacturer: _____

Manufacturer's Authorized Representative Name *(print)*: _____

_____

(Authorized Signature)

If applicable, Witness Name *(print)*: _____

_____

(Witness Signature)

ATTACHMENT C - MANUFACTURER'S CERTIFICATE OF INSTALLATION VERIFICATION

MANUFACTURER'S CERTIFICATE OF INSTALLATION VERIFICATION

COUNTY _____ EQPT/SYSTEM _____

PROJECT NAME _____ EQPT TAG NO. _____

PROJECT NO. _____ EQPT SERIAL NO. _____

SPECIFICATION NO. _____

SPECIFICATION TITLE _____

I hereby certify the installation of the above-referenced equipment/system as defined in the Contract Documents.

NOTES:
Attach written certification report prepared by and signed by the electrical and/or instrumentation subcontractor.

Comments: _____

_____

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 this equipment/system, and (iii) authorized to make recommendations required to ensure that the equipment/system 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: _____

Manufacturer: _____

Manufacturer's Authorized Representative Name *(print)*: _____

By Manufacturer's Authorized Representative: _____
(Authorized Signature)

ATTACHMENT D - MANUFACTURER'S CERTIFICATE OF FUNCTIONAL COMPLIANCE

MANUFACTURER'S CERTIFICATE OF FUNCTIONAL COMPLIANCE

COUNTY _____ EQPT/SYSTEM _____
PROJECT NAME _____ EQPT TAG NO. _____
PROJECT NO. _____ EQPT SERIAL NO. _____
SPECIFICATION NO. _____
SPECIFICATION TITLE _____

I hereby certify the Functional Testing of the above-referenced equipment/system as defined in the Contract Documents.

NOTES:
Attach test results with collected data and test report.

Attach written certification report prepared by and signed by the electrical and/or instrumentation subcontractor.

Comments: _____

_____

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 this equipment/system, and (iii) authorized to make recommendations required to ensure that the equipment/system 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: _____

Manufacturer: _____

Manufacturer's Authorized Representative Name *(print)*: _____

By Manufacturer's Authorized Representative: _____
(Authorized Signature)

WITNESSES

By County's Authorized Representative: _____
(Authorized Signature)

By Engineer's Authorized Representative: _____
(Authorized Signature)

ATTACHMENT E - TRAINING EVALUATION FORM

TRAINING EVALUATION FORM

EQUIPMENT/SYSTEM ITEM: _____

VENDOR/MANUFACTURER: _____

DATE: _____ NAME OF REPRESENTATIVE: _____

1.	Was representative prepared?	Acceptable	Unacceptable	or	N/A
2.	Was an overview description presented?	Acceptable	Unacceptable	or	N/A
3.	Were specific details presented for system components?	Acceptable	Unacceptable	or	N/A
4.	Were alarm and shutdown conditions clearly presented?	Acceptable	Unacceptable	or	N/A
5.	Were step-by-step procedures for starting, stopping, and troubleshooting presented?	Acceptable	Unacceptable	or	N/A
6.	Were routine/preventative maintenance items clearly identified?	Acceptable	Unacceptable	or	N/A
7.	Was the lubrication schedule (if any) discussed?	Acceptable	Unacceptable	or	N/A
8.	Was the representative able to answer all questions?	Acceptable	Unacceptable	or	N/A
9.	Did the representative agree to research and answer unanswered questions?	Acceptable	Unacceptable	or	N/A

10. Comments: _____

_____

_____

_____

11. Overall Rating: Satisfactory Unsatisfactory

Note:

Sessions judged "Unsatisfactory" by a majority of attendees shall be revised and conducted again until a satisfactory rating is achieved.

ATTACHMENT F - COMMISSIONING ROLES AND RESPONSIBILITIES MATRIX

COMMISSIONING ROLES AND RESPONSIBILITIES MATRIX

NO.	TASK	COUNTY	CONTRACTOR	ENGINEER
Testing and Training Phase				
Source Testing				
	Source Testing	Non-Witnessed	Lead	Non-Witnessed Review
	Manufacturer's Certificate of Source Testing	No Action	Lead	Review
Installation Verification				
	Structural Anchorage Check	Witness	Lead	Review
	Health and Safety Check	Witness	Lead	Review
	Manufacturer Requirements Verification	No Action	Lead	Review
	Contract Documents Verification	No Action	Lead	Review
	Manufacturer's Certificate of Installation Verification	No Action	Lead	Review
Functional Testing				
	Checks	Witness	Lead	Witness, Review
	Tests	Witness	Lead	Witness, Review
	Manufacturer's Certificate of Functional Compliance	No Action	Lead	Witness, Review
System Testing				
	System Testing	Witness	Lead	Witness, Review
Start-Up Phase				
	Start-Up	Lead	Support	Witness, Review

Legend:
Lead: Primarily responsible for organization, coordination, and execution of task work product or result.
Support: Assist the lead with organization, coordination, and execution of task work product or result.
Witness: Observe and document completion of task work product or result.
No Action: Limited or no involvement.
Review: Approve for compliance with Contract Documents or reject.

ATTACHMENT G - FUNCTIONAL TESTING REQUIREMENTS

FUNCTIONAL TESTING REQUIREMENTS

System	Subsystem	Consecutive Day Test Duration (Days)	Significant Interruption Duration (Hours)	Test Liquid	System Operated By
Primary Effluent Distribution		1	2	Test Water	Contractor
	Distribution Structure Gates				
	Distribution Control Valves				
Bioreactor		5	8	Test Water	Contractor
	Anoxic/Swing Zone Mixers				
	MLR Pumps				
	MLR Channel Gates				
	Surface Wasting Gates				
	Surface Wasting Pumps				
	Aeration System Blowers Control Valves				
Secondary Clarification		3	4	Test Water	Contractor
	Mixed Liquor Gates				
	Polymer Blending				
	Clarifier Drives				
	Scum Pumping				

System	Subsystem	Consecutive Day Test Duration (Days)	Significant Interruption Duration (Hours)	Test Liquid	System Operated By
RAS		3	4	Test Water	Contractor
	RAS Suction Valves				
	RAS Pumping				
	RAS Flow Split				
Hydrocyclone		7	8	RAS	County
	Pump Suction Valves				
	Feed Valves				
	Feed Pumps				
	Hydrocyclone				
Polymer Blending and Feeding		3	2	Polymer	Contractor
WAS		3	2	Test Water	Contractor
	Pump Suction Valves				
	WAS Pumping				
Blowers					
Entire Liquid Process Flow Stream		5	4	Re-circulated water from a potable water source	Contractor
	Bar Screens				
	Flash Mix				
	Flocculation Basins				

System	Subsystem	Consecutive Day Test Duration (Days)	Significant Interruption Duration (Hours)	Test Liquid	System Operated By
	Filters				
	UV Disinfection System				
	Clearwell				
	Backwash Pump Station				
Entire Solids Handling Flow Stream				Solids from process	Contractor
	Sludge Hose Pumps	7	4		
	Solids Contact Clarifier	7	4	Solids from process	Contractor
Entire High Service Pump Station		4	2	Finished Water	County
	Pumps				
	Variable Frequency Drive(s)				
	Valves				
Standby Generator System		1	4	N/A	Contractor
	Switchgear				
	Engine Generators				

Notes:

1. As specified in Section 01_11_00 - Summary of Work.
2. As specified in Section 40_61_16 - Specific Control Strategies.
3. As specified in this Section under Functional Testing.
4. As specified in this Section under Functional Testing.

A. Schedule delays:
   1. Changes in the dates for source testing less than 30 days of the date provided in the latest approved Commissioning Schedule are considered delays.
   2. Contractor is responsible for associated costs resulting from delays:
      a. In person and/or virtual witnessing.
      b. Travel costs and witness labor costs.
         1) Witness labor costs at $250 per hour.

B. Repeat test costs:
   1. Contractor is responsible for associated costs for repeat testing:
      a. In person and/or virtual witnessing.
      b. Travel costs and witness labor costs.
         1) Witness labor costs at $250 per hour.

SECTION 01_75_18

DISINFECTION

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Cleaning and disinfection requirements for new and existing facilities affected by the Work.

1.02 REFERENCES

A. American Water Works Association (AWWA):
   1. C651 - Disinfecting Water Mains.
   2. C652 - Disinfection of Water Storage Facilities.
   3. C653 - Disinfection of Water Treatment Plants.
   4. C655 – Field Dechlorination.

B. U.S. Environmental Protection Agency (EPA):
   1. Method 524.2 Measurement of Purgeable Organic Compounds in Water by Capillary Column Gas Chromatography/Mass Spectrometry.
   2. Safe Drinking Water Act (SDWA).

1.03 SUBMITTALS

A. Submit disinfection test plan which details procedure to be utilized to disinfect the facilities including:
   1. Method and locations of disinfectant application.
   2. Locations of sampling points.
   3. Method of flushing and location of flushing ports (as appropriate for method of chlorination).
   4. Method of dechlorination (as appropriate for method of chlorination).
   5. Disposal location for chlorinated water (as appropriate for method of chlorination).

B. Submit disinfection reports and include the following:
   1. Date issued.
   2. Project name and location.
   3. Treatment subcontractor's name, address, and phone number.
   4. Type and form of disinfectant used.
   5. Time and date of disinfectant injection start.
   6. Time and date of disinfectant injection completion.
   7. Test locations.
   8. Initial and 24-hour disinfectant residuals in milligrams per liter for each outlet tested.
   9. Time and date of flushing start.
   10. Time and date of flushing completion.
   11. Disinfectant residual after flushing in milligrams per liter for each outlet tested.

C. Submit bacteriological reports and include the following:
   1. Date issued.
   2. Project name and location.
   3. Laboratory's name, certification number, address, and phone number.
   4. Time and date of water sample collection.
   5. Name of person collecting samples.
   6. Test locations.
   7. Time and date of laboratory test start.
   8. Coliform bacteria test results for each outlet tested.
   9. Certification that water conforms or fails to conform to bacterial standards of SDWA.
   10. Bacteriologist's signature and bacteriological laboratory's evidence of certification.

D. Submit required permits, including but not limited to permit clearance.
   1. Coordinate with County and Engineer to obtain any necessary signatures.

1.04 QUALITY ASSURANCE

A. Bacteriological and physical chemistry laboratory: Certified by state in which Project is located.

1.05 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Protect chlorine and bacteriological samples against damage and contamination.

B. Maintain caution labels on hazardous materials.

C. Maintain storage room dry and with temperatures as uniform as possible between 60 degrees Fahrenheit and 80 degrees Fahrenheit.

1.06 PROTECTION

A. Provide necessary signs, barricades, and notices to prevent persons from accidentally consuming water or disturbing system being treated.

PART 2 PRODUCTS

2.01 MATERIALS

A. Disinfectant: Free chlorine in liquid, powder, tablet, or gas form in accordance with AWWA C653.

B. Dechlorination agent: Sulfur dioxide, sodium bisulfate, sodium sulfite, or sodium thiosulfate in accordance with AWWA C655.

PART 3 EXECUTION

3.01 DISINFECTION OF WATER TREATMENT PLANTS

A. Perform disinfection of water treatment plants in accordance with AWWA C653 and as specified in this Section.

B. Complete hydrostatic/leakage tests prior to disinfection.

C. Clean newly constructed and/or modified facilities, including filters and conveyance facilities, such as pipes and channels at the plant, in accordance with AWWA C653 and the following:
   1. Remove debris and material not associated with the structure or process prior to disinfection.
   2. Clean wall, floor, ceiling, and attached surfaces by use of high-pressure water jet, sweeping, scrubbing, or equally effective means.
   3. Remove water, paint flakes, sediment, dirt, and foreign material accumulated during cleaning.
   4. Remove by flushing or other means, soil and debris from water pipes and channels in accordance with AWWA C651.
   5. Protect surfaces from adverse environmental exposure between the preliminary cleaning and the disinfection stages.

D. Prior to chlorination, clean newly constructed and/or modified facilities to be disinfected in accordance with AWWA C651, C652, or C653, as applicable.

E. Contractor shall provide necessary blind flanges, hoses, sample taps, or any other appurtenances that may be required to clean and disinfect the piping and wetted surfaces.

F. System treatment:
   1. Start disinfection when conditions are satisfactory.
   2. Perform disinfection of water lines and structures in accordance with AWWA C651, C652, and C653, and as specified in this Section.
   3. Starting at outlet closest to water source, bleed water from each outlet until water produces odor of disinfectant. Repeat process at each outlet throughout system.
   4. Test for disinfectant residual at each of following locations and other locations in accordance with submitted disinfection test plan:
      a. Ends of piping runs.
      b. Remote outlets.
      c. Tanks.
      d. At least 2 outlets on each building floor where directed.
      e. Drain lines.
      f. Filters and effluent channels and piping.
   5. Maintain disinfectant in system for appropriate 6-hour or 24-hour interval in accordance with AWWA C652.
   6. When disinfectant residual is less than 10 milligrams per liter after 24 hours, repeat system treatment.

7. Stainless steel piping:
    a. Modify procedures for disinfection of stainless steel piping and appurtenances as necessary to avoid causing corrosion, pitting, or attack of stainless steel materials.
        1) Take steps to eliminate chlorinated water trapped in crevices and under gaskets through the following procedures:
            a) Pressurize stainless steel piping systems so that gaskets and O-rings are seated before introducing chlorinated water into the system.
            b) Flush to displace a minimum of 3 pipe volumes at the conclusion of the disinfection procedure.
    b. Use the continuous-feed method to fill the stainless steel piping system with the minimum chlorine concentration required to provide a 10 milligrams per liter residual after 24 hours of contact time in accordance with AWWA C651.

3.02 SURFACES TO BE DISINFECTED

A. Disinfect the following:
    1. Interior surfaces of the filters, basins, filter channels, etc., including the ceilings.
    2. Wetted surfaces associated with conveyance elements, such as pipes and channels downstream of the filters, basins.
    3. Any existing wetted surface downstream of the filters, basins that may have been contaminated during the construction process.
    4. Disinfect wetted surfaces, underdrain equipment, filter media, and submerged accessories associated with the filters:
        a. Disinfect the entire filter by chlorination.
        b. Allow a minimum of 24 hours for disinfection of a filter.
    5. After the support gravel, filter sand, and anthracite layers have been brought to the specified gradation and thickness, disinfect each filter as follows:
        a. Inject sufficient chlorine into the washwater to produce a solution having a chlorine concentration of at least 25 milligrams per liter throughout the filter.
            1) Introduce sufficient washwater so that surfaces up to the maximum operating level of the filter will be in contact with the chlorinated water.
            2) Hold the chlorinated water for a minimum of 12 hours.
        b. As an alternative disinfection method, spray surfaces of the filter box up to the maximum operating level with a solution containing 200 milligrams per liter chlorine.
            1) Keep the solution in contact with the surfaces for a minimum 30 minutes.
            2) Disinfect the remaining portion of the filter with a 25 milligrams per liter chlorine solution for a minimum of 12 hours.
        c. Provide chlorine required for disinfection.
        d. Direct the chlorinated water from disinfection operations to the recycle basins or washwater ponds, as directed by the County or Engineer.
    6. Piping systems that are used to convey water, solutions, or chemicals to potable water facilities.

3.03 DISINFECTION OF WATER MAINS

A. Perform disinfection of water mains per AWWA C651 and as specified in this Section.

B. Cleaning:
   1. Remove by flushing or other means, soil and debris from the water tanks in accordance with AWWA C652 prior to chlorination.

C. Inspection:
   1. Verify that water system is completed and cleaned of soil and debris prior to chlorination.

3.04 DISINFECTION OF WATER STORAGE FACILITIES

A. Perform disinfection of water storage facilities in accordance with AWWA C652 and as specified in this Section.

B. Test for disinfectant residual at locations as specified in Disinfection Test Plan:
   1. Inlet and outlet piping.
   2. Drain line.

C. Maintain disinfectant in system for appropriate 6-hour or 24-hour interval in accordance with AWWA C652.

D. When disinfectant residual is less than 2 parts per million after 24 hours, repeat system treatment.

3.05 REPAIRS OR CONNECTIONS TO EXISTING LINES

A. Perform disinfection of repairs or connection to existing lines in accordance with AWWA C651 and as specified in this Section.

B. Clean and sterilize the interior surfaces of new piping, fittings, equipment, and appurtenances to be installed in an existing potable water system or connected to an existing system.

C. Clean and sterilize the existing pipe or facilities for a minimum distance of 3 pipe diameters back from the ends of the pipe. Plug the ends of the line when work is not being performed on the pipe.

D. Perform sterilization by swabbing each item with a concentrated chlorine solution.
   1. Each piece is to be disinfected prior to being assembled for installation in the existing pipe.
   2. Disinfect each piece just prior to assembly to help prevent recontamination.
   3. Plug the ends of the assembly until a new item is to be added to the assembly.
   4. Store disinfected materials on blocks to prevent contact with the ground.

3.06 FLUSHING

A. Remove disinfection water from the facilities as appropriate for the type of disinfectant and method used for disinfection.

B. Flush facilities with potable water containing no more disinfectant residual than the active distribution system or 1.0 milligrams per liter, whichever is greater (as appropriate for method of chlorination).

C. Continue flushing until water at designated flushing ports contains disinfectant residual equal to concentration specified above.

3.07 DISPOSAL OF CHLORINATED WATER

A. Dispose of chlorinated water in accordance with AWWA C655 and as specified in this Section.

B. Dispose of chlorinated water in accordance with the submitted disinfection test plan and applicable requirements of federal, state, county, and city having jurisdiction over disposal of hazardous wastes in location of the Project and disposal site.

C. Chlorinated water may only be disposed of in a sanitary sewer system with the written permission of the County. If allowed, discharge the chlorinated water at a low rate so it does not surcharge the sewer line.

3.08 BACTERIOLOGICAL TEST

A. Instruct bacteriological laboratory to collect water samples no sooner than 24 hours after start of disinfection of each facility.

B. A minimum of 24 hours after flushing system and within 24 hours before the water main is placed in service, collect bacteriological quality samples at each of following locations and other locations in accordance with the submitted disinfection test plan and Standard Methods for the Examination of Water and Wastewater:
   1. Where water enters system.
   2. Inlet piping.
   3. Ends of piping runs.
   4. Drain lines.
   5. Remote outlets.
   6. Tanks.
   7. At least 2 outlets on each building floor.

C. Analyze water samples in accordance with Standard Methods for Examination of Water and Wastewater.

D. When bacteriological test proves water quality to be unacceptable, repeat disinfection treatment process until water meets quality standards for disinfection.

END OF SECTION

SECTION 01_77_00

CLOSEOUT PROCEDURES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Contract closeout requirements including:
   1. Final cleaning.
   2. Waste disposal.
   3. Touch-up and repair.
   4. Disinfection of systems.
   5. Preparation and submittal of closeout documents.
   6. Final completion certification.

1.02 REFERENCES

A. American Water Works Association (AWWA).

1.03 FINAL CLEANING

A. Perform final cleaning prior to inspections for Final Completion.

B. Employ skilled workers who are experienced in cleaning operations.

C. Use cleaning materials which are recommended by manufacturers of surfaces to be cleaned.

D. Prevent scratching, discoloring, and otherwise damaging surfaces being cleaned.

E. Clean roofs, gutters, downspouts, and drainage systems.

F. Broom clean exterior paved surfaces and rake clean other surfaces of site work:
   1. Police yards and grounds to keep clean.

G. Remove dust, cobwebs, and traces of insects and dirt.

H. Clean grease, mastic, adhesives, dust, dirt, stains, fingerprints, paint, blemishes, sealants, plaster, concrete, and other foreign materials from sight-exposed surfaces, and fixtures and equipment.

I. Remove non-permanent protection and labels.

J. Polish waxed woodwork and finish hardware.

K. Wash tile.

L. Wax and buff hard floors, as applicable.

M. Wash and polish glass, inside and outside.

N. Wash and shine mirrors.

O. Polish glossy surfaces to clear shine.

P. Vacuum carpeted and soft surfaces.

Q. Clean permanent filters and replace disposable filters when heating, ventilation, and air conditioning units were operated during construction.

R. Clean ducts, blowers, and coils when units were operated without filters during construction.

S. Clean light fixtures and replace burned-out or dim lamps.

T. Probes, elements, sample lines, transmitters, tubing, and enclosures have been cleaned and are in like-new condition.

1.04 WASTE DISPOSAL

A. Arrange for and dispose of surplus materials, waste products, and debris off-site:
   1. Prior to making disposal on private property, obtain written permission from County of such property.

B. Do not fill ditches, washes, or drainage ways which may create drainage problems.

C. Do not create unsightly or unsanitary nuisances during disposal operations.

D. Maintain disposal site in safe condition and good appearance.

E. Complete leveling and cleanup prior to Final Completion of the Work.

1.05 TOUCH-UP AND REPAIR

A. Touch-up or repair finished surfaces on structures, equipment, fixtures, and installations that have been damaged prior to inspection for Substantial Completion.

B. Refinish or replace entire surfaces which cannot be touched-up or repaired satisfactorily.

1.06 FINAL CLEANING AND DISINFECTION OF SYSTEMS OF PLANT FACILITIES

A. Clean channels, pipe, basins, reservoirs, and tanks related to the filter system before the filter system functional testing.

B. Wash, wherever practicable, or broom sweep channels, pipe, basins, reservoirs, and tanks.

C. Disinfect filter basins, reservoirs, clear wells, tanks, channels, and piping intended to carry potable water as follows or in accordance with AWWA Standards.

D. Provide ample sampling outlets in pipe for testing.

E. Fill pipe and other plant facilities with chlorine solution of sufficient strength to retain residual of not less than 10 parts per million at end of 24 hours.

F. When reservoirs and basins are too large to be economically disinfected by filling with chlorine solution, spray reservoirs and basins with solution containing 100 parts per million of chlorine.

G. After disinfection, rinse entire potable water system with potable water sufficient to reduce chlorine residual to not more than 0.6 parts per million throughout system before system is put into service.

1.07 FINAL CLEANING AND DISINFECTION OF SYSTEMS OF POTABLE WATER MAINS

A. Clean interior of pipe and fittings.

B. When pipe contains dirt that cannot be removed by flushing, swab pipe interiors with solution containing not less than 500 parts per million of chlorine until clean.

C. Flush 12-inch in diameter and smaller pipe as thoroughly as available water sources will permit.

D. Fill pipe with chlorine solution of sufficient strength to provide 10 parts per million chlorine residual at end of 24 hours.

E. Flush pipes with potable water until chlorine residual is less than 0.6 parts per million before pipe are put into service.

1.08 CLOSEOUT DOCUMENTS

A. Submit the following Closeout Submittals before Substantial Completion:
   1. Punch list of items to be completed or corrected with the request for issuance of Substantial Completion.
   2. Evidence of Compliance with Requirements of Governing Authorities.
   3. Project Record Documents.
   4. Approved Operation and Maintenance Manuals.
   5. Approved Warranties and Bonds.
   6. Keys and Keying Schedule.
   7. Completed contract requirements for commissioning and process start-up.

B. Submit the following Closeout Submittals before final completion of the Work and at least 7 days prior to submitting Application for Final Payment:
   1. Punch list of items have been completed and Engineer and County are satisfied that all deficiencies are corrected.
   2. Evidence of Payment and Release of Liens or Stop Payment Notices as outlined in Conditions of the Contract.
   3. Release of claims as outlined in Conditions of the Contract.
   4. Submit certification of insurance for products and completed operations, as specified in the General Conditions.
   5. Final statement of accounting.

6. Submit Final (As-Built) Schedule as specified in Section 01_32_21 - Schedules and Reports.

1.09 EVIDENCE OF COMPLIANCE WITH REQUIREMENTS OF GOVERNING AUTHORITIES

A. Submit the following:
   1. Certificate of Occupancy.
   2. Certificates of Inspection:
      a. Mechanical:
      b. Electrical:

1.10 PROJECT RECORD DOCUMENTS

A. Maintain at Project site, available to County and Engineer, 1 copy of the Contract Documents, shop drawings, and other submittals in good order:
   1. Mark and record field changes and detailed information contained in submittals and change orders.
   2. Record actual depths, horizontal and vertical location of underground pipes, duct banks, and other buried utilities. Reference dimensions to permanent surface features.
   3. Identify specific details of pipe connections, location of existing buried features located during excavation, and the final locations of piping, equipment, electrical conduits, manholes, and pull boxes.
   4. Identify location of spare conduits including beginning, ending, and routing through pull boxes and manholes. Record spare conductors, including number and size, within spare conduits and filled conduits.
   5. Provide schedules, lists, layout drawings, and wiring diagrams.
   6. Make annotations in electronic format conforming to the following color code:

Additions:	Red
Deletions:	Green
Comments	Blue

B. Maintain documents separate from those used for construction:
   1. Label documents "RECORD DOCUMENTS."

C. Keep documents current:
   1. Record required information at the time the material and equipment is installed and before permanently concealing.
   2. Engineer will review Record Documents weekly to ascertain that changes have been recorded.

D. Affix civil engineer's or professional land surveyor's signature and registration number to Record Drawings to certify accuracy of information shown.

E. Deliver Record Documents with transmittal letter containing date, Project title, Contractor's name and address, list of documents, and signature of Contractor.

F. Record Documents will be reviewed monthly to determine the percent complete for the monthly pay application.

G. Updated Record Documents are a condition for Engineer's recommendation for progress payment.

H. Final Schedule Submittal as specified in Section (01_32_21) - Schedules and Reports.

1.11 MAINTENANCE SERVICE

A. Maintenance service as specified in technical specifications.

1.12 SUBSTANTIAL COMPLETION

A. Obtain Certificate of Substantial Completion.

1.13 FINAL COMPLETION

A. When Contractor considers the Work is complete, submit written certification that:
   1. Work has been completed in accordance with the Contract Documents:
   2. Punch list items have been completed or corrected.
   3. Work is ready for final inspection.

B. Engineer will make an inspection to verify the status of completion with reasonable promptness.

C. Should the Engineer consider that the Work is incomplete or defective:
   1. Engineer will promptly notify the Contractor in writing, listing the incomplete or defective work.
   2. Contractor shall take immediate steps to remedy the stated deficiencies and send a second written certification to the Engineer that the Work is complete.
   3. Engineer shall re-inspect the Work.

1.14 FINAL ADJUSTMENT OF ACCOUNTS

A. Submit a final statement of accounting to the Engineer at least 7 days prior to final Application for Payment.

B. Statement shall reflect all adjustments to the Contract amount.
   1. The original Contract amount.
   2. Additions and deductions resulting from:
      a. Change Orders.
      b. Units installed and unit prices.
      c. Set-offs for uncorrected or incomplete Work.
      d. Set-offs for liquidated damages.
      e. Set-offs for reinspection payments.
      f. Extended engineering and/or inspection services and inspection overtime.
      g. Excessive shop drawings review cost by the Engineer.
      h. Other adjustments.
   3. Total Contract amount, as adjusted.

4. Previous payments.
5. Remaining payment due.

C. Engineer will prepare a final Change Order reflecting approved adjustments to the Contract amount which were not previously made by Change Orders.

1.15 FINAL APPLICATION FOR PAYMENT

A. Contractor shall submit the final Application for Payment reflecting the agreed upon information provided in the final statement of accounting.

PART 2 PRODUCTS

2.01 SPARE PARTS

A. County may request advanced delivery of spare parts, maintenance products, and special tools.
   1. Deduct the delivered items from the inventory list and provide transmittal documentation.

B. Prior to Substantial Completion, arrange to deliver spare parts, maintenance products, and special tools to County at a location on site chosen by the County.
   1. Provide itemized list of spare parts and special tools that matches the identification tag attached to each item.
   2. County and Engineer will review the inventory and the itemized list to confirm it is complete and in good condition prior to signing for acceptance.

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01_78_24

OPERATION AND MAINTENANCE MANUALS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Preparation and submittal of manual with requirements to operate and maintain the equipment.

1.02 SUBMITTALS

A. Draft Operation and Maintenance Manuals:
   1. Submit prior to shipment of equipment or system to site.
   2. Shipment will be considered incomplete without the draft Operation and Maintenance Manuals.
   3. Quantity:
      a. Hard copy: 2 sets.
      b. Electronic: 2 CD-ROM or DVD.

B. Final Operation and Maintenance Manuals:
   1. Make additions and revisions in accordance with County's and Engineer's review comments on draft manuals.
   2. Submit approved Operation and Maintenance Manuals at least 30 days prior to Functional Testing and at least 60 days prior to County Training.
   3. Quantity:
      a. Hard copy: 6 sets.
      b. Electronic: 6 CD-ROM or DVD.

1.03 PREPARATION

A. General requirements:
   1. Provide dimensions in English units.
   2. Assemble material, where possible, in the same order within each volume.
   3. Reduce drawings and diagrams to 8 1/2 by 11-inch size, if possible unless otherwise specified.
   4. Complete forms on computer, handwriting not acceptable.
   5. Delete items or options not provided in the supplied equipment or system.
   6. Provide package control system annotated ladder logic for PLC, if applicable.

B. Hard copy requirements:
   1. Binders: 3-ring with rigid covers.
      a. Break into separate binders as needed to accommodate large size.
   2. Utilize numbered tab sheets to organize information.
   3. Provide original and clear text on reproducible non-colored paper, 8 1/2 by 11-inch size, 24 pound paper.

4. Drawings larger than 8 1/2 by 11 inch:
    a. Fold drawings separately and place in envelope bound into the manual.
    b. Label each drawing envelope on the outside regarding contents.

C. Electronic requirements:
1. File format:
    a. Entire manual in PDF format.
        1) Include text and drawing information.
        2) Provide a single PDF file even if the hard copy version is broken into separate binders due to being large.
        3) Create PDF from the native format of the document (Microsoft Word, graphics programs, drawing programs, etc.).
            a) If material is not available in native format and only available in paper format, remove smudges, fingerprints, and other extraneous marks before scanning to PDF format.
            b) Hard copy record drawing requirements:
                (1) Provide a single multipage PDF file of each set of the scanned drawings.
                (2) Page 1 shall be the cover of the drawing set.
            c) At file opening, display the entire cover.
                (1) Scan drawings at 200 to 300 dots per inch (DPI), black and white, Group IV Compression, unless otherwise specified.
                (2) Scan drawings with photos in the background at 400 dots per inch (DPI), black and white, Group IV Compression.
        4) Pagination and appearance to match hard copy.
        5) Searchable.
        6) Scanned images are not acceptable.
        7) Bookmarks:
            a) Bookmarks shall match the table of contents.
            b) Bookmark each section (tab) and heading.
            c) Drawings: Bookmark at a minimum, each discipline, area designation, or appropriate division.
            d) At file opening, display all levels of bookmarks as expanded.
        8) Thumbnails optimized for fast web viewing.
    b. Drawing requirements:
        1) Provide additional copy of drawings in most current version of AutoCAD format.
        2) Drawings shall have a white background.
        3) Drawing shapes shall not degrade when closely zoomed.
        4) Screening effects intended to de-emphasize detail in a drawing must be preserved.
        5) Delete items or options not provided in the supplied equipment or system.
2. Media:
    a. USB flash drive.
    b. Secure File Transfer Protocol (SFTP).
3. Label media with the following information:
    a. Operation and Maintenance Manual.
    b. Equipment name.
    c. Specification Section Number
    d. Equipment tag number.

e. County's name.
f. Project number and name.
g. Date.

4. If multiple submittals are made together, each submittal must have its own subdirectory that is named and numbered based on the submittal number.

1.04 CONTENTS

A. Cover page:
1. Operation and Maintenance Manual.
2. Equipment name.
3. Specification Section Number
4. Equipment tag number.
5. County's name.
6. Project number and name.
7. Date.

B. Table of Contents: General description of information provided within each tab section.

C. Complete Attachment A - Equipment Summary Form.

D. Description of system and components.

E. Description of equipment function, normal operating characteristics, and limiting conditions.

F. On-line resources.

G. Telephone resources.

H. Approved submittals.
1. Markup with any field changes.
2. Final programming.

I. Start-up procedures: Recommendations for installation, adjustment, calibration, and troubleshooting.

J. Operating procedures:
1. Step-by-step instructions including but not limited to the following:
a. Safety precautions and applicable Safety Data Sheets.
b. Guidelines.
c. Other information as needed for safe system operation and maintenance.

K. Preventative maintenance procedures:
1. Recommended steps and schedules for maintaining equipment.
2. Troubleshooting.

L. Lubrication information: Required lubricants and lubrication schedules.

M. Overhaul instructions: Directions for disassembly, inspection, repair and reassembly of the equipment; safety precautions; and recommended tolerances, critical bolt torques, and special tools that are required.

N. Parts list:
   1. Complete parts list for equipment including but not limited to the following information:
   2. Catalog data: Generic title and identification number of each component part of equipment.
   3. Include bearing manufacturer, model and ball or roller pass frequencies for every bearing.
   4. Availability.
   5. Service locations.

O. Spare parts list: Recommended number of parts.

P. Test data and performance curves, when applicable.

Q. Manufacturer's technical reference manuals.

R. Source (factory) Test results: Provide copies of Source Tests reports as specified in technical sections.

S. Functional Test results: After Functional Tests are completed, insert Functional Test reports as specified in technical sections.

1.05 ARCHIVAL DOCUMENTATION

A. Typically does not require updating to remain valid and should be stored in a format that preserves the document and limits one's ability to make changes.

B. Types of archival documents include the following:
   1. Record drawings.
   2. Reports.
   3. Specifications.
   4. Shop drawings.
   5. Vendor Equipment O & M Manuals.
   6. Photos.
   7. Demonstration and training videos.
   8. Other.

1.06 LIVING DOCUMENTATION

A. Requires periodic updates to remain valid and should be stored in formats that are easy to update.

B. Types of living documents include the following:
   1. Facility O&M Manuals.
   2. Standard Operating Procedures.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

ATTACHMENT A - EQUIPMENT SUMMARY FORM

EQUIPMENT SUMMARY FORM

1. EQUIPMENT ITEM _____

2. MANUFACTURER _____

3. EQUIPMENT TAG NUMBER(S) _____

4. LOCATION OF EQUIPMENT _____

5. WEIGHT OF INDIVIDUAL COMPONENTS (OVER 100 POUNDS) _____

_____

_____

_____

6. NAMEPLATE DATA -
   - Horsepower _____
   - Amperage _____
   - Voltage _____
   - Service Factor (S.F.) _____
   - Speed _____
   - ENC Type _____
   - Capacity _____
   - Other _____

7. MANUFACTURER'S LOCAL REPRESENTATIVE

   Name _____

   Address _____

   Telephone Number _____

8. MAINTENANCE REQUIREMENTS:

Maintenance Operation	Frequency	Lubricant (if applicable)	Comments
(List each operation required. Refer to specific information in Manufacturer's Manual, if applicable)	(List required frequency of each maintenance operation)	(Refer by symbol to lubricant list as required)	

9. LUBRICANT LIST:

Reference Symbol	Conoco Phillips	Exxon/Mobil	BP/Amoco	Other (List)
(Symbols used in Item 7 above)	(List equivalent lubricants, as distributed by each manufacturer for the specific use recommended)			

10. SPARE PARTS (recommendations)_____

_____

11. COMMENTS_____

12. GENERAL INFORMATION:

Date Accepted*: _____

Expected Life*: _____

Project Name & Number: _____

Design Engineer: _____

13. WARRANTY:

Start Date: _____

Expiration Date: _____

Prorated: _____

SECTION 01_81_50

DESIGN CRITERIA

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Design criteria for use in the selection of equipment and appurtenances specified in Technical Sections of these Specifications and indicated on the Drawings.
   2. Criteria for design of systems, components and equipment fabricated off site and shipped to the Work for installation.
   3. Criteria for design of anchors to connect equipment and appurtenances to supports and structures.

B. The criteria in this Section apply throughout the Work, unless additional criteria, or more restrictive criteria, are indicated.
   1. Additional criteria and requirements relevant to specific locations, specific materials, and specific equipment are indicated on the Drawings, and in the Technical Sections.

1.02 REFERENCES

A. American Society of Civil Engineers (ASCE):

B. American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE):
   1. ASHRAE Fundamentals Handbook.

C. International Code Council (ICC):
   1. International Energy Conservation Code (IECC).
   2. International Plumbing Code (IPC).

D. Sheet Metal and Air Conditioning Contractor’s National Association (SMACNA):
   1. Seismic Restraint Manual: Guidelines for Mechanical Systems, 3rd edition - 2008.

1.03 PROJECT DESIGN CRITERIA

A. Site name: South County Regional Water Treatment Plant
   1. Street Address: As specified in Section 01_11_00 - Summary of Work.
   2. Site elevation:
      a. Approximately 10 feet above mean sea level.

B. All equipment and materials for the project are to be suitable for performance in domestic water treatment plant environment and under following conditions:
   1. Design temperatures are:
      a. Outdoor temperatures: 40 to 100 degrees Fahrenheit.
      b. Indoor temperatures for the following buildings:
         1) Process areas: 55 to 95 degrees Fahrenheit.
         2) Electrical rooms: 55 to 85 degrees Fahrenheit.
   2. Moisture conditions:
      a. Outdoor relative humidity: 40 to 90 percent.
      b. Indoor relative humidity: 40 to 60 percent.
      c. Other areas: as defined in individual equipment sections.
   3. Other: Materials and equipment furnished shall be suitable for use outdoors in a humid subtropical climate

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 03_01_02

CONCRETE REPAIR MORTAR

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Concrete repair mortar.

1.02 REFERENCES

A. American Association of State Highway and Transportation Officials (AASHTO):
   1. T277 - Standard Method of Test for Electrical Indication of Concrete's Ability to Resist Chloride Ion Penetration.

B. ASTM International (ASTM):
   1. C109 - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50-mm] Cube Specimens).
   2. C293 - Standard Test Method for Flexural Strength of Concrete (Using Simple Beam With Center-Point Loading).
   3. C496 - Standard Test Method for Splitting Tensile Strength of Cylindrical Concrete Specimens.
   4. C882 - Standard Test Method for Bond Strength of Epoxy-Resin Systems Used With Concrete By Slant Shear.

1.03 SUBMITTALS

A. Product Data.

B. Manufacturer's Instructions.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle packaged materials in the manufacturer's original, sealed containers.

B. Clearly identify each container with the manufacturer's name, name and type of product, and batch numbers.
   1. Remove damaged material from the site.

C. Store and condition the specified product as recommended by the manufacturer.

D. Store materials subject to damage by dirt and moisture in a clean, dry location, off the ground and suitably protected.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. The following or equal:
   1. Sika, SikaTop 123 Plus.

2.02 DESIGN AND PERFORMANCE CRITERIA

A. General: Composed of pre-packaged polymer-modified portland cement mortar used to perform shallow repairs on horizontal, vertical, and overhead applications.

B. Design requirements:
   1. Provide material suitable for performing in environments subject to corrosive attack by chlorides and sulfates, freeze/thaw cycles, low permeability, and abrasion resistant.
   2. Capable of being poured in place or troweled in place to suit the conditions encountered.

2.03 MATERIALS

A. Water: Potable, clean, and not detrimental to mortar.

2.04 MANUFACTURED UNITS

A. Component A shall be a liquid polymer emulsion with an acrylic copolymer base and additives:
   1. pH: 4.5 to 6.5.
   2. Film forming temperature: 73 degree Fahrenheit maximum.
   3. Tear strength: 950 pounds per square inch minimum.
   4. Elongation at break: 500 percent minimum.
   5. Particle size: Less than 0.1 micron.

B. Component A shall contain an organic, penetrating corrosion inhibitor that has been independently proven to reduce corrosion in concrete.
   1. The corrosion inhibitor shall not be calcium nitrite, and shall have a minimum of 5 years of independent field-testing to document performance on actual construction projects.

C. Component B shall be a blend of selected portland cements, specially graded aggregates, admixtures for controlling setting time, water reducers for workability, and an organic accelerator.

D. Materials shall be supplied as a factory-blended unit.

E. Placeable in 1/8 inch to 1-1/2 inch depth per lift for vertical applications and 1/8 inch to 1 inch in depth for overhead applications.

F. Typical properties of the mixed concrete repair mortar:
   1. Working time: Approximately 10 to 15 minutes.
   2. Finishing time: 20 to 60 minutes.

3. Color: Concrete gray.

G. Properties of the cured concrete repair mortar:
   1. Compressive strength: In accordance with ASTM C109 modified:
      a. 1 day: 3,500 pounds per square inch minimum.
      b. 7 days: 6,000 pounds per square inch minimum.
      c. 28 days: 7,000 pounds per square inch minimum.
   2. Flexural strength: 2,000 pounds per square inch at 28 days in accordance with ASTM C293.
   3. Splitting tensile strength: 900 pounds per square inch at 28 days in accordance with ASTM C496.
   4. Bond strength: 2,200 pounds per square inch at 28 days in accordance with ASTM C882 modified.
   5. Permeability: 500 coulombs in accordance with AASHTO T 277
   6. Wet mix density: Approximately 132 pounds per cubic feet.
   7. Shall not produce a vapor barrier.

PART 3 EXECUTION

3.01 INSTALLATION

A. Mix in accordance with manufacturer's instructions.

B. At the time of application, substrate shall be saturated surface dry with no standing water.

C. Install in accordance with manufacturer's installation instructions.

D. Apply only when ambient conditions of moisture, temperature, humidity, and wind are favorable for curing:
   1. Do not allow to dry out during placement.
   2. Use water misting when required to prevent material from drying out before curing is started.

E. Moist cure with wet burlap or a fine mist for 7 days.

F. During the curing process, protect from rain, wind, or freezing as required. Keep sufficient covering on hand at all times for protection.

END OF SECTION

SECTION 03_21_17

ADHESIVE-BONDED REINFORCING BARS AND ALL THREAD RODS IN CONCRETE

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Bonding reinforcing bars and all thread rods in concrete using adhesives.

1.02 REFERENCES

A. American Concrete Institute (ACI).
   1. 355.4 - Qualification of Post-Installed Adhesive Anchors in Concrete and Commentary.

B. American National Standards Institute (ANSI):
   1. Standard B212.15 - Carbide Tipped Masonry Drills and Blanks for Carbide Tipped Masonry Drills.

C. ASTM international (ASTM):
   1. C881 - Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete.

D. Concrete Reinforcing Steel Institute (CRSI).

E. ICC Evaluation Service, Inc. (ICC-ES):
   1. AC308 - Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements.

F. NSF International (NSF):
   1. 61 - Drinking Water System Components - Health Effects.

G. Society for Protective Coatings (SSPC):
   1. SP-1 - Solvent Cleaning.

1.03 DEFINITIONS

A. Evaluation Service Report (ESR): Report prepared by ICC-ES, or other testing agency acceptable to Engineer and to the Building Official, that documents testing and review of a product to confirm that it complies with the requirements of designated ICC-ES Acceptance Criteria, and to document its acceptance for use under the Building Code specified in Section 01_41_00 - Regulatory Requirements.

1.04 SUBMITTALS

A. Product data: Technical data for adhesives, including:
   1. Manufacturer's printed installation instructions (MPII).

2. Independent laboratory test results indicating allowable loads in tension and shear for concrete of the types included in this Work, with load modification factors for temperature, spacing, edge distance, and other installation variables.
3. Handling and storage instructions.
4. Evidence of current listing under NSF-61 for use in contact with potable water.

B. Quality control submittals:
1. Special inspection: Detailed step-by-step instructions for the special inspection procedures required by the building code specified in Section 01_41_00 - Regulatory Requirements.
2. For each adhesive to be used, Evaluation Report confirming that the product complies with the requirements of AC308 for both un-cracked and cracked concrete and for use in Seismic Design Categories A through F.
3. Installer qualifications:
   a. Submit evidence of successful completion of adhesive manufacturer's installation training program.
   b. Submit evidence of current certification for installation of inclined and overhead anchors under sustained tension loading.

C. Inspection and testing reports:
1. Inspections: Field quality control: Reports of inspections and tests.
   a. Inspections: Field quality assurance: Reports of special inspections and tests.

1.05 QUALITY ASSURANCE

A. Qualifications:
1. Installation requirements:
   a. Have available at the site, and install anchors in accordance with, the adhesive manufacturer's printed installation instructions.
2. Installer qualifications:
   a. Demonstrating successful completion of adhesive manufacturer's on-site training program for installation of adhesive-bonded anchors.
   b. Holding current certification for installation of adhesive-bonded anchors by a qualified organization acceptable to the Engineer and to the Building Official.
      1) Organizations/certification programs deemed to be qualified are:
         a) ACI-CRSI Adhesive Anchor Installer Certification Program.
         b) Adhesive anchor manufacturer's certification program, subject to acceptance by the Engineer and the Building Official.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Store and protect products as follows, unless more restrictive requirements are recommended by the manufacturer:
1. Store adhesives and adhesive components on pallets or shelving in a covered-storage area protected from weather.

2. Control temperature to maintain storage within manufacturer's recommended temperature range.
    a. If products have been stored at temperatures outside manufacturer's recommended range, test by methods acceptable to the Engineer to confirm acceptability before installing in the Work.
3. Dispose of products that have passed their expiration date.

1.07 PROJECT CONDITIONS

A. As specified in Section 01_81_50 - Design Criteria.

PART 2 PRODUCTS

2.01 GENERAL

A. Like items of materials: Use end products of one manufacturer in order to achieve structural compatibility and singular responsibility.

B. Adhesives shall have a current Evaluation Report documenting testing and compliance with the requirements or ACI 355.4 and of ICC-ES AC308 for use with un-cracked concrete and with cracked concrete in the Seismic Design Category specified.

C. Bond reinforcing bars and all thread rods in concrete using epoxy adhesive unless other adhesives specified are specifically indicated on the Drawings or approved in writing by the Engineer.

D. For locations where adhesive will be in direct contact with potable water in the finished work, provide documentation of testing and listing under NSF-61. Testing shall be by a nationally recognized agency acceptable to the Engineer.

2.02 EPOXY ADHESIVE

A. Materials:
    1. Meeting the physical requirements of ASTM C881, Type IV, Grade 3, Class B or C depending on site conditions.
    2. 2-component, 100 percent solids, insensitive to moisture.
    3. Cure temperature, pot life, and workability: Compatible with intended use and environmental conditions.

B. Packaging:
    1. Disposable, self-contained cartridge system furnished in side-by-side cartridges designed to fit into a manually or pneumatically operated caulking gun, and with resin and hardener components isolated until mixing through manufacturer's static mixing nozzle.
        a. Nozzle designed to dispense components in the proper ratio and to thoroughly blend the components for injection from the nozzle directly into prepared hole.
        b. Provide nozzle extensions as required to allow full-depth insertion and filing from the bottom of the hole.

2. Container markings: Include manufacturer's name, product name, batch number, mix ratio by volume, product expiration date, ANSI hazard classification, and appropriate ANSI handling precautions.

C. Manufacturers: One of the following or equal:
   1. Hilti, Inc., HIT-RE 500-V3.
   2. Simpson Strong-Tie Co., Inc., SET-XP.

2.03 ACRYLIC AND HYBRID ADHESIVE

A. Materials:
   1. 2-component, high-solids, acrylic-based or hybrid acrylic and epoxy-based adhesive.
   2. Approved by the manufacturer for installation at substrate temperatures of 0 degrees Fahrenheit and above.

B. Packaging:
   1. Disposable, self-contained cartridge system furnished in side-by-side cartridges designed to fit into a manually or pneumatically operated caulking gun, and with resin and hardener components isolated until mixing through manufacturer's static mixing nozzle. Nozzle designed to dispense components in the proper ratio and to thoroughly blend the components for injection from the nozzle directly into prepared hole.
   2. Container markings: Include manufacturer's name, product name, batch number, mix ratio by volume, product expiration date, ANSI hazard classification, and appropriate ANSI handling precautions.

C. Manufacturers: One of the following or equal:
   1. Hilti, Inc., HIT-HY-200.
   2. Simpson Strong-Tie Co., Inc., AT-XP.

2.04 ALL THREAD RODS

A. Materials: As specified in Section 05_12_00 - Structural Steel Framing for rods, nuts and washers.

2.05 REINFORCING BARS

A. As specified in Section 03_20_00 - Concrete Reinforcing.

PART 3 EXECUTION

3.01 GENERAL

A. Execution of this work is restricted to installers who have personally completed the adhesive manufacturer's on-site training for the products to be installed, and who are personally certified through a qualified certification program described under Quality Assurance and accepted by the Engineer and the Building Official.
   1. Do not install holes or adhesive until training is complete.

B. Perform work in strict compliance with the accepted MPII and the following instructions. Where the accepted MPII and the instructions conflict, the MPII shall prevail.

C. Install reinforcing bars and all thread rods to embedment depth, and at spacing and locations indicated on the Drawings.
   1. If embedment depth is not indicated, contact Engineer for requirements.
   2. Do not install adhesive-bonded all thread rods or reinforcing bars in upwardly inclined or overhead applications unless accepted in advance by Engineer.

3.02 PREPARATION

A. Do not begin installation of adhesive bonded anchors until:
   1. Concrete has achieved an age of at least 21 days after placement.
   2. On-site training in installation of adhesive bonded anchors by manufacturer's technical representative is complete. Do not drill holes in concrete or install adhesive and embeds in holes.

B. Review manufacturer's printed installation instructions (MPII) and "conditions of use" stipulated in the Evaluation Report before beginning work.
   1. Bring to the attention of the adhesive manufacturer's technical representative any discrepancies between these documents and resolve before proceeding with installation.

C. Install adhesive bonded anchors in full compliance with manufacturer's printed installation instructions using personnel who have successfully completed manufacturer's on-site training for products to be used and who hold certifications specified in this Section.

D. Confirm that adhesive and substrate receiving adhesive are within manufacturer's recommended range for temperature and moisture conditions, and will remain so during the curing time for the product.

3.03 HOLE SIZING AND INSTALLATION

A. Drilling holes:
   1. Determine location of reinforcing bars or other obstructions with a nondestructive indicator device, and mark locations with construction crayon on the surface of the concrete.
   2. Do not damage or cut existing reinforcing bars, electrical conduits, or other items embedded in the existing concrete without prior acceptance by Engineer.

B. Hole drilling equipment:
   1. Electric or pneumatic rotary impact type with medium or light impact.
      a. Installation of anchors in cored holes is not permitted.
      b. Set drill to "rotation only" mode, or to "rotation plus hammer" mode in accordance with the manufacturer's installation instructions and the requirements of the Evaluation Report.

c. Where edge distances are less than 2 inches and "rotation plus hammer" mode is permitted, use lighter impact equipment to prevent micro-cracking and concrete spalling during the drilling process.

2. Drill bits: Carbide-tipped in accordance with ANSI B212-15 unless otherwise recommended by the manufacturer or required as a "condition of use" in the Evaluation Report.
   a. Hollow drill bits with flushing air systems are preferred. Air supplied to hollow drill bits shall be free of oil, water, or other contaminants that will reduce bond.

C. Hole diameter: As recommended in the manufacturer's installation instructions and the Evaluation Report.

D. Hole depth: As recommended in the manufacturer's installation instructions to provide minimum effective embedment indicated on the Drawings.

E. Obstructions in drill path:
   1. If an existing reinforcing bar or other obstruction is hit while drilling a hole, unless otherwise accepted by Engineer, stop drilling. Prepare and fill the hole with dry-pack mortar. Relocate the hole to miss the obstruction and drill another hole to the required depth.
      a. Obtain Engineer's acceptance of distance between abandoned and relocated holes before proceeding with the relocation.
      b. Allow dry-pack mortar to cure to a strength equal to that of the surrounding concrete before resuming drilling in the area.
      c. Epoxy grout may be substituted for dry-pack mortar when accepted by Engineer.
   2. Avoid drilling an excessive number of holes in an area of a structural member, which would excessively weaken the member and endanger the stability of the structure.
   3. When existing reinforcing steel is encountered during drilling and when specifically accepted by Engineer, enlarge the hole by 1/8 inch, core through the existing reinforcing steel at the larger diameter, and resume drilling at original hole diameter using pneumatic rotary impact drill.
   4. Bent bar reinforcing bars: Where edge distances are critical, and interference with existing reinforcing steel is likely, if acceptable to Engineer, drill hole at 10 degree (or less) angle from axis of reinforcing bar or all thread rod being installed.

F. Cleaning holes:
   1. Insert air nozzle to bottom of hole and blow out loose dust.
      a. Use compressed air that is free of oil, water, or other contaminants that will reduce bond.
      b. Provide minimum air pressure of 90 pounds per square inch for not less than 4 seconds.
   2. Using a stiff bristle brush with diameter that provides contact around the full perimeter of the hole, vigorously brush hole to dislodge compacted drilling dust.
      a. Insert brush to the bottom of the hole and withdraw using a simultaneous twisting motion.
      b. Repeat at least 4 times.

3. Repeat the preceding steps as required to remove drilling dust or other material that will reduce bond, and in the number of cycles required by the MPII and the Evaluation Report.
4. Leave prepared holes clean and dry.
5. Protect prepared and cleaned holes from contamination and moisture until adhesive is installed.
6. Re-clean and dry previously prepared holes if, in the opinion of the Engineer, the hole has become contaminated after initial cleaning.

3.04 INSTALLATION OF ADHESIVE AND INSERTS

A. Clean and prepare inserts reinforcing bars and all thread rods:
   1. Prepare embedded length of reinforcing bars and all thread rods by cleaning to bare metal. Inserts shall be free of oil, grease, paint, dirt, mill scale, rust, or other coatings that will reduce bond.
   2. Solvent clean prepared reinforcing bars and all thread rods over the embedment length in accordance with SSPC SP-1. Provide an oil and grease free surface for bonding of adhesive to steel.

B. Fill holes with adhesive:
   1. Starting at the bottom of the hole, fill hole with adhesive inserting the reinforcing bar or all thread rod.
   2. Fill hole as nozzle is withdrawn without creating air voids.
   3. Unless otherwise indicated on the Drawings, fill hole with sufficient adhesive so that excess adhesive is extruded out of the hole when the reinforcing bar or all thread rod is inserted.
   4. Where necessary, seal hole at surface of concrete to prevent loss of adhesive during curing.

C. Installing reinforcing bars and all thread rods.
   1. Unless otherwise indicated on the Drawings, install bars and rods perpendicular to the concrete surface.
   2. Insert reinforcing bars and all thread rods into adhesive in accordance with manufacturer's recommended procedures.
   3. Confirm that insert has reached the designated embedment in the concrete, and that adhesive completely surrounds the embedded portion.
   4. Securely brace bars and all thread rods in place to prevent displacement while the adhesive cures. Bars and rods displaced during curing will be considered damaged and replacement will be required.
   5. Clean excess adhesive from the mouth of the hole.

D. Curing and loading.
   1. Provide and maintain curing conditions recommended by the adhesive manufacturer for the period required to fully cure the adhesive at the temperature of the concrete.
   2. Do not disturb or load bonded embeds until manufacturer's recommended cure time, based on temperature of the concrete, has elapsed.

3.05 POST-INSTALLATION ACTIVITIES

A. Do not bend bars or all-thread rods after bonding to the concrete, unless accepted in advance by the Engineer.

B. Attachments to all thread rods:
   1. After assemblies to be connected are placed, install nuts and washers for threaded rods as indicated on the Drawings.
   2. Draw nuts down tight, using practices specified for "snug tight" installation of bolts in steel to steel connections.

3.06 FIELD QUALITY CONTROL

A. Provide field quality control over the Work of this Section as specified in Section 01_45_00 - Quality Control.

B. Do not allow work described in this Section to be performed by individuals who do not hold the specified certifications and who have not completed the specified job site training.

C. Manufacturer's services:
   1. Before beginning installation, furnish adhesive manufacturer's technical representative to conduct on-site training in proper storage and handling of adhesive, drilling and cleaning of holes, and preparation and installation of reinforcing bars and all thread rods.
      a. Provide notice of scheduled training to Engineer and to Special Inspector(s) not less than 10 working days before training occurs. Engineer and Special Inspector may attend training sessions.
   2. Submit record, signed by the manufacturer's technical representative, listing Contractor's personnel who completed the training. Only qualified personnel who have completed manufacturer's on-site training shall perform installations.

D. Field inspections and testing:
   1. Hole drilling and preparation.
   2. Results: Submit records of inspections and testing to Engineer by electronic copies within 24 hours after completion.

3.07 FIELD QUALITY ASSURANCE

A. Provide field quality assurance over the Work of this Section as specified in Section 01_45_00 - Quality Control.

B. Special inspections, special tests, and structural observation:
   1. Provide as specified in Section 01_45_24 - Regulatory Quality Assurance.
   2. Frequency of inspections:
      a. Unless otherwise indicated on the Drawings or in this Section, provide periodic special inspection as required by the Evaluation Report for the product installed.

b. Provide continuous inspection for the initial installation of each type and size of adhesive bonded reinforcing bar and all thread rod. Subsequent installations of the same anchor may be installed with periodic inspection as defined in subsequent paragraphs.

3. Preparation:
   a. Review Drawings and Specifications for the Work to be observed.
   b. Review adhesive manufacturer's MPII and recommended installation procedures.
   c. Review Evaluation Report "Conditions of Use" and "Special Inspection" requirements.
4. Inspection: Periodic:
   a. Initial inspection. Provide an initial inspection for each combination of concrete and reinforcing bar strength or concrete strength and all thread rod material being installed. During initial inspection, observe the following for compliance with the installation requirements.
      1) Concrete: Class (minimum specified compressive strength) and thickness.
      2) Environment: Temperature conditions at work area, and moisture conditions of concrete and drilled hole.
      3) Holes: Locations, spacing, and edge distances; verification of drill bit compliance with requirements; cleaning equipment and procedures; cleanliness of hole. Before adhesive is placed, confirm that depth and preparation of holes conforms to the requirements of the Contract Documents, the MPII, and the "conditions of use" listed in the Evaluation Report.
      4) Adhesive: Product manufacturer and name; lot number and expiration date; temperature of product at installation; installation procedure. Note initial set times observed during installation.
      5) Reinforcing bars and all thread rods: Material diameter and length; steel grade and/or strength; cleaning and preparation; cleanliness at insertion; minimum effective embedment provided.
   b. Subsequent inspections: Subsequent installations of the same reinforcing bars or all thread rods may be performed without the presence of the special inspector, provided that:
      1) There is no change in personnel performing the installation, the general strength and characteristics of the concrete receiving the inserts, or the reinforcing bars and all thread rods being used.
      2) For ongoing installations, the special inspector visits the site at least once per day during each day of installation to observe the work for compliance with material requirements and installation procedures.
5. Inspection: Continuous.
   a. Make observations as described under "Inspection - Periodic, Initial Inspection" during all drilling, cleaning, and bonding activities for all bars and rods installed.
6. Records of inspections:
   a. Provide a written record of each inspection using forms acceptable to the Engineer and to the Building Official.
   b. Submit electronic copies of inspection reports to Engineer within 24 hours after completion of inspection.

END OF SECTION

SECTION 03_30_01

CONCRETE WORK

TABLE OF CONTENTS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Concrete formwork, concrete accessories, concrete reinforcement, batching and mixing of concrete to be cast-in-place, concrete placement and curing, and tooled concrete finishes.

1.02 REFERENCES

A. American Concrete Institute (ACI):
   1. CODE-318 - Building Code Requirements for Structural Concrete and Commentary.
   2. MNL-66 - ACI Detailing Manual.
   3. PRC-305 - Specification for Hot Weather Concreting.
   4. PRC-306 - Standard Specification for Cold Weather Concreting.
   5. SPEC-117 - Standard Specifications for Tolerances for Concrete Construction and Materials.
   6. SPEC-301 - Specifications for Concrete Construction.

B. ASTM International (ASTM):
   1. A615 - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
   2. A1064 - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
   3. C31 - Standard Practice for Making and Curing Concrete Test Specimens in the Field.
   4. C33 - Standard Specification for Concrete Aggregates.
   5. C39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
   6. C94 - Standard Specification for Ready-Mixed Concrete.
   7. C138 - Standard Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete.
   8. C143 - Standard Test Method for Slump of Hydraulic-Cement Concrete.
   9. C150 - Standard Specification for Portland Cement.
   10. C156 - Standard Test Method for Water Loss from a Mortar Specimen Through Liquid Membrane-Forming Curing Compounds for Concrete.
   11. C171 - Standard Specification for Sheet Materials for Curing Concrete.
   12. C172 - Standard Practice for Sampling Freshly Mixed Concrete.
   13. C173 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.
   14. C260 - Standard Specification for Air-Entraining Admixtures for Concrete.
   15. C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
   16. C311 - Standard Test Methods for Sampling and Testing Fly Ash or Natural Pozzolans for Use in Portland-Cement Concrete.
   17. C494 - Standard Specification for Chemical Admixtures for Concrete.
   18. C595 - Standard Specification for Blended Hydraulic Cements.
   19. C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.

20. C989 - Standard Specification for Slag Cement for Use in Concrete and Mortars.
21. C1064 - Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete.
22. C1218 - Standard Test Method for Water-Soluble Chloride in Mortar and Concrete.
23. C1260 - Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method).
24. C1293 - Standard Test Method for Determination of Length Change of Concrete Due to Alkali-Silica Reaction.
25. C1778 - Standard Guide for Reducing the Risk of Deleterious Alkali-Aggregate Reaction in Concrete.
26. D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
27. D1752 - Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction.
28. D2103 - Standard Specification for Polyethylene Film and Sheeting.

C. Concrete Reinforcing Steel Institute (CRSI):
   1. Manual of Standard Practice.

1.03 TERMINOLOGY

A. The words and terms listed below, are not defined terms that require initial capital letters, but, when used in this Section have the indicated meaning.
   1. Alkali load: Amount of alkalies contributed by the cement in a concrete mixture, expressed in lb/yd^3, and calculated by multiplying the cement content of the concrete in lb/yd^3 by the alkali content of the Portland cement; or the Portland cement portion of a blended cement, divided by 100.
   2. Average daily temperature: The average of the highest and lowest temperatures during a 24-hour period from midnight to midnight.
   3. Cementitious materials: Portland cement or blended cement and supplementary cementitious materials.
   4. Green concrete: Concrete whose current compressive strength is less than 100 percent of the minimum specified compressive strength, f'c.
   5. Hand mixed concrete: Concrete mixed at or near the point of placement using shovels, hoes, or other similar manually operated tools.
   6. Hot weather: A period when project conditions such as low humidity, high temperature, solar radiation, and high winds promote rapid drying of freshly placed concrete.
   7. Neat cement grout: Grout made from a mixture of Portland cement and water.
   8. Supplementary cementitious material: Inorganic material such as fly ash, natural pozzolans, silica fume, or slag cement that reacts pozzolanically or hydraulically.

1.04 SUBMITTALS

A. General:
   1. Submittal as specified in Section 01_33_00 - Submittal Procedures unless modified in this Section.

B. Product data:
    1. Formwork:
        a. Formwork facing materials. Data on facing materials for concrete exposed to view in the finished work, if different from that specified in this Section.
        b. Form release agent. Manufacturer's name and catalog data, including materials safety datasheet and documentation of suitability for use in contact with potable water.
    2. Joint materials:
        a. Preformed expansion joint material: Manufacturer's name and catalog data with documentation of conformance to materials standards specified for each type and thickness of material.
    3. Reinforcement:
        a. Mill certificates for each heat of steel provided.
        b. Reinforcement placement drawings:
            1) Show anchor bolt locations based on anchor bolt templates for approved equipment.
        c. Concrete bar supports:
            1) Precast concrete bar supports ("dobies"): Manufacturer's product data indicating compression strength of concrete supports and material used for tie wires.
            2) Wire chairs and slab bolsters: Manufacturer's product data.
    4. Concrete materials:
        a. Cement:
            1) Mill certificate in accordance with ASTM C150 or ASTM C595. Include "Type" and results of testing for alkali content measured as equivalent alkalies.
        b. Supplementary cementitious materials:
            1) Fly Ash: Identify source and provide testing results documenting compliance with ASTM C618 and any additional requirements of this Section.
            2) Slag cement: Identify source and provide testing results documenting compliance with ASTM C989 and any additional requirements of this Section.
        c. Aggregates:
            1) Type, pit or quarry location, and producer's name.
            2) Commercial laboratory test reports for samples of each aggregate proposed for use. Tests shall have been made not more than 24 months prior to the date of the Submittal.
                a) Fine aggregate: Gradation analysis, specific gravity, reactivity, and reports of deleterious materials to document compliance with ASTM C33.
                b) Coarse aggregate: Gradation analysis, specific gravity, soundness, reactivity, and reports of deleterious materials to document compliance with ASTM C33 for each size used.
        d. Admixtures:
            1) Manufacturer's catalog cuts and product data indicating compliance with the standards specified.

5. Concrete mixes: Submit full details, including:
    a. Mix proportions measured by both weight and volume and concrete properties for each class of concrete proposed for use.
        1) Information on correction of batching for varying moisture contents of fine aggregate.
    b. Data to establish the average compressive strength:
        1) If established by field test records, submit:
            a) Product and test data for the materials actually used in the mix.
            b) Actual mix proportions used in the mix producing the record.
            c) Field test data for slump, air content, and 28-day compressive strength. Include not less than 15 tests in accordance with ACI SPEC-301.
        2) If established by testing of trial batches, submit:
            a) Confirmation that the materials and proportions used in the trial batches are those that will be provided for the mix.
            b) Mix test data for slump, air content, and 28-day compressive strength.
        3) For either method, include calculations for:
            a) Standard deviation: Calculated in accordance with ACI SPEC-301 requirements.
            b) Required average compression strength (f'cr) using the standard deviation calculated in accordance with ACI SPEC-301 requirements.
            c) Statement demonstrating that the average compression strength from field test records or from trial batch testing for each mix ($f'c_{avg}$) exceeds the required average compressive strength (f'cr) for that mix.
    c. Data to establish alkali load:
        1) Determine and include the alkali load of the proposed mix.
    d. Data to establish chloride content:
        1) Submit test results showing that the concrete mix contains water-soluble chloride ion content contributed from the constituents including water, aggregates, cementitious materials, and admixtures is less than the limit specified in Table B of this Section. Test shall be performed in accordance with ASTM C1218 at age between 28 and 42 days after mixing.
6. Concrete finishing and curing materials:
    a. Manufacturer's name and product datasheets.

C. Shop Drawings:
    1. Reinforcement:
        a. Submit Drawings showing bending and placement of reinforcement.
            1) Drawings shall be in accordance with ACI MNL-66.
            2) Clearly show placement, shapes, and dimensions of each bar listed in the bill of materials, including additional reinforcement at corners and openings required by details in the Contract Documents.
            3) Show splice locations and bar lengths reflecting Contractor's intended placement sequence.

D. Samples:
    1. Form ties: If requested by the Engineer.

2. Concrete bar supports: If requested by the Engineer, provide samples of:
    a. Precast concrete bar supports (“dobies”).
    b. Wire chairs and slab bolsters.

E. Procedures:
1. Contractor’s plans for production, placement, finishing, curing, protection, and temperature monitoring of concrete during the following environmental conditions:
    a. Hot weather.

F. Project record documents:
1. For the following items, note location of concrete in the structure, and include tag numbers of associated cylinders for compression strength tests.
2. Concrete delivery tickets. Submit copies of concrete delivery tickets within 24 hours after delivery.
3. Field test reports: Results of field-testing for slump, temperature, unit weight, and air entrainment.
4. Testing laboratory reports for compression strength.

G. Notifications:
1. Modifications to concrete mixes:
    a. Submit notification of any adjustments to mixture proportions and any changes in materials made during the course of the Work for Engineer’s review.
    b. Include details of the changes and supporting documentation.
2. Joint locations:
    a. Where joint locations other than those indicated on the Drawings are requested, submit proposed locations for Engineer’s review.
    b. Provide Drawings showing proposed joint locations with joint types labeled and joint details referenced.
3. Reinforcement placement: Where necessary to move reinforcement beyond the specified placing tolerances to avoid interference, submit the proposed arrangement for Engineer’s review.
4. Concrete placements: Submit notification of readiness for each concrete placement at least 24 hours in advance.
5. Concrete repairs:
    a. Where concrete surfaces or sections exhibit defects after removal of forms, submit description of existing conditions and of proposed repair procedures and materials.
    b. Include photos of existing conditions with Submittal.

1.05 QUALITY ASSURANCE

A. Tolerances on concrete construction: In accordance with ACI SPEC-117 unless more stringent requirements are specified in the Contract Documents.

B. Concrete mixtures:
1. Ensure that concrete produced has the specified characteristics in the freshly mixed state, and that those are maintained to during transport and delivery and to the point of final placement.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle concrete materials in manner as to prevent damage and inclusion of foreign substances.

B. Deliver reinforcing steel bundled and tagged with identifying tags marked in a legible manner with waterproof markings showing the same designations as indicated on the submitted Shop Drawings.
   1. Store off the ground and protect from moisture, dirt, oil, and other injurious contaminants.

C. Protect concrete accessories from weather and direct exposure to sunlight before installation.

1.07 PROJECT CONDITIONS

A. Environmental requirements:
   1. Hot weather concreting: Construct in accordance with ACI PRC-305 during conditions when the ambient air temperature is above 90 degrees Fahrenheit.
   2. Conditions that promote rapid drying of freshly placed concrete, such as low humidity, high temperature, and wind: Take corrective action to minimize loss of water from the concrete.

1.08 SEQUENCING AND SCHEDULING

A. Schedule placing of concrete in such a manner that completes any single placing operation to a construction or expansion joint as indicated on the Drawings or accepted by the Engineer in advance of the placement.

PART 2 PRODUCTS

2.01 FORMWORK

A. Forms:
   1. Design and performance requirements:
      a. Design and performance of formwork shall be the responsibility of the Contractor, subject to the requirements of the Contract Documents.
      b. Design, construct, and brace formwork to:
         1) Carry all loads applied or transmitted, including the pressure resulting from placement and vibration of plastic concrete.
         2) Remain tight to prevent loss of mortar.
         3) Maintain specified tolerances and provide finished surfaces as specified.
      c. Maximum deflection of facing materials and supporting members on surfaces exposed to view in the finished work: 0.0042 times the clear span (span/240).
      d. Maximum deviation from alignment (horizontal or vertical): In accordance with ACI SPEC-117.

2. Form facing materials:
    a. Surfaces exposed to view in the finished work:
        1) Facing materials shall produce a smooth, uniform texture on the concrete.
        2) Do not use materials with raised grain, tears, worn edges, patches, dents, or other similar defects.
        3) Acceptable materials: Plywood with “C” or better face, plastic-faced plywood, tempered concrete form grade hardboard, or steel.
    b. Surfaces not exposed to view in the finished work:
        1) Special form facing material not required.
3. Forms for chamfers and keyways:
    a. Uniform steel, plastic, or lumber section of dimensions shown or specified.
    b. Provide adequate stiffness and support to maintain a true line at the concrete surface.
    c. Treated to eliminate bond with the concrete if required to produce a smooth, uniform, and undamaged finish upon removal.

B. Form ties:
1. General:
    a. Provide form ties fabricated by recognized manufacturer of concrete forming equipment and suitable for use with the forming system selected.
    b. Provide ties that accurately tie, lock, and spread forms:
        1) Do not use wire ties or wood spreaders.
    c. Provide form ties manufactured such that, when forms are removed, the tie leaves no metal or other material within 1-1/2 inches of the surface of the concrete.
    d. Do not allow tie holes through forms for ties to leak during concrete placement.
2. Cone snap ties: Tie with removable plastic cone leaving a tapered depression having a minimum diameter of 1 inch at the surface of the concrete and a depth of 1-1/2 inches below the surface.

C. Dry-pack mortar for filling cone snap tie holes:
1. Proportioned mix of 1 part of Portland cement to 1 part plaster sand with potable water added to provide a stiff consistency that can be driven into holes and properly compacted.
2. For repairs in concrete exposed to view in the finished work, mix repair mortar using the same cement and sand as that used for the concrete being patched.
    a. Mix a trial batch and confirm color compatibility with the surrounding material.
    b. Adjust color to match that of the surrounding concrete by adding white Portland cement if necessary.
3. Admixtures or additives to mortar are not permitted.

D. Form release agent: Commercially manufactured, non-staining formwork release agent that will prevent absorption of water by the formwork and will prevent bond between the formwork and the concrete.
1. Form release agent to comply with local air quality management regulations.

2.02 JOINT MATERIALS

A. Synthetic sponge rubber expansion joint material:
   1. Elastic sponge rubber compound in accordance with ASTM D1752, Type I.
   2. Concrete-gray color unless otherwise noted.
   3. Thickness: As indicated on the Drawings.
   4. Manufacturers: One of the following or equal:
      a. Williams Products Inc., Everlastic 1300.
      b. WR Meadows, Seal Tight Sponge Rubber Expansion Joint.

B. Bituminous fiber expansion joint material:
   1. Thickness: To match joint width indicated on the Drawings.
   2. Asphalt-impregnated fiberboard in accordance with ASTM D1751.
      a. Manufacturers: One of the following or equal:
         1) Durajoint.
         2) W.R. Meadows, SealTight Fibre Expansion Joint.

2.03 REINFORCEMENT

A. Materials:
   1. Deformed bars: In accordance with ASTM A615 Grade 60.
   2. Welded wire fabric: Sheets of plain wire in accordance with ASTM A1064.
   3. Bar supports:
      a. Over ground or “mud mat”:
         1) Precast concrete blocks with cast-in annealed steel tie wires, 16 gauge or heavier.
            a) Compressive strength of blocks equal to or exceeding the compressive strength of the surrounding concrete.
         2) Height as required for minimum 3 inches of clear concrete cover below reinforcement.
         3) Minimum block “footprint” of 4 square inches, or as required to supporting load from reinforcement while maintaining the required concrete cover.
      b. Wire supports: Class 3, bright basic wire with galvanized coating in accordance with CRSI Manual of Standard Practice.
   4. Tie wire: Annealed steel.

B. Fabrication:
   1. Cut and cold-bend bars in accordance with provisions of ACI MNL-66 and ACI CODE-318.
   2. Fabricate reinforcement to the tolerances in accordance with ACI SPEC-117.
   3. Provide bars free from defects and kinks and from bends not indicated on the Drawings.

2.04 SOURCE QUALITY CONTROL

A. Submit documentation that the proposed concrete mixes will conform to the requirements of this Section and will produce concrete having the required proportions and properties specified.
   1. Do not place concrete until the design for that mix and the results of any trial batch testing have been accepted by the Engineer.

2. If the Engineer requires changes to the mix design, modify mixes within limits set forth in this Section and submit new mix design for Engineer's review.

B. After acceptance, do not change mixes or mix proportions without prior acceptance by the Engineer.
   1. Exception: At all times, adjust batching of water to compensate for free moisture content of aggregates. Total water content in the mix shall not exceed that specified.

C. If there is change in source of cement or aggregate, or if there is a significant change in the characteristics or quality of any constituent material received from a source accepted to supply materials, submit new design mixes for each class of concrete affected.

D. Testing of materials and mixes before placement to demonstrate that they comply with the requirements of this Section shall be at the Contractor's expense.

2.05 CONCRETE MIXES

A. Constituent materials:
   1. Cement:
      a. Portland cement: In accordance with ASTM C150, Type I or II:
         1) Cement for finishes or repairs: Provide cement from same source and of same type as concrete to be finished.
   2. Blended hydraulic cement:
      a. In accordance with ASTM C595:
         1) Type IL (MS).
   3. Supplementary Cementitious Materials (SCM):
      a. Fly ash:
         1) In accordance with ASTM C618, Class F.
         2) Sampling and testing: In accordance with ASTM C311.
         3) Loss on ignition: Not to exceed 4 percent.
      b. Slag cement:
         1) Grade 80, 100, or 120 in accordance with ASTM C989, except as modified below:
            a) Fineness: Amount retained on a No. 325 sieve: 20 percent maximum.
            b) Total alkalies $Na_2O + 0.658\ K_2O$:
               (1) Minimum: 0.60 percent.
               (2) Maximum: 0.90 percent.
   4. Aggregates:
      a. General:
         1) Provide normal weight concrete aggregates that are sound, uniformly graded, and free of deleterious material in excess of the amounts specified.
         2) Do not use aggregate made from recycled materials such as crushed and screened hydraulic-cement concrete, brick, or other construction waste.
         3) Obtain aggregate from source that is capable of providing uniform quality, moisture content, and grading during any single day's operations.

4) Alkali-silica reactivity:
   a) Provide fine and coarse aggregate classified as aggregate-reactivity class of R0 in accordance with ASTM C1778 and with expansion not greater than 0.10 percent at 14 days when tested in accordance with ASTM C1260 and not greater than 0.04 percent at 1 year when tested in accordance with ASTM C1293.

b. Fine aggregate:
   1) Provide fine aggregate consisting of clean, natural sand or of sand prepared from crushed stone or crushed gravel.
   2) In accordance with ASTM C33.

c. Coarse aggregate:
   1) Provide coarse aggregate consisting of gravel or crushed stone made up of clean, hard, durable particles free from calcareous coatings, organic matter, or other foreign substances; and in accordance with ASTM C33, Class 4S.
   2) Grading: Unless otherwise specified or accepted in writing by the Engineer, provide the following:
      a) Aggregate for Class A, C, and PM Concrete: ASTM C33, Size Number 57.
      b) Aggregate for Class CE Concrete: ASTM C33, Size Number 8.
      c) Where a combination of 2 or more sizes of coarse aggregate are used, the gradation of the blend shall conform to the grading requirements in accordance with ASTM C33 for the size number specified.

5. Water:
   a. Water for concrete mixes, for washing aggregate, and for curing concrete: Potable water, clean and free from oil and deleterious amounts of alkali, acid, organic matter, or other substances.
   b. Do not exceed the optional chemical limits of ASTM C1602.

6. Admixtures:
   a. General:
      1) Do not use admixtures, except those specified, unless written authorization has been obtained from the Engineer.
      2) Admixtures shall be compatible with concrete and other admixtures. Admixtures (other than fly ash) shall be the products of a single manufacturer to ensure compatibility.
      3) Do not use admixtures containing chlorides in excess of 0.5 percent by weight of cement when calculated as chloride ion.
   b. Air entraining admixture: In accordance with ASTM C260.
   c. Water reducing admixture:
      1) In accordance with ASTM C494, Type A or Type D.
      2) Not containing air-entraining agents.
   d. High range water reducing admixtures/plasticizing admixtures:
      1) High-range water reducing admixtures: In accordance with ASTM C494, Type F.
      2) Use shall produce non-segregating concrete mixture with little bleeding that remains in a plastic state for not less than 2 hours.

B. Mix design and proportioning:
   1. Proportion mixes to provide compression strength, workability, and durability as specified in this Section.
   2. Submit documentation that the proposed mixes will conform to the requirements of this Section and will produce concrete having the required properties.
   3. Compression strength:
      a. Proportion each concrete mix to provide the required average compressive strength (f'cr) determined in accordance with the provisions of ACI SPEC-301.
      b. Determine required average compressive strength (f'cr) for each class of concrete using the specified compressive strength of the mix, f'c, and the standard deviation determined in accordance with ACI SPEC-301.
         1) Establish the standard deviation in accordance with ACI SPEC-301 and based on either field test records or based on trial batches.
         2) Documentation of standard deviation based on field test records:
            a) Calculate standard deviation in accordance with ACI SPEC-301 procedures using test records that:
               (1) Represent materials, quality control procedures, and conditions similar to those expected for this Work.
               (2) Do not include provisions for materials and proportions that are more restrictive than the materials proposed for use in this Work.
               (3) Represent a mix proportioned to provide a specified compressive strength (f'c) within 1,000 pounds per square inch of that specified for the corresponding mix in this Section.
         3) Documentation of standard deviation based on trial batches plus empirical code requirements:
            a) When records including at least 15 consecutive tests that span a period of at least 45 calendar days are not available, determine required average compressive strength (f'cr) from Table A:

Table A: Required Average Compressive Strength

Specified Compressive Strength f'c (pounds per square inch)	Required Average Compressive Strength f'cr (pounds per square inch)
Less than 3,000	f'c + 1,000
3,000 to 5,000	f'c + 1,200

   4. Workability:
      a. Provide concrete with workability and consistency that can be readily worked into corners and angles of forms and around reinforcement without excessive vibration and without permitting materials to segregate or free water to collect on the surface.
   5. Cement content:
      a. Cementitious materials content: Conform to values specified in Table B of this Section.
      b. Ratio of water to cementitious materials:
         1) Conform to values specified in Table B of this Section.
         2) Total water, including that from moisture content of aggregates and admixtures, shall not exceed that specified in Table B of this Section.

6. Supplementary Cementitious Materials:
    a. Fly ash:
        1) Maximum of 25 percent by weight of total weight of cementitious materials (cement plus fly ash).
        2) Other supplemental cementitious materials shall not be used without prior acceptance by the Engineer.
    a. Slag cement:
        1) Minimum slag cement content: 20 percent of the total weight of cementitious materials.
        2) Maximum slag cement content: 30 percent of the total weight of cementitious materials.
7. Aggregates:
    a. Ratio of coarse aggregate to fine aggregate: Not less than 1.0 or more than 2.0 for all concrete classes, with exception of Class CE.
8. Admixtures:
    a. Use in accordance with manufacturer's instructions.
    b. Air entraining admixture:
        1) Not required.
    c. Water reducing admixture:
        1) No decrease in cementitious materials content is permitted as a result of use of water-reducing admixture.
    d. High range water reducing admixture/plasticizing admixture:
        1) Proportion for a slump of 2 to 4 inches before the admixture is added, and a maximum slump of 8 inches after the admixture is added.
9. Concrete mix design requirements by class:
    a. Provide concrete mixes for each "class" specified in this Section and indicated in Table B of this Section.
    b. Use each class at the locations specified in the following paragraphs or indicated on the Drawings.
        1) "Class A" concrete: General use. Use at all locations unless otherwise indicated on the Drawings or listed in the following paragraphs.
        2) "Class C" concrete: May be used as fill for unauthorized excavation, for thrust blocks and ground anchors for piping, for bedding of pipe, and elsewhere as indicated on the Drawings.
        3) "Class CE" concrete: Use for electrical conduit and duct bank encasements.
        4) Class PM concrete: Use for concrete pavement, cart paths, curbs, gutters, and sidewalks.
    c. Pumped concrete: Provide a separate mix design and substantiation testing for each "class" to be placed by pumping.

Table B: Concrete Classes									
Concrete Class	**Minimum Specified Compressive Strength at 28 days, f'c[1] (pounds per square inch)**	**Ratio of water to cementitious materials[2,3] (minimum - maximum)**	**Cementitious Materials Content[3] (pounds per cubic yard of concrete by weight)**	**Cement Type**	**Maximum Chloride Content (percent by weight of cement)**	**Maximum Coarse Aggregate Size[4]**	**Air Entrainment (percent) (N/R: not required)**	**Admixtures required[5]**	**Slump Range (inches)**
A	4,500	0.40 to 0.45	535 to 575	ASTM C150, Type II(MH) or ASTM C595, Type IL(<15)	0.30	57	N/R	WRA	2 to 4
C	2,500	0.62 max.	423 min.	ASTM C150, Type II(MH) or ASTM C595, Type IL(<15)	No limit	57	N/R	WRA	3 to 6
CE	2,500	0.62 max.	423 min.	ASTM C150, Type II(MH) or ASTM C595, Type IL(<15)	No limit	8	N/R	WRA CA	3 to 6
PM	5,000	0.40	535 to 575	ASTM C150, Type II(MH) or ASTM C595, Type IL(<15)	0.15	57	5+1.5	AEA WRA	3 to 6

Notes:

(1) At locations where concrete will not be subjected to load from other elements of the structure or from Contractor's placing operations, maximum time period for achievement of specified compressive strength may be extended to 56 days when accepted by the Contractor's Engineer.

(2) W/C Ratio = Ratio of water to cementitious materials (Portland cement plus supplemental cementitious material) by weight Include weight of admixtures in the water content of the mix when the quantity of the admixtures exceeds 10 ounces per 100 pounds of cement.

(3) Provide mix within the range of W/C ratio and cementitious materials content indicated.

(4) Size number in ASTM C33, Table 2.

(5) Admixtures are designated as follows:

AEA: Air entraining admixture.

CA: Coloring admixture.

HRWR: High-range water reducing admixture.

WRA: Water reducing admixture.

2.06 CONCRETE BATCHING AND MIXING EQUIPMENT

A. Provide equipment and facilities for accurate measurement and control of materials.
   1. At all times, maintain proportions of concrete mix within specified limits.
   2. Control and adjust batch weights to secure maximum yield.

B. Measuring or weighing equipment:
   1. Furnish apparatus for weighing aggregates and cementitious materials that is suitably designed and constructed for this purpose.
   2. Devices shall bear the current and valid seal of the Sealer of Weights and Measures in the Authority having jurisdiction.
   3. Furnish devices capable of providing successive quantities of individual materials measured to within 2 percent of desired amount of that material.

C. Mixing equipment:
   1. Mixes shall be ready-mix or transit-mixed concrete in accordance with ASTM C94.
      a. Hand-measured or hand-mixed batches shall not be used.
      b. On-site volumetric batching using pre-packaged dry materials shall not be used.
   2. Provide equipment capable of combining aggregates, cementitious materials, water, and admixtures into a thoroughly mixed and uniform mass during the time periods specified, and capable of discharging the resulting mixture without segregation.
   3. Maintain mixing equipment in good working order. Operate at loads and speeds, and for periods of time recommended by the manufacturer or specified in this Section.

2.07 CONCRETE FINISHING AND CURING MATERIALS

A. Evaporation retardant:
   1. Manufacturers: One of the following or equal:
      a. Master Builders Solutions, MasterKure ER 50.
      b. Euclid Chemical Co., Eucobar.

B. Plastic membrane for curing:
   1. White polyethylene film in accordance with ASTM C171:
      a. Nominal thickness not less than 0.0040 inches when measured in accordance with ASTM D2103, and thickness at any point not less than 0.0030 inches.
      b. Loss of moisture: Not to exceed 0.055 grams per square centimeter of surface when tested in accordance with ASTM C156.

C. Sprayed membrane curing compound:
   1. In accordance with ASTM C309, Type 1D. Clear with fugitive dye.

PART 3 EXECUTION

3.01 GENERAL

A. Preparation:
   1. Use construction methods and sequences that allow time for concrete to reach adequate strength to prevent damage to or overstress of the concrete structure or its elements during construction.
   2. Locations of construction and expansion joints are indicated on the Drawings.
      a. Make no other joints, except as accepted in advance by the Engineer.
      b. Schedule placing of concrete to complete any single placing operation between designated joints.
      c. Schedule and sequence placements to allow adequate time for concrete to achieve adequate strength before subsequent placements and loads are applied to the structure.

B. Verification of conditions:
   1. Do not place concrete until:
      a. Forms have been thoroughly cleaned of dirt and debris, and form release agents have been applied.
      b. Forms have been thoroughly checked for alignment, level, strength, and accurate location of reinforcement, joint accessories, and mechanical and electrical inserts or other embedded items.
      c. Reinforcement is secure and properly fastened in its correct position.
      d. Dowels, bucks, sleeves, hangers, pipes, conduits, anchor bolts, and any other fixtures required to be embedded in concrete have been placed and adequately anchored.
      e. Forms are aligned and secured, and loose form ties at construction joints have been retightened.
   2. Notify the Engineer in writing of readiness, not just intention, to place concrete in any portion of the work:
      a. Provide this notification in advance of operations, allowing such time as the Engineer deems necessary to make final observation of preparations at location of the concrete placement.
      b. Have forms, reinforcement, screeds, anchors, ties, embeds, and inserts in place before notifying Engineer of readiness for final observations.
   3. Do not place concrete until Engineer has completed final observations of conditions at the placement and has given acceptance to proceed.

3.02 FORMING

A. General:
   1. Do not use earth cuts as forms for vertical or sloped surfaces unless specifically required by or indicated on the Contract Documents.
   2. Joints: Locate joints as indicated on the Drawings:
      a. Submit joint locations other than or differing from those indicated on the Drawings for Engineer’s review before construction.
   3. Chamfers:
      a. Permanently exposed outside corners: Provide 3/4-inch chamfer.
      b. Re-entrant corners:
         1) Chamfer not required.

2) Corner may be left square.

c. Edges of formed joints: Chamfer not required except where indicated on the Drawings.

4. Level strips: Install level strips at top of wall concrete placements to maintain true line at horizontal construction joints.

B. Constructing and erecting formwork:

1. Brace and anchor formwork to ensure vertical and lateral stability and to maintain finish tolerances when subjected to uplift pressures and lateral pressures from plastic concrete.
   a. Ensure that formwork is positioned, braced, and firmly held against previously placed concrete to maintain flush surfaces and to prevent loss or leaking of mortar at construction joints.
      1) At joints with flush surfaces exposed to view, lap contact surface of form a maximum of 1 inch over the previously placed concrete.
   b. Design and construct forms with sufficient strength and stiffness that deflections resulting from loading by plastic concrete will not exceed the surface tolerance limits specified.
   c. Set forming materials in an orderly and symmetrical arrangement, keeping the number of seams to a practical minimum.
   d. Form ties: Tie forms together using cone snap ties placed at not more than 2-foot centers vertically and horizontally.
   e. Construct formwork to permit easy removal without damage to formed surfaces.
   f. Provide temporary openings at the base of column and wall formwork to allow cleaning and inspection immediately before concrete placement.
   g. Cracks, openings, or offsets at joints in formwork: Close those that are 1/16-inch or larger by tightening forms or by filling with acceptable crack filler.
2. Where forms are reused, clean surfaces of mortar, grout, and foreign materials before coating with form release agent and setting.
3. Cover formwork surfaces with form release agent to prevent bond with the concrete:
   a. Do not allow form release agent to puddle in the forms.
   b. Do not allow form release agent to contact reinforcement, embeds, or previously placed concrete.
4. Provide runways supported directly on the formwork for moving equipment and supplies during preparations for concreting:
   a. Do not rest such runways on reinforcement.

C. Embeds, joints, and accessories:

1. Position pipes, sleeves, conduits, inserts, anchors, castings, and other embedded items in the forms, and anchor to formwork to prevent displacement.
2. Fill voids in sleeves, pipes, inserts and anchor slots with readily removable material, and seal if required to prevent entry of mortar.
3. For pipe or conduit runs, position embeds to allow at least 3 inches of clear concrete separation between parallel runs of pipes, conduits or any combination of these items with each other or with reinforcement.

D. Removing formwork:
   1. Remove forms after the specified time for curing and protection has been provided and when operations will not damage concrete.
   2. Immediately after forms are removed, carefully examine concrete surfaces.
      a. Report any irregularities in surfaces and finishes to the Engineer.
      b. Where surface repairs are needed, contact Engineer with description of conditions and description of repair procedures before proceeding with work.
   3. Immediately follow form removal with installation of specified curing materials and procedures.
   4. After forms are removed from wall and curing is complete, fill tie holes as follows:
      a. Remove form ties and cones from surfaces.
      b. Roughen cone-shaped tie holes by heavy sandblasting before repair.
      c. Clean and dampen tie holes, maintaining a saturated surface for at least 2 hours before applying dry-pack mortar.
      d. Dry pack cone-shaped tie holes with dry-pack mortar as specified in this Section.

3.03 PLACING CONCRETE REINFORCEMENT, EMBEDS, AND ACCESSORIES

A. Preparation:
   1. Cut and bend deformed steel reinforcement in the shop and deliver completed bars to the site for installation.
      a. Do not field-bend deformed reinforcement.
   2. Surface preparation:
      a. Thoroughly clean reinforcing bars from rust scale, loose mill scale, rust coat, dirt, oil, and other coatings that adversely affect bonding capacity when placed in the work.
         1) Thin coating of red rust resulting from short exposures will not be considered objectionable.
      b. Remove concrete or other deleterious coatings on dowels and other reinforcement projecting from previous placements by wire brushing or sandblasting before the reinforcement is embedded in the subsequent placement.

B. Support of reinforcement and accessories:
   1. Provide supports for deformed bars and wire fabric to maintain reinforcement position indicated on the Drawings and to provide specified minimum clear concrete cover around the reinforcement.
   2. Use number of supports required to prevent reinforcement from sagging and to support loads during construction, but in no fewer quantities and locations than recommended by ACI MNL-66 and CRSI Manual of Standard Practice.
   3. Support wire fabric from reinforcing supports:
      Do not place wire fabric on grade or forms for subsequent lifting into plastic concrete during the concrete placement.
      a. Take care to maintain specified position of wire fabric in the concrete section and to prevent bending, draping, or kinking of the wires.
   4. Do not:
      a. Use brick, broken concrete masonry units, concrete spalls, rocks, or other such material for supporting reinforcement.

b. Support reinforcement on additional reinforcing bars installed with less cover than that required by the Contract Documents ("give away bars").
c. Adjust location of reinforcement indicated on the Drawings to increase cover over support bars.

5. Furnish and use templates for placing column and wall dowels.

C. Placing reinforcement:
1. Locate reinforcement to provide minimum clear concrete cover specified:
a. Where cover is not specified, provide cover in accordance with ACI CODE-318.
2. Accurately place reinforcement in accordance with the tolerances of ACI SPEC-117:
a. Where reinforcement must be moved beyond the specified placing tolerances to avoid interference with other reinforcement, conduits, or embeds, submit the proposed arrangement for Engineer's review.
3. Fasten reinforcement securely in place with wire ties:
a. After tying, bend ends of wire ties inward towards the center of the concrete to match clear concrete cover provided for reinforcement.
4. Do not weld reinforcing bars or wires.
5. Deformed reinforcing bars:
a. Tie slab bars at every intersection around the perimeter of slabs.
b. Tie wall bar and slab bar intersections, other than those around the perimeter, at every 4th intersection, but not more than 48 inches on center each way.
c. Lap splices:
1) Lap reinforcement at splices as indicated on the Drawings or specified.
2) Unless indicated on the Drawings, install lap splices with bars in contact and fastened together with tie wire.
3) If lap splice length is not indicated on the Drawings, provide lap splice equal to 40 times reinforcing bar diameter.
6. Welded wire fabric reinforcement:
a. Bend fabric as indicated on the Drawings or required to fit work.
b. Straighten fabric to make reinforcement in each face a flat, planar surface before placing in the Work.
c. Extend welded wire fabric across concrete section to provide fabric to within 2 inches of vertical concrete edges.
d. Lap splice welded wire fabric as indicated on the Drawings:
1) If no splice details are indicated, lap fabric at least 12 inches, fasten with wire ties spaced not more than 24 inches on center, and lace lap with wire of the same diameter of the fabric.

3.04 BATCHING, MIXING, TRANSPORTING, AND DELIVERING CONCRETE

A. General:
1. Measure, batch, mix, transport, and deliver ready-mixed concrete in accordance with ASTM C94.

B. Measuring and batching:
   1. Measure materials by weighing, except as otherwise specified or where other methods are specifically authorized in writing by the Engineer.
      a. Weigh cementitious materials separately.
   2. Furnish satisfactory means for checking moisture content of aggregates before batching.
      a. Adjust mix water to compensate for free moisture content of aggregate.
   3. Mixing water:
      a. Measure by volume or by weight.
      b. Maximum water-to-cementitious materials ratio for each concrete class shall not exceed that specified in Table B of this Section.
   4. Admixtures:
      a. Provide admixtures as specified.
      b. Batch products by means of mechanical batcher capable of accurate measurement, and in accordance with the admixture manufacturer's instructions.

C. Mixing and transporting:
   1. Mixing:
      a. Equip each truck mixer with device capable of counting number of drum revolutions and interlocked to prevent discharge of concrete from drum before required number of revolutions is complete.
      b. Once drum revolutions commence, continuously revolve drum until it has completely discharged its batch.
      c. Do not add water until drum commences revolutions.
      d. Engineer may require an increase in the designated minimum number of revolutions, or a decrease in the designated maximum number of revolutions if necessary to obtain satisfactory mixing.
         1) Incorporate such changes without additional costs to County.
   2. Do not exceed the following time period for mixing and delivery:
      a. Total elapsed time from addition of water at batch plant through discharging of mix: Not to exceed the lesser of 90 minutes or 300 revolutions of the mixer drum.
      b. Total elapsed time for from arrival at the project site to completing discharge of mix: Not to exceed 30 minutes.
      c. Under conditions contributing to quick setting, the Engineer may reduce total elapsed time permitted.

D. On-site acceptance of concrete mixes:
   1. Concrete shall possess the properties specified in this Section at the point of placement.
   2. Do not place concrete:
      a. Having slump outside the limits indicated in Table B of this Section.
      b. That does not conform to specifications for entrained air content.
      c. For which the total elapsed time of mixing or elapsed time at the site exceeds the specified maximums.

3.05 CONVEYING, DEPOSITING, AND CONSOLIDATING CONCRETE

A. Preparation:
   1. General:
      a. Clean construction joints and forming surfaces of dirt, sawdust, chips, and other debris after forms are built and immediately before concrete or grout placement.
         1) Use vacuum cleaner if required to provide clean surfaces.
      b. Remove snow, ice, frost, and standing water from surfaces of formwork, reinforcement, and embeds in contact with concrete.
      c. Secure reinforcement, joint materials, anchors, embeds, and other items in place.
      d. During conveying, placement, consolidation, and finishing of concrete, protect surrounding construction, including concrete walls and slab surfaces, from concrete splatter.
      e. Thoroughly clean surrounding construction at the completion of each placement and before splatter sets up.
   2. Concrete construction on grade:
      a. Provide subgrade preparation, base materials, and compaction as required by the Contract Documents.
      b. Remove loose soils, debris, standing water, snow, or ice from subgrade.
      c. Provide moist subgrade with no standing or free water and no muddy or soft spots.
         1) When subgrade is not moist, sprinkle with water not less than 2 or more than 6 hours in advance of placing concrete.
         2) If subgrade becomes dry prior to actual placing of concrete, sprinkle again, without forming pools of water.
   3. Weather conditions:
      a. Hot weather: In hot weather conditions, make provisions in advance of placement for windbreaks, shading, fogging, sprinkling, ponding, or wet covering.
      b. Cold weather: In cold weather conditions, make provisions to maintain the required concrete temperatures without overheating or drying, and without exposing concrete to carbon dioxide from heater exhaust.
      c. Precipitation:
         1) Do not begin placements while rain, sleet, or snow is falling or anticipated, or unless adequate protection is provided.
         2) Do not allow precipitation to increase concrete water content or to damage the surface of the concrete.
      d. Wind:
         1) Do not begin placements during wind events that will blow dust or debris into the plastic concrete.
         2) Do not allow wind-blown debris to become embedded in or to damage the surface of the concrete.
         3) At all times, have sufficient coverings on hand to protect new concrete from excessive drying or blowing debris.

B. Conveying concrete:
   1. Convey concrete from mixer to place of final deposit by methods that prevent segregation or loss of materials.

2. Use chutes, pumps, and conveyors of size and design that will ensure continuous flow of concrete at point of delivery without cold joints.
3. Design and use chutes and devices for conveying and depositing concrete that direct concrete vertically downward when discharged from the chute or conveying device.
4. Keep conveying equipment clean by thoroughly washing and scraping upon completion of any placement.

C. Depositing concrete:
   1. Do not place concrete under the following conditions:
      a. After initial set has occurred.
      b. When re-tempering has occurred.
   2. Deposit concrete at or near its final position to avoid segregation caused by rehandling or flowing.
      a. Do not use vibrators to move concrete from its point of deposit.
      b. Use tremies for placing concrete where drop is over 5 feet.
   3. Place concrete continuously in approximately horizontal layers not exceeding 24 inches in depth. Bring level up evenly in all parts of forms.
      a. After placement begins, continue without significant interruption and as a continuous operation until the end of that placement is reached.
      b. Do not allow “cold joints” to form between adjacent layers or areas of the placement, or initial set to form on “wet edge” of placements.
      c. Take precautions to prevent delays between placement of adjacent layers or areas from exceeding 20 minutes.
         1) If more than 20 minutes elapse after the initial surface was placed, spread a layer of neat cement grout, as specified for construction joints before depositing additional concrete.
   4. Placing concrete on slopes: Commence placement at bottom of slope and work upward.
   5. Placing horizontal concrete monolithically with structures below:
      a. If concrete for slabs, beams, or walkways is to be cast monolithically with walls or columns below, do not place the horizontal concrete elements until the concrete in walls or columns below has been placed, consolidated, and allowed to achieve initial set.
      b. Allow set time of not less than 1 hour.
      c. Maintain a moist surface at the top of the walls or columns during the setting period.
   6. Placing a second concrete lift over hardened concrete below:
      a. Take special precautions in form work at top of old lift and bottom of new lift to prevent:
         1) Spreading and vertical or horizontal displacement of forms.
         2) Grout “bleeding” onto finished concrete surfaces.

D. Consolidating concrete:
   1. Thoroughly consolidate concrete into forms and around reinforcement, pipes, and other embeds using mechanical vibrators.
      a. Take special care to place concrete solidly against forms, leaving no voids.
      b. Make concrete solid, dense, compact, and smooth.
   2. Provide vibration energy sufficient to cause concrete to flow and readily settle into place, leaving no voids. Vibration should visibly affect concrete over a radius of at least 18 inches without segregation.

3. Vibrators:
    a. At all times, have sufficient vibrators on hand to consolidate concrete as it is placed.
    b. In addition to vibrators in use while concrete is being placed, have on hand at least 1 spare vibrator in serviceable condition.
    c. Place no concrete until it has been ascertained that all vibrating equipment, including spares, are in serviceable condition.

3.06 FINISHING CONCRETE

A. Provide concrete finishes as indicated on the Drawings.

B. Liquid evaporation retardant:
1. Apply evaporation retardant when environmental conditions will result in rapid evaporation of moisture from the surface of the fresh concrete during finishing operations. Such conditions include low humidity, high heat, and wind occurring alone or in combination.
2. Immediately after the concrete is screeded, coat the surface of the concrete with a liquid evaporation retardant.
3. Apply the evaporation retardant again after each work operation as necessary to prevent drying shrinkage cracks and crazing at the surface.

3.07 CURING AND PROTECTING CONCRETE

A. Curing concrete:
1. Cure concrete by methods specified in this Section.
2. Keep concrete continuously moist and at a temperature of at least 50 degrees Fahrenheit for at least 7 days after placement unless the details of a particular method specify a longer period.
3. Make provisions to maintain moisture or curing membrane integrity at edges of slabs, tops of walls, and joint surfaces, and to prevent loss of protection.
4. Schedule of curing methods:
    a. Concrete surfaces that will receive additional materials that require bond to the initial placement (including concrete; concrete repairs, coatings, paints, sealers; grout; and other materials):
        1) Water curing or plastic membrane curing.
    b. Formed surfaces:
        1) If non-absorbent forms are left in place for 7 days after placement: No additional requirements.
        2) For absorbent forms or when forms are removed during the 7 days following placement: Cure by water curing, plastic membrane curing, or sprayed membrane curing.
    c. Unformed concrete surfaces:
        1) Water curing, plastic membrane curing, or sprayed membrane curing.
5. Water curing:
    a. Keep surfaces of concrete constantly and visibly saturated by ponding, continuous fogging, or continuous sprinkling at all times during curing period.
        1) Cover surfaces if required to maintain saturated conditions.

2) For horizontal surfaces, pond the surface with at least 2 inches of water or cover with saturated mats or fabric kept continuously wet.

b. Formed surfaces:
   1) Each day forms remain in place may be counted as 1 day of water curing.
   2) Do not loosen form ties while concrete is being cured by forms left in place.
   3) No further credit for curing time will be allowed after contact between the concrete surface and the forms has been broken.

6. Plastic membrane curing:
   a. Cover concrete with plastic membrane, sealing joints and edges against displacement by wind or site operations and to prevent loss of moisture.
   b. Install plastic membrane as soon as concrete is finished and can be walked on without damage.
   c. Keep all surfaces of concrete under plastic membrane moist at all times during the curing period.
7. Sprayed membrane curing:
   a. Application of curing compound:
      1) Apply curing compound to concrete surface after repairing and patching, and within 1 hour after forms are removed.
         a) If more than 1 hour elapses between removal of forms and application of curing compound, provide water curing of affected surfaces for the full curing period.
      2) Contractor is cautioned that the method of applying curing compound specified in this Section may require more compound than normally suggested by manufacturer of compound, and also more than is customary in the trade.
      3) Apply curing compound by mechanical, power-operated sprayer with mechanical agitator that will uniformly mix all pigment and compound.
      4) Apply compound in at least 2 coats, with each subsequent coat in a direction turned 90 degrees from the preceding coat.
      5) Apply curing compound in sufficient quantity that concrete has uniform appearance and that the natural color of the concrete is effectively and completely concealed immediately after spraying.
      6) Continue to coat and recoat surfaces until specified coverage is achieved and until coating film remains on concrete surfaces.
      7) Apply compound to a film thickness that can be scraped from surfaces at any and all points after drying for at least 24 hours.
      8) Take care to apply curing compound to edges of placements and over full surface profile of construction joints.
   b. Removal of curing compound:
      1) Do not remove curing compound from concrete in less than 7 days after application.
      2) Before placing fresh concrete against a surface previously coated with curing compound, remove the curing compound by heavy sandblasting, or alternate method acceptable to the Engineer.
      3) Prior to final acceptance of the work, remove any curing compound on surfaces exposed to view by sandblasting or other acceptable method. After removal, only the natural color of finished concrete shall remain visible, and such color shall be uniform over the entire surface.

B. Protecting concrete:
   1. Immediately after placement, protect concrete from hot or cold weather, and mechanical damage.
   2. Temperature:
      a. Cold weather: Protect concrete during the curing period so that the concrete temperature is maintained within the following requirements.
         1) Sections less than 12-inches thick: Minimum 55 degrees Fahrenheit.
         2) Sections 12- to 36-inches thick: Minimum 50 degrees Fahrenheit.
      b. Hot weather: Protect concrete during the curing period so that the concrete temperature does not exceed 90 degrees Fahrenheit.
      c. Remove protection against temperature gradually so that concrete surface temperature does not drop or rise by more than 40 degrees Fahrenheit during any 24-hour period.
   3. Maintain forms, shoring, and bracing in place after concrete placement for a period after concrete placement as indicated in the following paragraphs. Forms may be removed after these periods if the concrete has developed sufficient strength and hardness to resist surface or other damage.
      a. Vertical forms:
         1) General: Minimum 24 hours after concrete placement.
         2) Sides of footings: Minimum 24 hours after concrete placement.
         3) Sides of beams, girders, and similar members: Minimum 48 hours after concrete placement.
      b. Horizontal forms:
         1) Slabs, beams, and girders: Until concrete reaches specified compressive strength, f'c, or until shoring is installed.
      c. Shoring for slabs, beams, and girders:
         1) Shore until concrete strength reaches specified compressive strength, f'c.
            a) Temporary shoring may be required after the specified compressive strength is reached if construction loads will exceed the designated live load capacity of the structure.
      d. Wall bracing:
         1) Brace until strength of concrete beams and slabs laterally supporting the wall reaches specified compressive strength, f'c.

C. Loads against or on the concrete:
   1. Loading of green concrete, by backfilling or by placing personnel and equipment on the surface, is not permitted.
   2. Backfilling: Do not place backfill against concrete walls until the wall and all elements attached to it, including connecting slabs or beams, are fully braced by the structure, and have achieved their minimum specified compressive strength, f'c.

3.08 JOINTS AND JOINT PREPARATION

A. Joint locations and details:
   1. Construct concrete work as monolith to the extent practical.
   2. Construct joints as indicated on the Drawings and as specified.

3. Locations of construction, expansion, and other joints are indicated on the Drawings or specified in this Section.
    a. Do not relocate, add, or delete joints without prior approval from the Engineer.

B. Construction joints:
    1. Where spacing is not indicated on the Drawings, provide construction joints in slabs and walls at intervals not greater than 35 feet.
    2. Construct as indicated on the Drawings.
    3. Before placing fresh concrete against the joint: Use heavy sandblast to thoroughly clean joint surfaces and reinforcement crossing the joint of laitance, grease, oil, mud, dirt, curing compounds, mortar droppings, or other objectionable matter.
    4. Just before placing concrete against the joint, wash surface with water to saturate joint surface and concrete surfaces within 12 inches of the joint.
    5. Horizontal joints:
        a. Immediately before placing concrete, thoroughly spread bed of neat cement grout over the joint surface. Grout shall be as follows:
            1) Use same sand-to-cementitious materials ratio that is used for concrete mix.
            2) Use same materials that are used for concrete.
            3) Use water-to-cementitious materials ratio that is no more than that specified for concrete.
        b. Grout thickness: Not less than 1/2 inch, or more than 1 inch.

C. Expansion joints:
    1. Where width is not indicated on the Drawings, provide 3/4-inch wide joint.
    2. Construct as indicated on the Drawings.
    3. Do not extend reinforcement, conduits, or other items through expansion joints unless details for such crossings are indicated on the Drawings.
    4. Preformed expansion joint material:
        a. Accurately position joint filler in the joint.
            1) Fasten to concrete or forms with adhesive.
            2) Fastening joint filler using nails, bolts, screws, or similar items is not permitted.
        b. Tape splices in joint filler to prevent intrusion of mortar.

3.09 TOLERANCES

A. Concrete:
    1. Finished concrete: Conform to shapes, lines, grades, and dimensions indicated on the Drawings.
    2. In accordance with ACI SPEC-117, except as modified in the following paragraphs:
        a. Where more restrictive tolerances to accommodate equipment are indicated on the Drawings.
        b. Slabs where slope is indicated:
            1) Uniformly slope to drain.
            2) Without depressions that puddle water.

c. Slabs indicated to be level:
    1) Maximum deviation of 1/8 inches in 10 feet without any apparent changes in grade.
    2) Without depressions that puddle water.

B. Embeds:
1. General:
    a. Sleeves and inserts: Plus or minus 1/8 inch.
    b. Projected ends of anchor bolts: Plus 1/4 inch; minus 0 inches.
    c. Anchor bolt position: Plus or minus 1/16 inch.
2. Equipment: Set inserts to tolerances required for proper installation and operation of equipment or systems to which insert pertains.

3.10 FIELD QUALITY CONTROL BY CONTRACTOR

A. Provide quality control over the Work of this Section as specified in Section 01_45_00 - Quality Control.

B. Field tests:
1. During progress of construction, provide testing to determine whether the concrete, as being produced, complies with requirements specified.
2. Sampling and testing shall be performed by Contractor's testing laboratory. Requirements as specified in Section 01_45_00 - Quality Control.
    a. Cooperate in testing by allowing free access to the Work for testing laboratory to sample and test materials.
    b. Provide full access for Engineer to observe concrete sampling and testing at any time.
    c. Contractor is responsible for providing care of and curing conditions for test specimens in accordance with ASTM C31 until specimens are collected by testing laboratory.
    d. Provide firmly braced, insulated, heated, closed wooden curing boxes. Include cold weather temperature and hot weather temperature control thermostat for initial curing and storage from time of fabrication through receipt at Contractor's testing laboratory.
3. Testing shall include:
    a. Sampling of concrete in accordance with ASTM C172.
    b. Temperature of concrete at delivery in accordance with the requirements of ASTM C1064 and as specified in this Section.
    c. Slump of concrete using slump cone in accordance with the requirements of ASTM C143. Test slump at the following intervals:
        1) Test slump at the beginning of each placement.
        2) As often as necessary to keep slump within the specified range, but not less than every 6th truck.
        3) When requested to do so by the Engineer.
        4) Observe concrete during slump test for signs of segregation:
            a) Observe concrete for mortar or moisture flow from slumped concrete.
            b) Reject concrete if mortar or moisture flows out of the mix.
    d. Unit weight of concrete in accordance with ASTM C138.

e. Air entrainment in accordance with ASTM C173. Test air content at the following intervals:
    1) At the beginning of each placement.
    2) As often as necessary to keep entrained air within the specified range, but not less than every 6th truck.
    3) When requested to do so by the Engineer.
f. Compressive strength, f'c, in accordance with ASTM C39. Required number of cylinders:
    1) Not less than 4 cylinder specimens, 4-inch diameter by 8-inches long, will be tested for each 150 cubic yards of each class of concrete; not less than 4 specimens for each half day of placement.
    2) One cylinder will be broken at 7 days and 3 cylinders will be broken at 28 days.

4. Contractor shall:
    a. Furnish concrete for test specimens and provide manual assistance to testing lab in preparing said specimens.
    b. Assume responsibility for providing care and on-site curing and protection for test specimens in accordance with ASTM C31.

3.11 FIELD QUALITY CONTROL BY COUNTY

A. Provide on-site observation and field quality assurance for the Work of this Section as specified in Section 01_45_00 - Quality Control.

B. Field inspections:
    1. Required inspections:
        a. Observe construction for conformance to the Contract Documents and the accepted Submittals.
    2. Records of inspections:
        a. Provide record of each inspection.
        b. Submit copies to Contractor upon request.

C. Field tests:
    1. Engineer may request, at any time, additional testing to confirm that materials being delivered and placed conform to the requirements of the Specifications.
        a. If such additional testing shows that the materials do not conform to the specified requirements, Contractor shall pay the cost of these tests.
        b. If such additional testing shows that the materials do conform to the specified requirements, Engineer will pay the cost of these tests.

3.12 NON-CONFORMING WORK

A. Enforcement of specification requirements:
    1. Do not place concrete that does not conform to the requirements of these Specifications. Remove non-conforming materials from the site.
    2. Strength requirements:
        a. Concrete is expected to reach higher compressive strength than the minimum specified compressive strength f'c as indicated in Table B of this Section.

b. Concrete strength will be considered acceptable if following conditions are satisfied:
    1) Averages of all sets of 3 consecutive strength test results are greater than or equal to specified compressive strength f'c.
    2) No individual strength test (average of 2 cylinders tested at 28 days) falls below specified compressive strength f'c by more than 500 pounds per square inch.
c. Whenever 1 or both of the conditions stated above is not satisfied, provide additional curing or testing of the affected portion as directed by the Engineer.
    1) The costs of such curing or testing shall be at the Contractor's expense.

3.13 ADJUSTING

A. Remove and replace or repair defective work as directed by the Engineer:
    1. Do not patch, repair, or cover defective work before observation by the Engineer.
    2. Make no repairs until Engineer has accepted proposed methods for preparation and repair.

END OF SECTION

SECTION 03_60_00

GROUTING

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Cement grout.
   2. Cement mortar.
   3. Dry-pack mortar.
   4. Epoxy grout.
   5. Grout.
   6. Non-shrink epoxy grout.
   7. Non-shrink grout.

1.02 REFERENCES

A. ASTM International (ASTM):
   1. C109 - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (using 2-inch cube specimens).
   2. C230 - Standard Specification for Flow Table for Use in Tests of Hydraulic Cement.
   3. C531 - Standard Test Method for Liner Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes.
   4. C579 - Standard Test Method for Compressive Strength of Chemical-Resistant Mortars, Grouts, and Monolithic Surfacings and Polymer Concretes.
   5. C939 - Standard Test Method for Flow of Grout for Preplaced-Aggregate Concrete (Flow Cone Method).
   6. C942 - Standard Test Method for Compressive Strength of Grouts for Preplaced-Aggregate Concrete in the Laboratory.
   7. C1107 - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Non-shrink).
   8. C1181 - Standard Test Methods for Compressive Creep of Chemical-Resistant Polymer Machinery Grouts.

B. International Concrete Repair Institute (ICRI):
   1. 310.2R - Selecting and specifying Concrete Surface Preparations for Sealers, Coatings, Polymer Overlays, and Concrete Repair.

C. NSF International (NSF):
   1. 61 – Drinking Water System Components - Health Effects.

1.03 SUBMITTALS

A. Cement grout:
   1. Mix design.
   2. Material Submittals.

B. Cement mortar:
   1. Mix design.
   2. Material Submittals.

C. Non-shrink epoxy grout:
   1. Manufacturer's literature.

D. Non-shrink grout:
   1. Manufacturer's literature.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to jobsite in their original, unopened packages or containers, clearly labeled with manufacturer's product identification and printed instructions.

B. Store materials in cool dry place and in accordance with manufacturer's recommendations.

C. Handle materials in accordance with the manufacturer's instructions.

PART 2 PRODUCTS

2.01 MANUFACTURED UNITS

A. Non-shrink epoxy grout:
   1. Manufacturers: One of the following or equal:
      a. Five Star Products, Inc., Five Star DP Epoxy Grout.
      b. Master Builder Solutions, MasterFlow 648.
      c. L&M Construction Chemicals, Inc., EPOGROUT.
   2. All wetted materials shall confirm to NSF 61 or other acceptable standards per FAC 62-555.
   3. Non-shrink epoxy grout shall be 100 percent solid, premeasured, prepackaged system containing 2-component thermosetting epoxy resin and inert aggregate.
   4. Maintain flowable consistency for at least 45 minutes at 70 degrees Fahrenheit.
   5. Shrinkage or expansion: Less than 0.0006 inches per inch when tested in accordance with ASTM C531.
   6. Minimum compressive strength: 10,000 pounds per square inch at 24 hours and 14,000 pounds per square inch at 7 days when tested in accordance with ASTM C579, Method B.
   7. Compressive creep: Not exceed 0.0037 inches/per inch when tested under 400 pounds per square inch constant load at 140 degrees Fahrenheit in accordance with ASTM C1181.
   8. Coefficient of thermal expansion: Not exceed 0.000018 inches per inch per degree Fahrenheit when tested in accordance with ASTM C531, Method B.

B. Non-shrink grout:
   1. Manufacturers: One of the following or equal:
      a. Five Star Products, Inc., Five Star Grout.
      b. Master Builder Solutions, MasterFlow 928.
      c. L&M Construction Chemicals, Inc., CRYSTEX.
   2. In accordance with ASTM C1107.
   3. All wetted materials shall confirm to NSF 61 or other acceptable standards per FAC 62-555.
   4. Preportioned and prepackaged cement-based mixture.
   5. Contain no metallic particles such as aluminum powder and no metallic aggregate such as iron filings.
   6. Require only addition of potable water.
   7. Water for pre-soaking, mixing, and curing: Potable water.
   8. Free from emergence of mixing water from within or presence of water on its surface.
   9. Remain at minimum flowable consistency for at least 45 minutes after mixing at 45 degrees Fahrenheit to 90 degrees Fahrenheit when tested in accordance with ASTM C230.
      a. If at fluid consistency, verify consistency in accordance with ASTM C939.
   10. Dimensional stability (height change):
      a. In accordance with ASTM C1107, volume-adjusting Grade B or C at 45 degrees Fahrenheit to 90 degrees Fahrenheit.
      b. Have 90 percent or greater bearing area under bases.
   11. Have minimum compressive strengths at 45 degrees Fahrenheit to 90 degrees Fahrenheit in accordance with ASTM C1107 for various periods from time of placement, including 5,000 pounds per square inch at 28 days when tested in accordance with ASTM C109 as modified by ASTM C1107.

2.02 MIXES

A. Cement grout:
   1. Use same sand-to-cementitious materials ratio for cement grout mix that is used for concrete mix.
   2. Use same materials for cement grout that are used for concrete.
   3. Use water-to-cementitious materials ratio that is no more than that specified for concrete.
   4. For spreading over surfaces of construction or cold joints.

B. Cement mortar:
   1. Use same sand-to-cementitious materials ratio for cement mortar mix that is used for concrete mix.
   2. Use same materials for cement mortar that are used for concrete.
   3. Use water-to-cementitious materials ratio that is no more than that specified for concrete being repaired.
   4. At exposed concrete surfaces not to be painted or submerged in water: Use sufficient white cement to make color of finished patch match that of surrounding concrete.

C. Dry-pack mortar:
   1. Proportions by weight: 1 part Portland cement to 2 parts concrete sand.
      a. Portland cement: As specified in Section 03_30_01 - Concrete Work.

b. Concrete sand: As specified in Section 03_30_01 - Concrete Work.

D. Epoxy grout:
1. Consist of mixture of epoxy or epoxy gel and sand.
a. Epoxy: As specified in Section 03_63_01 - Epoxies.
b. Epoxy gel: As specified in Section 03_63_01 - Epoxies.
c. Sand: Clean, bagged, graded, and kiln-dried silica sand.
2. Proportioning:
a. For horizontal work: Consist of mixture of 1 part epoxy with not more than 2 parts sand.
b. For vertical or overhead work: Consist of 1 part epoxy gel with not more than 2 parts sand.

E. Grout:
1. Mix in proportions by weight: 1 part Portland cement to 4 parts concrete sand.
a. Portland cement: As specified in Section 03_30_01 - Concrete Work.
b. Concrete sand: As specified in Section 03_30_01 - Concrete Work.

F. Non-shrink epoxy grout:
1. Mix in accordance with manufacturer's installation instructions.

G. Non-shrink grout:
1. Mix in accordance with manufacturer's installation instructions such that resulting mix has flowable consistency and is suitable for placing by pouring.

PART 3 EXECUTION

3.01 EXAMINATION

A. Inspect concrete surfaces to receive grout or mortar and verify that they are free of ice, frost, dirt, grease, oil, curing compounds, paints, impregnations, and loose material or foreign matter likely to reduce bond or performance of grout or mortar.

3.02 PREPARATION

A. Surface preparation for grouting other baseplates:
1. Remove grease, oil, dirt, dust, curing compounds, laitance, and other deleterious materials that may affect bond to concrete and bottoms of baseplates.
2. Roughen concrete surfaces in contact with grout to ICRI CSP-6 surface profile or rougher.
a. Remove loose or broken concrete.
3. Metal surfaces in contact with grout: Grit blast to white metal surface.

3.03 INSTALLATION

A. Mixing:
1. Cement grout:
a. Use mortar mixer with moving paddles.
b. Pre-wet mixer and empty out excess water before beginning mixing.

2. Cement mortar:
    a. Use mortar mixer with moving paddles.
    b. Pre-wet mixer and empty out excess water before beginning mixing.
3. Dry-patch mortar:
    a. Use only enough water so that resulting mortar will crumble to touch after being formed into ball by hand.
4. Non-shrink epoxy grout:
    a. Keep temperature of non-shrink epoxy grout from exceeding manufacturer's recommendations.
5. Non-shrink grout:
    a. May be drypacked, flowed, or pumped into place. Do not overwork grout.
    b. Do not retemper by adding more water after grout stiffens.

B. Placement:
1. Cement grout:
    a. Exercise care in placing cement grout because it is required to furnish structural strength, impermeable water seal, or both.
    b. Do not use cement grout that has not been placed within 30 minutes after mixing.
2. Cement mortar:
    a. Use mortar mixer with moving paddles.
    b. Pre-wet mixer and empty out excess water before beginning mixing.
3. Epoxy grouts:
    a. Wet surfaces with epoxy for horizontal work or epoxy gel for vertical or overhead work prior to placing epoxy grout.
4. Non-shrink epoxy grout:
    a. Mix in complete units. Do not vary ratio of components or add solvent to change consistency of mix.
    b. Pour hardener into resin and mix for at least 1 minute and until mixture is uniform in color. Pour epoxy into mortar mixer wheelbarrow and add aggregate. Mix until aggregate is uniformly wetted. Over mixing will cause air entrapment in mix.
5. Non-shrink grout:
    a. Add non-shrink cement grout to premeasured amount of water that does not exceed the manufacturer's maximum recommended water content.
    b. Mix in accordance with manufacturer's instructions to uniform consistency.

C. Curing:
1. Cement based grouts and mortars:
    a. Keep continuously wet for minimum of 7 days. Use wet burlap, soaker hose, sun shading, ponding, and in extreme conditions, combination of methods.
    b. Maintain above 40 degrees Fahrenheit until it has attained compressive strength of 3,000 pounds per square inch, or above 70 degrees Fahrenheit for minimum of 24 hours to avoid damage from subsequent freezing.
2. Epoxy based grouts:
    a. Cure grouts in accordance with manufacturers' recommendations.
        1) Do not water cure epoxy grouts.
    b. Do not allow any surface in contact with epoxy grout to fall below 50 degrees Fahrenheit for minimum of 48 hours after placement.

D. Grouting equipment bases, baseplates, soleplates, and skids: As specified in Section 46_05_10 - Common Work Results for Mechanical Equipment.

E. Grouting other baseplates:
   1. General:
      a. Use non-shrink grout as specified in this Section.
      b. Baseplate grouting shall take place from 1 side of baseplate to other in continuous flow of grout to avoid trapping air in grout.
      c. Maintain hydrostatic head pressure by keeping level of grout in headbox above bottom of baseplate. Fill headbox to maximum level and work grout down.
      d. Vibrate, rod, or chain non-shrink grout to facilitate grout flow, consolidate grout, and remove trapped air.
   2. Forms and headboxes:
      a. Build forms using material with adequate strength to withstand placement of grouts.
      b. Use forms that are rigid and liquidtight. Caulk cracks and joints with elastomeric sealant.
      c. Line forms with polyethylene for easy grout release. Coating forms with 2 coats of heavy-duty paste wax is also acceptable.
      d. Headbox shall be 4 to 6 inches higher than baseplate and shall be located on 1 side of baseplate.
      e. After grout sets, remove forms and trim back grout at 45 degree angle from bottom edges of baseplate.

3.04 FIELD QUALITY CONTROL

A. Non-shrink epoxy grout:
   1. Test for 24-hour compressive strength in accordance with ASTM C579, Method B.

B. Non-shrink grout:
   1. Test for 24-hour compressive strength in accordance with ASTM C942.

END OF SECTION

SECTION 03_63_01

EPOXIES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Epoxy.
   2. Epoxy gel.
   3. Epoxy bonding agent.

1.02 REFERENCES

A. ASTM International (ASTM):
   1. C881 - Standard Specification for Epoxy-Resin-Base Systems for Concrete.
   2. C882 - Standard Test Method for Bond Strength of Epoxy-Resin Systems Used with Concrete by Slant Shear.
   3. D638 - Standard Test Method for Tensile Properties of Plastics.
   4. D695 - Standard Test Method for Compressive Properties of Rigid Plastics.

B. NSF International (NSF):
   1. 61 - Drinking Water System Components - Health Effects.

1.03 SUBMITTALS

A. General: Submit as specified in Section 01_33_00 - Submittal Procedures.

B. Product Data: Submit manufacturer's data completely describing epoxy materials:
   1. Submit evidence of conformance to ASTM C881. Include manufacturer’s designations of Type Grade, Class, and Color.
   2. Submit documentation that materials meet or exceed the specified strength and performance characteristics. Indicate test methods and test results.
   3. Submit documentation confirming listing under NSF-61.

C. Quality control submittals:
   1. Manufacturer's installation instructions.

PART 2 PRODUCTS

2.01 DESIGN AND PERFORMANCE CRITERIA

A. Performance requirements:
   1. Provide epoxy materials that are new.
   2. Store and use products within limitations set forth by manufacturer.
   3. Perform and conduct work of this Section in neat orderly manner.

2.02 MATERIALS

A. General:
   1. Moisture tolerant, water-insensitive, two-component epoxy resin adhesive material containing 100 percent solids, and meeting or exceeding the performance properties specified when tested in accordance with the standards specified.
   2. Listed under NSF-61 for use in direct contact with potable water.

B. Epoxy: Low viscosity product in accordance with ASTM C881; Types I, II and IV; Grade 1; Class C , except as modified in this Section.
   1. Manufacturers: One of the following or equal:
      a. Dayton Superior, Unitex Pro-Poxy 100.
      b. Sika Corporation, Sikadur 35 Hi-Mod LV.
   2. Required properties:

Table 1 - Material Properties - Epoxy.

Property	Test Method	Required Results ("neat")
Tensile Strength (7-day)	ASTM D638	7,000 pounds per square inch, minimum.
Compressive Yield Strength (7-day)	ASTM D695	10,000 pounds per square inch, minimum.
Bond Strength (harded concrete to harded concrete after2-day cure)	ASTM C882	1,000 pounds per square inch, minimum. Concrete failure before failure of epoxy.
Viscosity (mixed)		250-550 centipoise
Notes:	Testing results are for materials installed and cured at a temperature between 72 and 78 degrees Fahrenheit for 7 days, unless otherwise noted.	

C. Epoxy gel: Non-sagging product in accordance with ASTM C881, Types I and IV, Grade 3, Class C.
   1. Manufacturers: One of the following or equal:
      a. Sika Corp., Sikadur 31, Hi-Mod Gel.
   2. Required properties:

Table 2 - Material Properties - Epoxy Gel.

Property	Test Method	Required Results ("neat")
Tensile Strength (7-day)	ASTM D638	2,000 pounds per square inch, minimum.
Compressive Yield Strength (7-day)	ASTM D695	8,000 pounds per square inch, minimum.
Bond Strength (14-day)	ASTM C882	1,500 pounds per square inch, minimum.

Table 2 - Material Properties - Epoxy Gel.		
Property	**Test Method**	**Required Results ("neat")**
Notes:	Testing results are for materials installed and cured at a temperature between 72 and 78 degrees Fahrenheit for 7 days, unless otherwise noted.	

D. Epoxy bonding agent: Non-sagging product in accordance with ASTM C881, Type II, Grade 2, Class C.
   1. Manufacturers: One of the following or equal:
      a. Master Builders Solutions, MasterEmaco ADH 326.
      b. Dayton Superior, Sure Bond J58.
      c. Sika Chemical Corp., Sikadur 32 Hi-Mod LPL.
   2. Required properties.

Table 3 - Material Properties - Epoxy Bonding Agent		
Property	**Test Method**	**Required Results**
Tensile Strength (7-day)	ASTM D638	3,300 pounds per square inch, minimum.
Compressive Yield Strength (7-day)	ASTM D695	8,300 pounds per square inch, minimum.
Bond Strength (14-days)	ASTM C882	1,800 pounds per square inch, minimum. Concrete failure before failure of epoxy bonding agent.
Pot Life	-	Minimum 60 minutes at 100 degrees Fahrenheit.
Notes:	Testing results are for materials installed and cured at a temperature between 72 and 78 degrees Fahrenheit for 7 days, unless otherwise noted.	

PART 3 EXECUTION

3.01 INSTALLATION

A. Install and cure epoxy materials in accordance with manufacturer's installation instructions.

B. Epoxy:
   1. Apply in accordance with manufacturer's installation instructions.

C. Epoxy gel:
   1. Apply in accordance with manufacturer's installation instructions.
   2. Use for vertical or overhead work, or where high viscosity epoxy is required.
   3. Epoxy gel used for vertical or overhead work may be used for horizontal work.

D. Epoxy bonding agent:
   1. Apply in accordance with manufacturer's installation instructions.
   2. Bonding agent will not be required for filling form tie holes or for normal finishing and patching of similar sized small defects.

END OF SECTION

SECTION 05_05_24

MECHANICAL ANCHORING AND FASTENING TO CONCRETE AND MASONRY

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Cast-in anchors and fasteners:
      a. Anchor bolts.
      b. Anchor rods.
      c. Concrete inserts.
   2. Post-installed steel anchors and fasteners:
      a. Screw anchors.
   3. Appurtenances for anchoring and fastening:
      a. Anchor bolt sleeves.
      b. Isolating sleeves and washers.
      c. Thread coating for threaded stainless steel fasteners.

1.02 REFERENCES

A. American Concrete Institute (ACI):
   1. 355.2 - Qualification of Post-Installed Mechanical Anchors in Concrete & Commentary.

B. American National Standards Institute (ANSI):
   1. B212.15 - Cutting Tools - Carbide-tipped Masonry Drills and Blanks for Carbide-tipped Masonry Drills.

C. American Welding Society (AWS):
   1. D1.1 - Structural Welding Code - Steel.
   2. D1.6 - Structural Welding Code - Stainless Steel.

D. ASTM International (ASTM):
   1. A29 - Standard Specification for Steel Bars, Carbon and Alloy, Hot-Wrought, General Requirements for.
   2. A36 - Standard Specification for Carbon Structural Steel.
   3. A53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
   4. A108 - Standard Specification for Steel Bars, Carbon and Alloy, Cold Finished.
   5. A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
   6. A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
   7. A240 - Standard Specification for Chromium and Chromium Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.

8. A380 - Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems.
9. A563 - Standard Specification for Carbon and Alloy Steel Nuts.
10. A1064 - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plan and Deformed, for Concrete.
11. B633 - Standard Specification for *Electrodeposited* Coatings of Zinc on Iron and Steel.
12. B695 - Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel.
13. E488 - Standard Test Methods for Strength of Anchors in Concrete Elements.
14. F436 - Standard Specification for Hardened Steel Washers.
15. F593 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws and Studs.
16. F594 - Standard Specification for Stainless Steel Nuts.
17. F1554 - Standard Specification for Anchor Bolts, Steel, 36, 55 and 105-ksi Yield Strength.
18. F2329 - Standard Specification for Zinc Coating, Hot-Dip, Requirements for Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners.

E. International Code Council Evaluation Service, Inc. (ICC-ES):
1. AC193 - Acceptance Criteria for Mechanical Anchors in Concrete Elements.

1.03 DEFINITIONS

A. Built-In Anchor: Headed bolt or assembly installed in position before filling surrounding masonry units with grout.

B. Cast-In Anchor: Headed bolt or assembly installed in position before placing plastic concrete around.

C. Overhead Installations: Fasteners installed on overhead surfaces where the longitudinal axis of the fastener is more than 60 degrees above a horizontal line so that the fastener resists sustained tension loads.

D. Passivation: Chemical treatment of stainless steel with a mild oxidant for the purpose of enhancing the spontaneous formation of the steel's protective passive film.

E. Post-Installed Anchor: Fastener or assembly installed in hardened concrete or finished masonry construction, typically by drilling into the structure and inserting a steel anchor assembly.

F. Terms relating to structures or building environments as used with reference to anchors and fasteners:
1. Corrosive locations: Describes interior and exterior locations as follows:
a. Locations used for delivery, storage, transfer, or containment (including spill containment) of chemicals used for plant treatment processes.

2. Wet and moist locations: Describes locations, other than “corrosive locations,” that are submerged, are immediately above liquid containment structures, or are subject to frequent wetting, splashing, or wash down. Includes:
    a. Exterior portions of buildings and structures.
    b. Liquid-containing structures:
        1) Locations at and below the maximum operating liquid surface elevation.
        2) Locations above the maximum operating liquid surface elevation and:
            a) Below the top of the walls containing the liquid.
            b) At the inside faces and underside surfaces of a structure enclosing or spanning over the liquid (including walls, roofs, slabs, beams, or walkways enclosing the open top of the structure).
    c. Liquid handling equipment:
        1) Bases of pumps and other equipment that handles liquids.
    d. Indoor locations exposed to moisture, splashing, or routine wash down during normal operations, including floors with slopes toward drains or gutters.
    e. Other locations indicated on the Drawings.
3. Other locations:
    a. Interior dry areas where the surfaces are not exposed to moisture or humidity in excess of typical local environmental conditions.

1.04 SUBMITTALS

A. General:
    1. Submit as specified in Section 01_33_00 - Submittal Procedures.
    2. Submit information listed for each type of anchor or fastener to be used.

B. Action submittals:
    1. Product data:
        a. Cast-in anchors:
            1) Manufacturer’s data including catalog cuts showing anchor sizes and configuration, materials, and finishes.
        b. Post-installed anchors:
            1) For each anchor type, manufacturer’s data including catalog cuts showing anchor sizes and construction, materials and finishes, and load ratings.
    2. Samples:
        a. Samples of each type of anchor, including representative diameters and lengths, if requested by the Engineer.
    3. Certificates:
        a. Cast-in anchors:
            1) Mill certificates for steel anchors that will be supplied to the site.
        b. Post-installed anchors:
            1) Manufacturer’s statement or certified test reports demonstrating that anchors that will be supplied to the site comply with the materials properties specified.

4. Test reports:
    a. Post-installed anchors: For each anchor type used for the Work:
        1) Current ICC-ES Report (ESR), or equivalent acceptable to the Engineer and the authority having jurisdiction, demonstrating:
            a) Acceptance of that anchor for use under the building code specified in Section 01_41_00 - Regulatory Requirements.
5. Manufacturer's instructions:
    a. Requirements for storage and handling.
    b. Recommended installation procedures including details on drilling, hole size (diameter and depth), hole cleaning and preparation procedures, anchor insertion, and anchor tightening.
    c. Requirements for inspection or observation during installation.
6. Qualification statements:
    a. Post-installed anchors: Installer qualifications:
        1) Submit list of personnel performing installations and include date of manufacturer's training for each.

1.05 QUALITY ASSURANCE

A. Qualifications:
    1. Post installed anchors shall be in accordance with building code specified in Section 01_41_00 - Regulatory Requirements.

B. Special inspection:
    1. Provide special inspection of post-installed anchors as specified in Section 01_45_24 - Regulatory Quality Assurance and this Section.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver post-installed anchors in manufacturer's standard packaging with labels visible and intact. Include manufacturer's installation instructions.

B. Handle and store anchors and fasteners in accordance with manufacturer's recommendations and as required to prevent damage.

C. Protect anchors from weather and moisture until installation.

1.07 PROJECT CONDITIONS

A. Seismic Design Category (SDC) for structures is indicated on the Drawings.

PART 2 PRODUCTS

2.01 MANUFACTURED UNITS

A. General:
   1. Furnish threaded fasteners with flat washers and hex nuts fabricated from materials corresponding to the material used for threaded portion of the anchor.
      a. Cast-in anchors: Provide flat washers and nuts as listed in the ASTM standard for the anchor materials specified.
      b. Post-installed anchors: Provide flat washers and nuts supplied for that product by the manufacturer of each anchor.
   2. Size of anchors and fasteners, including diameter and length or minimum effective embedment depth: As indicated on the Drawings or as specified in this Section. In the event of conflicts, contact Engineer for clarification.
   3. Where anchors and connections are not specifically indicated on the Drawings or specified, their material, size and form shall be equivalent in quality and workmanship to items specified.

B. Materials:
   1. Provide and install anchors of materials as in this Section.

2.02 CAST-IN ANCHORS AND FASTENERS

A. Anchor bolts:
   1. Description:
      a. Straight steel rod having one end with an integrally forged head, and one threaded end. Embedded into concrete with the headed end cast into concrete at the effective embedment depth indicated on the Drawings or specified, and with the threaded end left to project clear of concrete face as required for the connection to be made.
      b. Furnish anchor bolts with heavy hex forged head or equivalent acceptable to Engineer.
         1) Rods or bars with angle bend for embedment in concrete (i.e., “L” or “J” shaped anchor bolts) are not permitted in the Work.
   2. Materials:
      a. Type 316 stainless steel:
         1) Surfaces descaled, pickled, and passivated in accordance with ASTM A380.
         2) Bolts: ASTM F593, Group 2, Condition CW, coarse threads.
         3) Nuts: ASTM F594. Match alloy (group and UNS designation) and threads of bolts.
         4) Washers: Type 316 stainless steel.
      b. Type 304 stainless steel:
         1) Surfaces descaled, pickled, and passivated in accordance with ASTM A380.
         2) Bolts: ASTM F593, Group 1, Condition CW, coarse threads.
         3) Nuts: ASTM F594. Match alloy (group and UNS designation) and threads of bolts.
         4) Washers: Type 304 stainless steel.

c. Galvanized steel:
1) Hot-dip galvanized coating in accordance with ASTM F2329.
2) Bolt: ASTM F1554, Grade 36, heavy hex, coarse thread.
3) Nuts: ASTM A563, Grade A, heavy hex, threads to match bolt.
4) Washers: ASTM F436, Type 1.

B. Anchor rods:
1. Description: Straight steel rod having threads on each end or continuously threaded from end to end. One threaded end is fitted with nuts or plates and embedded in concrete to the effective depth indicated on the Drawings, leaving the opposite threaded end to project clear of the concrete face as required for the connection to be made at that location.
2. Materials:
a. Stainless steel: Type 316:
1) Surfaces descaled, pickled, and passivated in accordance with ASTM A380.
2) Rod: ASTM F593, Group 2, Condition CW, coarse threads.
3) Nuts: ASTM F594. Match alloy (group and UNS designation) and threads of rods.
4) Washers: Type 316 stainless steel.
5) Plates (embedded): ASTM A240.
b. Stainless steel: Type 304:
1) Surfaces descaled, pickled, and passivated in accordance with ASTM A380.
2) Rod: ASTM F593, Group 1, Condition CW, coarse threads.
3) Nuts: ASTM F594. Match alloy (group and UNS designation) and threads or rods.
4) Washers: Type 304 stainless steel.
5) Plates (embedded): ASTM A240.
c. Galvanized: steel:
1) Hot-dip galvanized with coating in accordance with ASTM F2329.
2) Rod: ASTM F1554, Grade 36, coarse thread.
3) Nuts: ASTM A563, Grade A, threads to match rod.
4) Washers: ASTM F436, Type 1.
5) Plates (embedded): ASTM A36.

C. Concrete insert: Ductile embed:
1. Description: 1-piece, integrally hot forged sleeve for embedment in concrete. Provided with flange for nailing to forms and female threaded coupler at the exposed concrete face, and washer-faced hex headed foot to resist pullout from concrete at the embedded end.
2. Manufacturers: The following or equal:
a. Dayton Superior, F-54 Ductile Embed Insert.
3. Materials:
a. Stainless steel: Not available.
b. Galvanized steel:
1) Hot-dip galvanized coating in accordance with ASTM A123 or A153 where indicated on the Drawings.
2) Steel: ASTM A29 hot rolled, Grade 1045.

2.03 POST-INSTALLED ANCHORS AND FASTENERS - ADHESIVE

A. Epoxy bonding of reinforcing bars, all thread rods, and threaded inserts in concrete: As specified in Section 03_21_17 - Adhesive-Bonded Reinforcing Bars and All Thread Rods in Concrete.

2.04 POST-INSTALLED ANCHORS AND FASTENERS - MECHANICAL

A. General:
   1. Post-installed anchors used for the Work shall hold a current ICC Evaluation Service Report demonstrating acceptance for use under the building code specified in Section 01_41_00 - Regulatory Requirements. Reports prepared by other recognized evaluation agencies may be submitted for consideration if acceptable to the Engineer and to the authority having jurisdiction.
      a. Conditions of use: The acceptance report shall indicate acceptance of the product for use under the following conditions:
         1) In regions of concrete where cracking has occurred or may occur.
         2) To resist short-term loads due to wind forces.
         3) To resist short-term loading due to seismic forces for the Seismic Design Category of the structure where the product will be used.
   2. Substitutions: When requesting product substitutions, submit calculations, indicating the diameter, effective embedment depth and spacing of the proposed anchors, and demonstrating that the substituted product will provide load resistance that is equal to or greater than that provided by the anchors listed in this Section.
      a. Calculations shall be prepared by and shall bear the signature and seal of a Professional Engineer licensed in the State of Florida.
      b. Decisions regarding the acceptability of proposed substitutions shall be at the discretion of the Engineer.

B. Screw anchors:
   1. Description: Post-installed concrete anchor that develops tensile strength from mechanical interlock provided by creating a helical “key” that is larger than the diameter of the bolt itself along the length of the anchor shaft.
   2. Screw anchors for anchorage to concrete:
      a. Acceptance criteria:
         1) Screw anchors shall have a current ICC-ES Report demonstrating that the anchors have been tested and qualified for performance in both cracked and un-cracked concrete, and for short-term loading due to wind and seismic forces for Seismic Design Categories A through F in accordance with ACI 355.2 and ICC ES AC193 (including all mandatory tests and optional tests for seismic tension and shear in cracked concrete).
         2) Screw anchor performance in the current ICC-ES Report shall be “Category 1” as defined in ACI 355.2.
      b. Manufacturers: Screw anchor: One of the following or equal:
         1) Hilti, Hex head, HUS-EZ Screw Anchor:
            a) With internally threaded head: HUS-EZ I Hanger Anchor.
         2) DEWALT/Powers, Screwbolt+ Screw Anchor:
            a) With internally threaded head: Vertigo+ Rod Hanging System.

3) Simpson Strong-Tie, Titen® HD Screw Anchor:
a) With internally threaded head: Titen® HD Rod Hanger.

c. Materials:
1) Stainless steel: Not available.
2) Galvanized steel: Carbon steel, zinc plated in accordance with ASTM B633, minimum 5 microns (Fe/Zn 5) or equal.

2.05 APPURTENANCES FOR ANCHORING AND FASTENING

A. Anchor bolt sleeves:
1. Having inside diameter approximately 2 inches greater than bolt diameter and minimum 10-bolt diameters long.
2. Plastic sleeves:
a. High-density polyethylene, corrugated sleeve, threaded to provide adjustment of location on the anchor bolt.
b. Manufacturers: The following or equal:
1) Portland Bolt & Manufacturing Co.

B. Isolating sleeves and washers:
1. Manufacturers: One of the following or equal:
a. Central Plastics Co.
b. Allied Corrosion Industries.
2. Sleeves: Mylar, 1/32-inch thick, 4,000 volts per mil dielectric strength, of proper size to fit bolts and extending half way into both steel washers.
3. One sleeve required for each bolt.
4. Washers: The inside diameter of all washers shall fit over the isolating sleeve, and both the steel and isolating washers shall have the same inside diameter and outside diameter.
a. Proper size to fit bolts.
b. Two 1/8-inch thick steel washers for each bolt.
c. G3 Phenolic: 2 insulating washers are required for each bolt:
1) Thickness: 1/8 inch.
2) Base material: Glass.
3) Resin: Phenolic.
4) Water absorption: 2 percent.
5) Hardness (Rockwell): 100.
6) Dielectric strength: 450 volts per mil.
7) Compression strength: 50,000 pounds per square inch.
8) Tensile strength: 20,000 pounds per square inch.
9) Maximum operating temperature: 350 degrees Fahrenheit.

C. Coating for repair of galvanized surfaces:
1. Manufacturers: The following or equal:
a. Jelt, Galvinox.

D. Thread coating: For use with threaded stainless steel fasteners:
1. Manufacturers: One of the following or equal:
a. Bostik, Never-Seez.
b. Oil Research, Inc., WLR No. 111.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine Work in place to verify that it is satisfactory to receive the Work of this Section. If unsatisfactory conditions exist, do not begin this Work until such conditions have been corrected.

3.02 INSTALLATION: GENERAL

A. Where anchors and fasteners are not specifically indicated on the Drawings or specified, make attachments with materials specified in this Section.

B. Substitution of anchor types:
   1. Post-installed anchors may not be used as an alternative to cast-in/built-in anchors at locations where the latter are indicated on the Drawings.
   2. Cast-in/built-in anchors may be used as an alternative to post-installed mechanical anchors at locations where the latter are indicated on the Drawings.

C. Protect products from damage during installation. Take special care to protect threads and threaded ends.

D. Accurately locate and position anchors and fasteners:
   1. Unless otherwise indicated on the Drawings, install anchors perpendicular to the surfaces from which they project.
   2. Install anchors so that at least 2 threads, but not more than 1/2 inch of threaded rod, projects past the top nut.

E. Interface with other products:
   1. Where steel anchors come in contact with dissimilar metals (aluminum, stainless steel, etc.), use stainless steel anchors and separate or isolate dissimilar metals using isolating sleeves and washers.
   2. Prior to installing nuts, coat threads of stainless steel fasteners with thread coating to prevent galling of threads.

3.03 INSTALLATION: CAST-IN ANCHORS

A. General:
   1. Accurately locate cast-in and built-in anchors.
      a. Provide anchor setting templates to locate anchor bolts and anchor rods. Secure templates to formwork.
      b. Brace or tie off embedments as necessary to prevent displacement during placement of plastic concrete or of surrounding masonry construction.
      c. Position and tie cast-in and built-in anchors in place before beginning placement of concrete or grout. Do not “stab” anchors into plastic concrete, mortar, or grout.
      d. Do not allow cast-in anchors to touch reinforcing steel. Where cast-in anchors are within 1/4 inch of reinforcing steel, isolate the metals by wrapping the anchors with a minimum of 4 wraps of 10-mil polyvinyl chloride tape in area adjacent to reinforcing steel.

2. For anchoring at machinery bases subject to vibration, use 2 nuts, with 1 serving as a locknut.
3. Where anchor bolts or anchor rods are indicated on the Drawings as being for future use, thoroughly coat exposed surfaces that project from concrete or masonry with non-oxidizing wax. Turn nuts down full length of the threads, and neatly wrap the exposed thread and nut with a minimum of 4 wraps of 10-mil waterproof polyvinyl tape.

B. Anchor bolts:
1. Minimum effective embedment: 10-bolt diameters, unless a longer embedment is indicated on the Drawings.
2. Where indicated on the Drawings, set anchor bolts in plastic, galvanized steel or stainless steel sleeves to allow for adjustment. Seal top of sleeve to prevent grout from filling sleeve.

C. Anchor rods:
1. Install as specified for anchor bolts.

D. Concrete inserts:
1. Provide inserts with minimum clear concrete cover not less than that specified for reinforcing bars.

3.04 INSTALLATION: POST-INSTALLED ADHESIVE ANCHORS

A. Epoxy and acrylic adhesive bonding of reinforcing bars, all thread rods, and internally threaded inserts in concrete: As specified in Section 03_21_17 - Adhesive-Bonded Reinforcing Bars and All Thread Rods in Concrete.

3.05 INSTALLATION: POST-INSTALLED MECHANICAL ANCHORS

A. General:
1. Install anchors in accordance with the manufacturer's instructions, ACI 355.2, the anchor's ICC-ES Report. Where conflict exists between the ICC-ES Report and the requirements in this Section, the requirements of the ICC-ES Report shall control.
2. Where anchor manufacturer recommends the use of special tools and/or specific drill bits for installation, provide and use such tools.
3. After anchors have been positioned and inserted into concrete or masonry, do not:
   a. Remove and reuse/reinstall anchors.
   b. Loosen or remove bolts or studs.

B. Holes drilled into concrete and masonry:
1. Do not drill holes in concrete or masonry until the material has achieved its minimum specified compression strength (f'c or f'm).
2. Accurately locate holes:
   a. Before drilling holes, use a reinforcing bar locator to identify the position of all reinforcing steel, conduit, and other embedded items within a 6-inch radius of each proposed hole.

b. If the hole depth exceeds the range of detection for the rebar locator, the Engineer may require radiographs of the area designated for investigation before drilling commences.

3. Exercise care to avoid damaging existing reinforcement and other items embedded in concrete and masonry.
   a. If embedments are encountered during drilling, immediately stop work and notify the Engineer. Await Engineer's instructions before proceeding.
4. Unless otherwise indicated on the Drawings, drill holes perpendicular to the concrete surface into which they are placed.
5. Drill using anchor manufacturer's recommended equipment and procedures:
   a. Unless otherwise recommended by the manufacturer, drill in accordance with the following:
      1) Drilling equipment: Electric or pneumatic rotary type with light or medium impact. Where edge distances are less than 2 inches, use lighter impact equipment to prevent micro-cracking and concrete spalling during drilling process.
      2) Drill bits: Carbide-tipped in accordance with ANSI B212-15. Hollow drills with flushing air systems are preferred.
6. Drill holes at manufacturer's recommended diameter and to depth required to provide the effective embedment indicated.
7. Clean and prepare holes as recommended by the manufacturer and as required by the ICC-ES Report for that anchor.
   a. Unless otherwise recommended by anchor manufacturer, remove dust and debris using brushes and clean compressed air.
   b. Repeat cleaning process as required by the manufacturer's installation instructions.
   c. When cleaning holes for stainless steel anchors, use only stainless steel or non-metallic brushes.

C. Insert and tighten (or torque) anchors in full compliance with the manufacturer's installation instructions.
   1. Once anchor is tightened (torque), do not attempt to loosen or remove its bolt or stud.

D. Concrete anchors: Minimum effective embedment lengths unless otherwise indicated on the Drawings:

Concrete Anchors			
Nominal Diameter	**Minimum Effective Embedment Length**		**Minimum Member Thickness**
	In Concrete	**In Grouted Masonry**	
3/8 inch	2 1/2 inch	2 5/8 inch	8 inch
1/2 inch	3 1/2 inch	3 1/2 inch	8 inch
5/8 inch	4 1/2 inch	4 1/2 inch	10 inch
3/4 inch	5 inch	5 1/4 inch	12 inch

E. Screw anchors:
   1. Minimum effective embedment lengths unless otherwise indicated on the Drawings:

Screw Anchors			
Nominal Diameter	Minimum Effective Embedment Length		Minimum Member Thickness
	In Concrete	In Grouted Masonry	
3/8 inch	2 1/2 inch	3 1/4 inch	8 inch
1/2 inch	3 1/4 inch	4 1/2 inch	8 inch
5/8 inch	4 inch	5 inch	10 inch
3/4 inch	5 1/2 inch	6 1/4 inch	12 inch

1. Install screw anchors using equipment and methods recommended by the manufacturer. Continue driving into hole until the washer head is flush against the item being fastened.

3.06 FIELD QUALITY CONTROL

A. Contractor shall provide quality control over the Work of this Section as specified in Section 01_45_00 - Quality Control.
   1. Expenses associated with work described by the following paragraphs shall be paid by the Contractor.

B. Post-installed anchors:
   1. Review anchor manufacturer's installation instructions and requirements of the Evaluation Service Report (hereafter referred to as "installation documents") for each anchor type and material.
   2. Observe hole-drilling and cleaning operations for conformance with the installation documents.
   3. Certify in writing to the Engineer that the depth and location of anchor holes, and the torque applied for setting the anchors conforms to the requirements of the installation documents.

3.07 FIELD QUALITY ASSURANCE

A. County's Representative will provide on-site observation and field quality assurance for the Work of this Section.
   1. Expenses associated with work described by the following paragraphs shall be paid by the County.

B. Field inspections and special inspections:
   1. Required inspections: Observe construction for conformance to the approved Contract Documents, the accepted submittals, and manufacturer's installation instructions for the products used.
   2. Record of inspections:
      a. Maintain record of each inspection.
      b. Submit copies to Engineer upon request.
   3. Statement of special inspections: At the end of the project, prepare and submit to the Engineer and the authority having jurisdiction inspector's statement that the Work was constructed in general conformance with the approved Contract Documents, and that deficiencies observed during construction were resolved.

C. Special inspections: Anchors cast into concrete and built into masonry.
    1. Provide special inspection during positioning of anchors and placement of concrete or masonry (including mortar and grout) around the following anchors:
        a. Anchor bolts.
        b. Anchor rods.
        c. Concrete inserts (all types).
    2. During placement, provide continuous special inspection at each anchor location to verify that the following elements of the installation conform to the requirements of the Contract Documents.
        a. Anchor:
            1) Type and dimensions.
            2) Material: Galvanized steel, Type 304 stainless steel, or Type 316 stainless steel as specified in this Section or indicated on the Drawings.
            3) Positioning: Spacing, edge distances, effective embedment, and projection beyond the surface of the construction.
            4) Reinforcement at anchor: Presence, positioning, and size of additional reinforcement at anchors indicated on the Drawings.
    3. Following hardening and curing of the concrete or masonry surrounding the anchors, provide periodic special inspection to observe and confirm the following:
        a. Base material (concrete or grouted masonry):
            1) Solid and dense concrete or grouted masonry material within required distances surrounding anchor.
            2) Material encapsulating embedment is dense and well-consolidated.

D. Special Inspections: Post-installed mechanical anchors placed in hardened concrete and in grouted masonry.
    1. Provide special inspection during installation of the following anchors:
        a. Screw anchors.
    2. Unless otherwise noted, provide periodic special inspection during positioning, drilling, placing, and torquing of anchors.
        a. Provide continuous special inspection for post-installed anchors in “overhead installations” as defined in this Section.
    3. Requirements for periodic special inspection:
        a. Verify items listed in the following paragraphs for conformance to the requirements of the Contract Documents and the Evaluation Report for the anchor being used. Observe the initial installation of each type and size of anchor, and subsequent installation of the same anchor at intervals of not more than 4 hours.
            1) Any change in the anchors used, in the personnel performing the installation, or in procedures used to install a given type of anchor shall require a new “initial inspection.”
        b. Substrate: Concrete or masonry surfaces receiving the anchor are sound and of a condition that will develop the anchor’s rated strength.
        c. Anchor:
            1) Manufacturer, type, and dimensions (diameter and length).
            2) Material (galvanized, Type 304 stainless steel, or Type 316 stainless steel).

d. Hole:
    1) Positioning: Spacing and edge distances.
    2) Drill bit type and diameter.
    3) Diameter, and depth.
    4) Hole cleaned in accordance with manufacturer's required procedures. Confirm multiple repetitions of cleaning when recommended by the manufacturer.
    5) Anchor's minimum effective embedment.
    6) Anchor tightening/installation torque.

4. Requirements for continuous special inspection:
    a. The special inspector shall observe all aspects of anchor installation, except that holes may be drilled in his/her absence provided that he/she confirms the use of acceptable drill bits before drilling, and later confirms the diameter, depth, and cleaning of drilled holes.

E. Field tests:
1. County's Representative may, at any time, request testing to confirm that materials being delivered and installed conform to the requirements of the Specifications.
    a. If such additional testing shows that the materials do not conform to the specified requirements, the Contractor shall pay the costs of these tests.
    b. If such additional testing shows that the materials do conform to the specified requirements, the County shall pay the costs of these tests.

3.08 NON-CONFORMING WORK

A. Remove misaligned or non-performing anchors.

B. Fill empty anchor holes and repair failed anchor locations as specified in Section 03_60_00 - Grouting using high-strength, non-shrink, non-metallic grout.

C. If more than 10 percent of all tested anchors of a given diameter and type fail to achieve their specified torque or proof load, the Engineer will provide directions for required modifications. Make such modifications, up to and including replacement of all anchors, at no additional cost to the County.

3.09 SCHEDULES

A. Provide and install anchor materials as scheduled in the following Table.

Table - Required Anchoring Materials by Location

Location/Exposure		Materials	Notes
1.	**Anchors into concrete and grouted masonry for attachment of carbon steel, including structural steel and other steel fabrications:**		
a)	Interior dry areas	Carbon steel - galvanized	
b)	Locations with galvanized steel structures or fabrications	Stainless steel - Type 304 or 316	1

Table - Required Anchoring Materials by Location			
Location/Exposure		**Materials**	**Notes**
c)	Exterior and interior wet and moist locations	Stainless steel - Type 316	1
d)	Corrosive locations	Stainless steel - Type 316	1
2.	**Anchors into concrete and grouted masonry for attachment of aluminum, stainless steel, or fiber-reinforced plastic (FRP) shapes and fabrications:**		
a)	Interior dry areas	Stainless steel - Type 304 or 316	1
b)	Exterior and interior wet and moist locations	Stainless steel - Type 316	1
c)	Corrosive locations	Stainless steel - Type 316	1
3.	**Anchors for attaching equipment and its appurtenances:**		
a)	All locations	Stainless steel - Type 316 (unless Type 304 is specifically indicated in the specifications for the equipment.)	1
Notes: (1) Where anchors are in contact with a metal that differs from that of the anchor, provide isolation sleeves and washers.			

END OF SECTION

SECTION 40_05_00.01

COMMON WORK RESULTS FOR GENERAL PIPING

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Basic materials and methods for metallic and plastic piping systems.

1.02 REFERENCES

A. American Society of Mechanical Engineers (ASME):
   1. B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 Through 24.
   2. B16.47 - Large Diameter Steel Flanges: NPS 26 Through NPS 60 Metric/Inch Standard.

B. American Water Work Association (AWWA):
   1. C11 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe.
   2. C151 - Ductile-Iron Pipe, Centrifugally Cast.
   3. C207 - Standard for Steel Pipe Flanges for Waterworks Services-Size 4 In. Through 144 In.

C. ASTM International (ASTM):
   1. A74 - Standard Specification for Cast Iron Soil Pipe and Fittings.
   2. A193 - Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications.
   3. A194 - Standard Specification for Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.
   4. A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 PSI Tensile Strength.
   5. A320 - Standard Specification for Alloy-Steel and Stainless Steel Bolting for Low-Temperature Service.
   6. A563 - Standard Specification for Carbon and Alloy Steel Nuts.
   7. B88 - Standard Specification for Seamless Copper Water Tube.
   8. D2000 - Standard Classification System for Rubber Products in Automotive Applications.
   9. D2513 - Standard Specification for Polyethylene (PE) Gas Pressure Pipe, Tubing and Fittings.
   10. F2329 - Standard Specification for Zinc Coating, Hot-Dip, Requirements of Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners.

D. California Health and Safety Code.

E. NSF International (NSF):
   1. 61 - Drinking Water System Components - Health. Effects.

1.03 DEFINITIONS

A. Buried Pipes: Pipes that are buried in the soil with or without a concrete pipe encasement.

B. Exposed Pipe: Pipes that are located above ground, or located inside a structure, supported by a structure, or cast into a concrete structure.

C. Pipes Adjacent to a Wet Wall: Pipe centerline within 10 inches of the wet wall.

D. Underground Pipes: Buried pipes - see A. above.

E. Underwater Pipes: Pipes below the top of walls in basins or tanks containing water.

F. Wet Wall: A wall with water on at least 1 side.

PART 2 PRODUCTS

2.01 GENERAL

A. Materials as specified in Section 01_60_00 - Product Requirements including special requirements for materials in contact with drinking water.

B. Coatings and linings requirements stated in the Pipe Schedule as modified in the individual pipe Technical Sections and Section 09_96_01 - High-Performance Coatings.

2.02 FLANGE BOLTS AND NUTS

A. General:
   1. Washer:
      a. Provide a washer for each nut and bolt.
      b. Washer shall be of the same material as the nut.
   2. Nuts: Heavy hex-head.
   3. Cut and finish flange bolts to project:
      a. Face of the bolt shall exceed face of nut by 1/16 inch minimum.
      b. A maximum of 1/4 inch beyond outside face of nut after assembly.
   4. Tap holes for cap screws or stud bolts when used.
   5. Lubricant for stainless steel bolts and nuts:
      a. Chloride-free.
      b. Manufacturers: One of the following or equal:
         1) Huskey FG-1800 Anti-Seize.
         2) Weicon Anti-Seize High-Tech.

B. Ductile iron pipe:
   1. On pipes and pipes adjacent to wet walls:
      a. Bolts: In accordance with ASTM A193, Grade B8M.
      b. Nuts: In accordance with ASTM A194, Grade 8M.
   2. On buried pipes:
      a. Bolts: In accordance with ASTM A193, Grade B8M.

b. Nuts: In accordance with ASTM A194, Grade 8M for nuts.

C. Plastic pipe:
1. On pipes and pipes adjacent to wet walls:
a. Bolts: In accordance with ASTM A193, Grade B8M.
b. Nuts: In accordance with ASTM A194, Grade 8M.

D. Steel pipe:
1. On pipes and pipes adjacent to wet walls:
a. Bolts: In accordance with ASTM A193, Grade B8M.
b. Nuts: In accordance with ASTM A194, Grade 8M.

2.03 MECHANICAL JOINTS BOLTS AND NUTS

A. Bolts including T-Bolts:
1. Type 316 stainless steel in accordance with ASTM F593.

B. Heavy Hex Nuts:
1. Type 316 stainless steel in accordance with ASTM F594.

2.04 GASKETS

A. General.
1. Gaskets shall be suitable for the specific fluids, pressure, and temperature conditions.
2. Capable of being applied on surface of piping with cavities to provide for an improved seal with the internal piping pressure.

B. Gaskets for flanged joints in ductile iron and steel piping for sewage service:
1. Suitable for pressures equal and less than 150 pounds per square inch gauge, temperatures equal and less than 250 degrees Fahrenheit, and raw sewage service.
2. Gasket material:
a. EPDM material with 80 Shore A durometer rating.
b. Reinforcement: Cloth or synthetic fiber.
c. Thickness: Minimum 3/32-inch thick for less than 10-inch pipe; minimum 1/8 inch thick for 10-inch and larger pipe.
3. Manufacturers: One of the following or equal:
a. Pipe less than 48 inches in diameter:
1) Garlock, Style 7797.
2) John Crane, similar product.
b. Pipe 48 inches in diameter and larger:
1) Garlock, Style 3760.
2) John Crane, similar product.

C. Gaskets for flanged joints in polyvinyl chloride and polyethylene piping:
1. Suitable for pressures equal to and less than 150 pounds per square inch gauge, with low flange bolt loadings, temperatures equal to and less than 120 degrees Fahrenheit, and polymer, chlorine, caustic solutions, and other chemicals, except chemicals which liberate free fluorine including fluorochemicals and gaseous fluorine.

2. Material:
    a. Chemical systems: 0.125-inch thick Viton™ rubber.
    b. Sewer and water: 0.125-inch thick SBR.
3. Manufacturers: One of the following or equal:
    a. Garlock.
    b. John Crane, similar product.

D. Gaskets for flanged joints in ductile iron or steel drinking water piping meeting NSF 61 requirements:
1. Suitable for hot or cold water, pressures equal to or less than 150 pounds per square inch gauge, and temperatures equal to or less than 160 degrees Fahrenheit.
2. Material:
    a. EPDM material with 80 Shore A durometer rating.
3. Manufacturers: One of the following or equal:
    a. Garlock, 98206.
    b. John Crane, similar product.

PART 3 EXECUTION

3.01 INSTALLATION

A. General:
1. Piping drawings:
    a. Except in details, piping is indicated diagrammatically. Not every offset and fitting, or structural difficulty that may be encountered has been indicated on the Drawings. Sizes and locations are indicated on the Drawings.
    b. Perform minor modifications to piping alignment where necessary to avoid structural, mechanical, or other type of obstructions that cannot be removed or changed.
        1) Modifications are intended to be of minor scope, not involving a change to the design concept or a change to the Contract Price or Contract Times.
2. Piping alternatives:
    a. Provide piping as specified in this Section, unless indicated on the Drawings or specified otherwise.
    b. Alternative pipe ratings:
        1) Piping with greater pressure rating than specified may be substituted in lieu of specified piping without changes to the Contract Price.
        2) Piping of different material may not be substituted in lieu of specified piping.
    c. Valves in piping sections: Capable of withstanding specified test pressures for piping sections and fabricated with ends to fit piping.
    d. Grooved joints: Use couplings, flange adapters, and fittings of the same manufacturer.
        1) Manufacturer’s factory trained representative:
            a) Provide on-site training for Contractor’s field personnel.
            b) Periodically visit the jobsite to verify Contractor is following best recommended practices.

2) Distributor's representative is not considered qualified to conduct the training or jobsite visits.

e. Flanged joints: where 1 of the joining flanges is raised face type, provide a matching raised face type flange for the other joining flange.

3. Unless otherwise indicated on the Drawings, piping at pipe joints, fittings, couplings, and equipment shall be installed without rotation, angular deflection, vertical offset, or horizontal offset.

B. Exposed piping:

1. Install exposed piping in straight runs parallel to the axes of structures, unless otherwise indicated on the Drawings:
   a. Install piping runs plumb and level, unless otherwise indicated on the Drawings.
      1) Slope plumbing drain piping with a minimum of 1/4-inch per foot downward in the direction of flow.
2. Install exposed piping after installing equipment and after piping and fitting locations have been determined.
3. Support piping: As specified in Section 40_05_07.01 - Pipe Supports, Section 40_05_07.03 - Preformed Channel Pipe Support System, and Section 40_05_07.05 - Non-Metallic Pipe Support System:
   a. Do not transfer pipe loads and strain to equipment.
4. In addition to the joints indicated on the Drawings, provide unions, flexible couplings, flanged joints, flanged coupling adapters, and other types of joints or means which are compatible with and suitable for the piping system, and necessary to allow ready assembly and disassembly of the piping.
5. Assemble piping without distortion or stresses caused by misalignment:
   a. Match and properly orient flanges, unions, flexible couplings, and other connections.
   b. Do not subject piping to bending or other undue stresses when fitting piping.
   c. Do not correct defective orientation or alignment by distorting flanged joints or subjecting flange bolts to bending or other undue stresses.
   d. Flange bolts, union halves, flexible connectors, and other connection elements shall slip freely into place.
   e. Alter piping assembly to fit when proper fit is not obtained.
   f. Install eccentric reducers or increasers with the top horizontal for pump suction piping.

C. Buried piping:

1. Bury piping with minimum 3-foot cover without air traps, unless otherwise indicated on the Drawings.
2. Where 2 similar services run parallel to each other, piping for such services may be laid in the same trench.
   a. Lay piping with sufficient room for assembly and disassembly of joints, for thrust blocks, for other structures, and to meet separation requirements of public health authorities having jurisdiction.
3. Laying piping:
   a. Lay piping in finished trenches free from water or debris. Begin at the lowest point with bell ends up slope.
   b. Place piping with top or bottom markings with markings in proper position.

c. Lay piping on an unyielding foundation with uniform bearing under the full length of barrels.
d. Where joints require external grouting, banding, or pointing, provide space under and immediately in front of the bell end of each section laid with sufficient shape and size for grouting, banding, or pointing of joints.
e. At the end of each day's construction, plug open ends of piping temporarily to prevent entrance of debris or animals.

D. Venting piping under pressure:
1. Lay piping under pressure flat or at a continuous slope without air traps, unless otherwise indicated on the Drawings.
2. Install plug valves as air bleeder cocks at high points in piping.
a. Provide 1-inch plug valves for water lines, and 2-inch plug valves for sewage and sludge lines, unless otherwise indicated on the Drawings.
3. Provide additional pipe taps with plug cocks and riser pipes along piping as required for venting during initial filling, disinfecting, and sampling.
4. Before piping is placed into service, close plug valves and install plugs. Protect plugs and plug valves from corrosion in as specified in Section 09_96_01 - High-Performance Coatings.

E. Restraining buried piping:
1. Restrain piping at valves and at fittings where piping changes direction, changes sizes, and at ends:
a. When piping is underground, use concrete thrust blocks, mechanical restraints, or push-on restraints.
b. Determine thrust forces by multiplying the nominal cross-sectional area of the piping by design test pressure of the piping.
2. Provide restraints with ample size to withstand thrust forces resulting from test pressures:
a. During testing, provide suitable temporary restraints where piping does not require permanent restraints.
3. Place concrete thrust blocks against undisturbed soil.
4. Place concrete so piping joints, fittings, and other appurtenances are accessible for assembly and disassembly.
5. Provide underground mechanical restraints where specified in Attachment A - Piping Schedule.

F. Restraining above ground piping:
1. Restrain piping at valves and at fittings where piping changes direction, changes sizes, and at ends:
a. When piping is aboveground or underwater, use mechanical or structural restraints.
b. Determine thrust forces by multiplying the nominal cross-sectional area of the piping by design test pressure of the piping.
2. Provide restraints with ample size to withstand thrust forces resulting from test pressures:
c. During testing, provide suitable temporary restraints where piping does not require permanent restraints.

G. Connections to existing piping:
    1. Expose existing piping to which connections are to be made with sufficient time to permit, where necessary, field adjustments in line, grade, or fittings:
        a. Protect domestic water/potable water supplies from contamination:
            1) Make connections between domestic water supply and other water systems in accordance with requirements of public health authorities.
            2) Provide devices approved by County of domestic water supply system to prevent flow from other sources into the domestic supply system.
    2. Make connections to existing piping and valves after sections of new piping to be connected have been tested and found satisfactory.
    3. Provide sleeves, flanges, nipples, couplings, adapters, and other fittings needed to install or attach new fittings to existing piping and to make connections to existing piping.
    4. For flanged connections, provide stainless steel bolts with isolation bushings and washers, and full-face flange gaskets.

H. Connections between ferrous and nonferrous metals:
    1. Connect ferrous and nonferrous metal piping, tubing, and fittings with dielectric couplings especially designed for the prevention of chemical reactions between dissimilar metals.
    2. Nonferrous metals include aluminum, copper, and copper alloys.

I. Flanged connections between dissimilar metals such as ductile iron pipe and steel pipe:
    1. Provide stainless steel bolts with isolation bushings and washers, and full-face flange gaskets.

3.02 CLEANING

A. Piping cleaning:
    1. Upon completion of installation, clean piping interior of foreign matter and debris.
    2. Perform special cleaning when required by the Contract Documents.

B. Cleaning chlorine piping:
    1. General:
        a. Coordinate with County and attend a pre-cleaning meeting with County before cleaning chlorine piping.
        b. Work with County during cleaning and conform to plant operational and shut down constraints.
        c. Clean chlorine piping in accordance with the requirements of the Chlorine Institute-Pamphlet 6 and meet the following requirements.
    2. Steel Piping:
        a. Dry chlorine gas or liquid chlorine piping:
            1) Do not put water into any of the chlorine gas or liquid piping.
            2) Blow chlorine piping clean of loose debris with compressed air at 4,000 fpm.
            3) Clean chlorine piping by pulling clean cloths saturated with an approved solvent through piping:
                a) Do not use hydrocarbons or alcohols that may react with chlorine.

b) Use solvents in accordance with manufacturer's safety recommendations to avoid serious physiological effects.
c) Remove all dirt and debris of any nature from the chlorine lines.

4) Disassemble and clean valves and equipment that have oil residues before installation.
5) Dry piping immediately before effecting final connections for service.
   a) Keep piping sealed to prevent moisture from entering chlorine piping.
   b) Supply compressors, air dryers, and dew point testing equipment necessary to dry and test for dryness the new chlorination system piping.
6) Drying procedure:
   a) Pass dry commercial grade nitrogen gas that has a dew point of minus 40 degrees Fahrenheit or less through the piping until exhausted air at three Engineer-approved locations has a dew point of minus 40 degrees Fahrenheit.
   b) Confirm dew point with a hygrometer.
   c) Re-dry the chlorine piping system in the event subsequent work opens any part of the system to the atmosphere.

C. Conduct pressure and leak test, as specified.

3.03 PIPE SCHEDULE

A. As specified in Attachment A - Pipe Schedule.

END OF SECTION

ATTACHMENT A - PIPE SCHEDULE

Service	Nominal Diameter (inches)	Material	Pressure Class Special Thickness Class Schedule Wall Thickness	Pipe Spec. Section	Joints/ Fittings	Test Pressure/ Method	Lining	Coating	Service Conditions	Comments
Lime Softened Water Overflow	4-36	DIP	150	40_05_19.01 - Ductile Iron Pipe: AWWA C151	As indicated on the Drawings	15 feet/GR	CM	EPP		

GA Gauge, preceded by the designation GEGrooved end joint
GL Glass lined
GSP Galvanized steel pipe
MJ Mechanical joint
MWA Mechanical wedge action
NPS Nominal pipe size, followed by the number in inches
psi pounds per square inch
psig pounds per square inch gauge
PE Polyethylene
PEE Polyethylene encasement
PTW Polyethylene tape wrap
PVC Polyvinyl Chloride
RPO Restrained push-on
SCH Schedule, followed by the designation
SCRD Screwed-On
SST Stainless steel
SW Solvent welded
VCP Vitrified clay piping
WLD Weld

SECTION 40_05_19.01

DUCTILE IRON PIPE: AWWA C151

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Ductile iron pipe, joints, connections, fittings, and pipe linings and coatings.

B. As specified in Section 40_05_00.01 - Common Work Results for General Piping.

1.02 REFERENCES

A. American Society of Mechanical Engineers (ASME):
   1. B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.

B. American Water Works Association (AWWA):
   1. C104 – Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings.
   2. C105 - Polyethylene Encasement for Ductile-Iron Pipe Systems.
   3. C110 - Standard for Ductile-Iron and Gray-Iron Fittings.
   4. C111 - Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
   5. C150 - Standard for Thickness Design of Ductile-Iron Pipe.
   6. C151 - Standard for Ductile-Iron Pipe, Centrifugally Cast.
   7. C153 - Standard for Ductile-Iron Compact Fittings for Water Service.
   8. C210 - Liquid-Epoxy Coatings and Linings for Steel Water Pipe and Fittings.
   9. C222 - Polyurethane Coatings and Linings for Steel Water Pipe and Fittings.
   10. C600 - Installation of Ductile Iron Water Mains and Their Appurtenances.
   11. C606 - Standard for Grooved and Shouldered Joints.

C. American Welding Society (AWS):
   1. D11.2 - Guide for Welding Iron Castings.

D. ASTM International (ASTM):
   1. A536 - Standard Specifications for Ductile Iron Castings.
   2. B1000 - Standard Practices for Casting Preparation and Test Procedure of Porcelain Enamel-Lined Pipe, Fittings, and Valves for Use in the Municipal Wastewater, Sewage, and Water Treatment Industry.
   3. C33 - Standard Specification for Concrete Aggregates.
   4. C150 - Standard Specification for Portland Cement.
   5. C283 - Standard Test Methods for Resistance of Porcelain Enameled Utensils to Boiling Acid.
   6. D792 - Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement.
   7. D4541 - Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers.

E. Ductile Iron Pipe Research Association (DIPRA):
   1. Thrust Restraint Design Manual.

F. International Organization for Standardization (ISO):
   1. 8179 - Ductile iron pipe, fittings, accessories and their joints - External zinc-based coating –Part 1: Metallic zinc with finishing layer.

G. National Association of Pipe Fabricators, Inc. (NAPF):
   1. 500-03 - Surface Preparation Standard for Ductile Iron Pipe and Fittings in Exposed Locations Receiving Special External Coatings and/or Special Internal Linings.

H. NSF International (NSF):
   1. 61 – Drinking Water System Components - Health Effects.

I. Society for Protective Coatings (SSPC):
   1. SP 5 - White Metal Blast Cleaning.
   2. PA-2 - Measurement of Dry Coating Thickness With Magnetic Gages.

1.03 SUBMITTALS

A. Submit as specified in Section 01_33_00 - Submittal Procedures.

B. Product data.

C. Manufacturer's qualifications.
   1. Manufacturer qualifications and list of projects using the specified material: 5 years minimum.

D. Manufacturer's Quality Assurance Manual:
   1. Submit manufacturer's coating and lining application quality assurance manual to Engineer prior to beginning coating application.
      a. Strict conformance to the requirements of the manual will be required.
      b. Deviation from the requirements of the manual will be grounds for the Engineer to reject the applied coating.

E. Shop drawings:
   1. Detailed layout drawings showing alignment of pipes, location of valves, fittings, and appurtenances, types of joints, and connections to pipelines or structures.
   2. Thrust restraint systems.
   3. Photographs, drawings, and descriptions of fittings, gaskets, couplings, grooving of pipe and fittings.

F. Calculations:
   1. Calculations for thrust restraint system design.

G. Manufacturer's Certificate of Source Testing for ceramic epoxy, glass lined, plural component polyurethane, and zinc materials:
   1. Certify successful performance of holiday detection tests on 100 percent of lining in accordance with ASTM B1000.

2. Identify each test piece by mark designation and show the actual test results during the final inspection by manufacturer prior to shipment.
3. Zinc coating: Regular measurements in accordance with ISO 8179 Part 4.4.
4. Include Coating Manufacturer's Technical Representative's reports.

1.04 QUALITY ASSURANCE

A. Ductile iron pipe shall be supplied by a single manufacturer.

B. Hydrostatically test each joint of ductile iron pipe in accordance with AWWA C151.

C. Pre-installation meeting:
1. Arrange for Coating Manufacturer's Technical Representative to attend preconstruction conferences, and to make periodic visits to factory or shop to inspect surface preparation of pipe, fittings, and accessories; and to inspect application of linings to interior and coatings to exterior of pipe, fittings, and accessories.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Block piping and associated fittings for shipment to prevent damage to coatings and linings.

B. Carefully handle piping and associated fittings during loading, unloading, and installation:
1. Do not drop piping material from cars or trucks.
2. Lower piping by mechanical means.
3. Do not drop or pound pipe to fit grade.

C. Handle pipe from the outside if lined with ceramic epoxy, glass or plural component polyurethane.
1. No forks, chains, straps, hooks, or other lifting device shall be placed inside the pipe or fittings for lifting, positioning, or laying.

D. Protect gaskets and polyethylene encasement from long-term exposure to sunlight.

E. Store piping, fittings, and other accessories such that they do not accumulate and hold rainwater, dirt, and debris.

PART 2 PRODUCTS

2.01 MANUFACTURED UNITS

A. Ductile iron piping:
1. Manufacturers: One of the following or equal:
a. American Cast Iron Pipe Co.
b. McWane Ductile.
c. SIP Industries.
d. U.S. Pipe.

2.02 THRUST RESTRAINT SYSTEM DESIGN

A. The length of pipe that must be restrained on each side of the focus of a thrust load as indicated on the Drawings

B. Design pressure: Test pressure

C. Laying condition: Type 3 in accordance with AWWA C150.

D. Soil type: Silt 1.

E. Unit friction resistance for polyethylene encasement of pipe: DIPRA factor multiplied by a safety factor of 1.5.

2.03 CONCRETE THRUST BLOCK RESTRAINT

A. Joint thrust restraint system designed by Contractor.
   1. Concrete thrust blocks will not be permitted for DIP restraint**.**

2.04 DUCTILE IRON JOINTS AND CONNECTIONS

A. General:
   1. Pressure class or special thickness class as indicated in the Piping Schedule provided in Section 40_05_00.01 - Common Work Results for General Piping.
   2. In accordance with AWWA C150 and AWWA C151.
   3. Joints:
      a. Flanged.
      b. Grooved.
      c. Mechanical.
      d. Push-on Rubber Gasket.
      e. Integrally Restrained Mechanical.
      f. Mechanical Wedge Action.
      g. Integrally Restrained Push-On.
      h. Push-On Joint Restraint Harness.
   4. Connections:
      a. Tapping saddle.
      b. Tapping sleeve.
      c. Welded outlet.
   5. Fittings.

B. Joints:
   1. Flanged joints:
      a. Screw-on flanges:
         1) Comply with the diameter, thickness, drilling, and other characteristics in accordance with ASME B16.1.
         2) Ductile iron.
         3) Long hub, threaded, and specially designed for ductile iron pipe.
         4) After attaching to pipe, machine flange face to make pipe end and flange even and perpendicular to the axis of the pipe.
      b. Bolt holes on flanges: 2-holed and aligned at both ends of pipe.
      c. Cap screw or stud bolt holes: Tapped.

d. Bolts and nuts:
    1) As specified in Section 40_05_00.01 - Common Work Results for General Piping.
e. Gaskets:
    1) Standard styrene butadiene copolymer (SBR) unless specified otherwise in Section 40_05_00.01 - Common Work Results for General Piping.

2. Grooved joints:
    a. In accordance with AWWA C606, as complemented and modified below, radius-cut type.
    b. Couplings:
        1) Rigid type, cast from ductile iron in accordance with ASTM A536, Grade 65-45-12.
    c. Bolts and nuts:
        1) As specified in Section 40_05_00.01 - Common Work Results for General Piping.
    d. Gaskets:
        1) As specified in Section 40_05_00.01 - Common Work Results for General Piping.
    e. Fittings:
        1) In accordance with AWWA C606, rigid radius-cut groove:
        2) Center-to-center dimensions: In accordance with AWWA C110.
        3) Wall thickness and other characteristics: In accordance with AWWA C606.
    f. Flanged unit connections:
        1) Flanged to grooved joint adapters or a long enough spool with one end flanged and the other end grooved to prevent interference with the operation of adjacent valves, pumps, or other items.
3. Mechanical joints:
    a. In accordance with AWWA C111.
    b. Gaskets:
        1) As specified in Section 40_05_00.01 - Common Work Results for General Piping.
    c. Bolts and nuts, including T-bolts:
        1) As specified in Section 40_05_00.01 - Common Work Results for General Piping.
4. Push-on rubber gasket joints:
    a. In accordance with AWWA C111.
    b. Gaskets:
        1) As specified in Section 40_05_00.01 - Common Work Results for General Piping.
5. Mechanical wedge action joint restraints:
    a. Manufacturers: One of the following or equal:
        1) EBAA Iron, Inc., Megalug® Series 1100.
        2) Star Pipe Products, Split Stargrip Series 3000.
        3) Sigma Corp., One-Lok Model SLDE.
    b. Materials:
        1) Gland body:
            a) Ductile iron in accordance with ASTM A536.
        2) Wedges and wedge actuating components:
            a) Ductile iron in accordance with ASTM A536.

b) Wedges shall be heat treated to a minimum of 370 BHN.
3) Actuating bolts and nuts:
a) Ductile iron in accordance with ASTM A536.
b) Provide torque-limiting twist off components to ensure proper installation.
4) Gaskets:
a) As specified in Section 40_05_00.01 - Common Work Results for General Piping.
c. Coatings:
1) Provide manufacturer applied coating system.
2) Manufacturers: One of the following or equal:
a) EBAA Iron Inc., Mega-Bond.
b) Star Pipe Products, Star-Bond.
c) Sigma Corp., Corrsafe™ Electro-deposition coating.
d. Working pressure:
1) Shall include a minimum safety factor of 2:1.
2) For sizes 3- through 16-inch: 350 pounds per square inch.
3) For sizes 18- through 48-inch: 250 pounds per square inch.
e. Restraint shall consist of multiple gripping wedges incorporated into a follower gland meeting the requirements of AWWA C111.
f. Restraint shall allow post assembly angular deflection that is a minimum of 50 percent of the angular deflection allowed by the mechanical joint.
g. Restraint must be in accordance with applicable requirements of AWWA C110 and AWWA C111 for mechanical joints.

C. Connections:
1. Tapping saddle as specified in County standard specification.
a. If County does not have a standard specification, provide tapping saddles as specified in Section 40_05_06.01 - Piping Specialties.
2. Tapping sleeve as specified in County standard specification.
a. If County does not have a standard specification, provide tapping sleeves as specified in Section 40_05_06.01 - Piping Specialties.
3. Welded outlet:
a. Not allowed without Engineer approval.

D. Fittings:
1. Ductile iron in accordance with AWWA C110 or AWWA C153.
2. Joint type:
a. Same as that of the associated piping as specified in Section 40_05_00.01 - Common Work Results for General Piping.
3. Plain end-to-flanged joint connectors using setscrews are not acceptable.

2.05 CEMENT MORTAR

A. Line pipe with cement mortar in accordance with AWWA C104 and as specified in this Section.

B. Cement:
1. Cement: In accordance with ASTM C150, Type II.

C. Water:
   1. In accordance with AWWA C104 and as specified in this Section.

D. Sand and aggregate:
   1. In accordance with AWWA C104.
   2. Provide silica sand or other aggregate that is not subject to leaching in accordance with ASTM C33.

E. Lining:
   1. Minimum lining thickness: Standard in accordance with AWWA C104.
   2. Apply cement mortar on clean bare metal surfaces.
   3. Extend to faces of flanges, ends of spigots, and shoulders of hubs.
   4. Line special pieces or fittings by mechanical, pneumatic, or hand placement.
      a. Extend to faces of flanges and ends of spigots.
      b. Less than 12 inches in width: Coat with epoxy bonding agent prior to applying cement mortar.
      c. Larger than 12 inches in width: Reinforced with 2-inch by 4-inch No. 13 gauge welded steel wire mesh prior to applying cement mortar.
   5. Provide plastic end caps of sufficient thickness and strength to resist shipping, handling, and storage stresses.
   6. Repair damage to the cement mortar lining, including disbondment, or cracking caused by improper curing, shipping, handling, or installation in accordance with AWWA C104 and approved by the Engineer.
      a. Reinforce coating with 2 layers spirally-wound steel wire positioned approximately in center of mortar coating positioned approximately at the third points of mortar coating:
         1) No. 12 gage spaced at maximum 1-inch centers.
         2) No. 14 gage steel wire at maximum 1/2-inch centers.

2.06 POLYETHYLENE ENCASEMENT

A. General:
   1. Polyethylene encasement shall be supplied by the pipe manufacturer.

B. Materials: Supply one of the following polyethylene encasements:
   1. 2 layers of linear low-density polyethylene (LLDPE) film, minimum thickness of 8 mils in accordance with AWWA C105; or,
   2. Single layer of high-density, cross-laminated polyethylene (HDCLPE) film, minimum thickness of 4 mils in accordance with AWWA C105.
   3. Single layer of V-Bio® enhanced polyethylene encasement (3 layers of coextruded LLDPE film with anti-microbial additive and volatile corrosion inhibitor infused on the inside surface), meeting all requirements of AWWA C105.

PART 3 EXECUTION

3.01 INSTALLATION

A. General:
   1. Install ductile iron piping in accordance with AWWA C600, or as modified in Section 40_05_00.01 - Common Work Results for General Piping.

2. For underground piping, the trenching, backfill, and compaction:
    a. Inspect coating prior to backfill.
    b. As specified in Section 31_23_35 - Trenching.

B. Joints:
1. Install types of joints as specified in the piping schedule provided in Section 40_05_00.01 - Common Work Results for General Piping.
2. Mechanical joints are not acceptable in above ground applications.
3. Field closure for restrained push-on pipe:
    a. Locate field closures in areas where thrust calculations demonstrate restraint is not required.
4. Grooved joints:
    a. Install piping with grooved joints where specified in the piping schedule as specified in Section 40_05_00.01 - Common Work Results for General Piping.
    b. Assemble grooved joints in accordance with manufacturer's published instructions.
    c. Support grooved-end pipe in accordance with manufacturer's published instructions.
        1) Install at least 1 support between consecutive couplings.

C. Connection:
1. Tapping ductile iron pipe:
    a. Direct tapping of ductile iron pipe may be performed but is limited to the following conditions:
        1) Maximum allowable tap diameter by pipe diameter and pressure class:

Pipe Size (inches)	**Pressure Class**				
	150	**200**	**250**	**300**	**350**
	Maximum Allowable Direct Tap Size (inches)				
3	-	-	-	-	3/4
4	-	-	-	-	3/4
6	-	-	-	-	1
8	-	-	-	-	1
10	-	-	-	-	1
12	-	-	-	-	1-1/4
14	-	-	1-1/4	1-1/2	1-1/2
16	-	-	1-1/2	2	2
18	-	-	2	2	2
20	-	-	2	2	2
24	-	2	2	2	2

    b. The maximum allowable tap diameter for pipelines greater than 24 inches is 2 inches.

c. 2 layers of 3-mil thread sealant are required to minimize the torque required to effect a watertight connection.

2. Direct tapping of glass lined ductile iron pipe may be performed only when approved in writing by the Engineer. Direct tapping of glass lined pipe shall be performed in accordance with the above conditions for tapping ductile iron pipe in addition to the following conditions:
   a. Drilling and tapping shall be performed using a hole saw.
      1) Use of a large drill bit is not acceptable.
   b. As the hole saw approaches the glass lining, lessen the inward pressure to avoid excess chipping or cracking of the lining.
   c. Minor chipping or spalling of the glass lining shall be repaired using an epoxy resin “glass repair kit” provided by the fabricator.
      1) Manufacturers: One of the following or equal:
         a) Devoe - Devran 224 HS.
         b) Sherwin-Williams Co. - Sher-Tile High Solids Epoxy.
      2) Repair kit use is only allowed for areas of damage less than 1/2 inch in diameter.
         a) Larger areas of damage will require replacement.
      3) Surface shall be prepared and repair kit shall be applied in accordance with manufacturer and/or fabricator’s instructions.

3.02 DEFECTS IN COATINGS EXCEPT TAPE WRAP AND CEMENT MORTAR COATING

A. Engineer will identify defective coating to be field repaired in accordance with the applicable AWWA standard.
   1. Pipe joints exceeding the following defect maximum will be rejected.
      a. Minor defects:
         1) No more than 1.5 per 100 square feet of surface area.
         2) 2 or more minor repairs within an 8-inches diameter circle will be considered a single repair.
         3) Repairs for adhesion testing will not be included in the total number of repairs.
         4) Repair in accordance with manufacturer's requirements.
      b. Major defects:
         1) No more than 3 major repairs on each pipe joint.
         2) No more than 30 percent repairs on the pipe surface area with defects.
   2. Minor repairs:
      a. Repairs less than 8-inches in the greatest dimension.
      b. Repair in accordance with manufacturer's requirements.
   3. Major repairs:
      a. Repairs that exceed 8-inches in the greatest dimension.
      b. Repair in accordance with manufacturer's requirements.

3.03 PLURAL COMPONENT POLYURETHANE

A. Joints:
   1. Field applied coating or lining shall be of the same density, smoothness, and thickness as shop applied coating or lining.

2. Comply with same application requirements as shop applied coating or lining.
    a. Provide heating and/or dehumidification equipment as required to meet the environmental conditions necessary for proper coating application.

3.04 POLYETHYLENE ENCASEMENT

A. Wrap buried ductile iron pipe and fittings in 2 layers of loose low-density polyethylene wrap or a single layer of high-density polyethylene wrap in accordance with AWWA C105 and as specified in this Section.

B. Wrap polyethylene encasement to be continuous and terminated neatly at connections to below grade equipment or structures.

C. At wall penetrations, extend encasement to the wall and neatly terminate.

D. At slab penetrations, extend encasement to 2 inches below the top of slab and neatly terminate.

E. When rising vertically in unimproved areas, extend encasement on pipe 6 inches above existing grade and neatly terminate.

F. Repair tears and make joints with 2 layers of plastic tape.

G. Work shall be inspected prior to backfilling of pipe and associated items.

3.05 FIELD QUALITY CONTROL

A. Testing ductile iron piping:
    1. Test as specified in Section 40_05_00.01 - Common Work Results for General Piping and Section 40_05_00.09 - Piping Systems Testing.

B. Repair damaged cement mortar lining to match quality, thickness, and bonding of original lining in accordance with AWWA C104.
    1. When lining cannot be repaired or repairs are defective, replace defective piping with undamaged piping.

C. Verify that interior surfaces of ceramic epoxy and glass lined pipe and fittings have continuous coverage:
    1. Test random samples, as directed by Engineer, in accordance with ASTM B1000.
    2. Discard lined piping and fittings found to have pinholes, crazing, or fish scales, which expose the metal substrate.

END OF SECTION

SECTION 46_61_11

FILTER UNDERDRAIN SYSTEM

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Existing filter underdrain system: Remove and dispose existing filter media and underdrain system (clay tile blocks, grout between the blocks and the walls, grout between the blocks and the basin floor, grout between the adjacent blocks, anchor rods, PVC bridging, high density polyethylene end plates and grout stops), and prepare the six existing filter basins for the new underdrain system as indicated on the Drawings. Each filter basin measures 24'-0" lateral run x 12'0". The total filter area is 1,728 square feet.
   2. New filter underdrain system:
      a. Filter system supplier (FSS) shall furnish materials and Contractor shall install the new plastic block filter underdrain system, as specified and indicated on the Drawings.
      b. The new underdrain system shall include all items and materials within the filter cell to collect filtered water, uniformly distribute backwash water, retain the filter media, and to retain, support, and seal the filter underdrain system to make it complete and operable.

B. This specification was written such that the FSS will furnish the items covered by this section for installation by the Contractor. All other items shall be furnished and installed by the Contractor.

1.02 REFERENCES

A. NSF International (NSF):
   1. Standard 61 - Drinking Water System Components - Health Effects.

1.03 SUBMITTALS

A. Shop drawings:
   1. Submit complete and explicit details of the design, construction, and operating characteristics of the filter underdrain system prior to commencing any work on the system as specified in Section 01_33_00 - Submittal Procedures. Submittal data shall include:
      a. Complete structural design calculations showing conformity with all specification requirements signed and stamped by a Structural Engineer or Civil Engineer registered in the State of Florida.
      b. Materials of construction.
      c. Installation details and leveling requirements.
      d. Mathematical proof or test data to demonstrate maximum percentage of flow maldistribution within a filter cell and the maximum percentage of flow maldistribution within a given underdrain lateral.

e. Certification of compatibility of the underdrain system with the filter media specified in Section 46_61_13 - Filter Media.
f. Submit full and complete hydraulic test results and design calculations showing conformity with all flow design requirements to the Engineer for review and acceptance.
    1) Separate tests and design calculations shall be based on the filter cell design employed at the South County Regional Water Treatment Plant.
    2) Include the full range of flow conditions specified, and indicate pertinent physical relationships between the metering orifices, cross-sectional flow areas for water transport to the flow metering elements, relative magnitudes of entrance, transport, metering, and discharge losses; and such other data as may be required by the Engineer.
    3) All test setups, procedures, and instrumentation shall be capable of providing data accuracy of plus or minus 2 percent.
g. 1 sample of each component of the complete underdrain system intended for the project. Each sample of plastic block shall include at least 1 joint.
h. Proper current documentation showing NSF 61 certification of all underdrain components including sealing compound, caulks, and other materials.
i. The manufacturer's proposed method of testing the installed underdrain flow distribution.
j. All other data which in the judgement of the Engineer is necessary to demonstrate conformance with all specification requirements.

B. Field test reports: Submit to the Engineer 3 copies of full and complete test reports for all tests, describing the units tested; the type of test; test setups, procedures, and instrumentation; and test flow rates, pressures, levels, and all other data and results as required to demonstrate that all items tested meet specified requirements.

1.04 PRODUCT HANDLING, STORAGE, AND DELIVERY

A. Place or store underdrains and specialties only in designated staging areas or as approved by the Engineer.

B. Store underdrains and specialties off the ground, under ultraviolet-resistant tarps from time of delivery on-site until final installation in the filters.

C. Replace underdrains and specialties damaged during storage and delivery.

D. Underdrains and specialties are subject to inspection at the Engineer’s request if visual evidence of damage is observed.

1.05 QUALITY ASSURANCE

A. Certifications:
   1. Provide a manufacturer's certificate of proper installation that states the underdrain system has been installed in accordance with the manufacturer's requirements and has been supervised by an authorized representative of the manufacturer and that all of the specified testing has been conducted to insure proper performance.
   2. Provide a Certificate of Compliance with each shop drawing submittal, as specified in Section 01_33_00 - Submittal Procedures, certifying that the item covered is in compliance with the Contract Documents and identification of all deviations from the Contract Documents.

B. Plastic block underdrain system: Plastic block units with integral flow metering elements and specialties required for installation, such as special anchorage, grout retaining strips, grout plates, closures, gaskets, and clips shall all be furnished by a single supplier.

C. The underdrain manufacturer shall provide third party certification that the underdrain can withstand a minimum of 30 psi internal pressure without lifting or separating from the filter floor when properly installed with grout and/or mechanical anchoring. The certification and test report must be based on a representative test method to simulate an actual filter installation. A minimum of five (5) laterals shall be installed with a minimum length equal to at least one full length underdrain block. The test fixture shall have two side supports/walls and the ends of the underdrain blocks shall not be restrained or grouted in place.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Plastic block underdrain system : one of the following or equal:
   a. F.B. Leopold Co., Inc., Type XA.
   b. De Nora Water Technologies, Inc., TETRA LP Block.

2.02 DESIGN AND PERFORMANCE CRITERIA

A. General:
   1. Design the filter underdrain system to ensure long-term stability in its operating characteristics.
   2. It shall be resistant to changes in head loss, flow uniformity, corrosion, and any other effects which would in time cause loss of efficiency or effectiveness of its operation.
   3. Design the filter underdrain system to meet all requirements specified for delivery, storage, handling, installation, and operation.

B. Flow design requirements:
   1. Design the filter underdrain system to produce uniform water flows throughout the filter cell over the full range of normal backwash flow rates.

2. Flow uniformity per square foot of filter area shall be as required to permit efficient and effective filtration and backwashing.
3. The installed filter underdrain system shall satisfy both of the following criteria for acceptable flow uniformity:
    a. Maldistribution of water flows during backwash, for specified flow conditions, shall not exceed:
        1) Plus or minus 5 percent of average gallons per minute per square foot of filter area, including up to plus or minus 2.0 percent maldistribution for any given underdrain lateral for the plastic block system.
    b. Visual tests shall reveal no evidence of maldistribution or disturbance of filter media.
4. The filter underdrain systems shall be furnished and installed to perform satisfactorily and as specified when operated under the following flow conditions:
    a. Downflow of treated water at 3-6 gallons per minute/square foot.
    b. Upflow of backwash water at 4 to 20 gallons per minute/square foot.

C. Structural design requirements:
1. The filter underdrain system, including the concrete false floor and related appurtenances, plastic blocks, anchorage, and supports, shall be designed to safely withstand the specified loadings.
2. The plastic block underdrain system, when installed, shall be designed for an internal pressure during backwash of 200 percent of the maximum pressure at a 20 gallons per minute/square foot backwash rate.
3. Headloss through the filter media shall be included in the calculation of the maximum pressure.
4. There shall be no leakage from the seals, joints, or gaskets at the design pressure at maximum backwash rates.
5. The filter underdrain system shall be designed to withstand a net downward loading of not less than 1,400 pounds per square foot to account for the weight of the media, and the in-service hydraulic loading, plus its own dead weight.
6. Adequate safety factors to account for dynamic loading (such as during the initiation and termination of backwash) shall be included in the design to account for any dynamic loading above and beyond that described above.
7. The design shall adequately provide for all loads incurred during shipment, handling, and installation.

D. Performance requirements: Furnish such installation details and recommendations as are necessary to acceptably interface the filter underdrain system with all surrounding structures, including requirements for leveling, grouting keys and pockets, dowels, support ledges and piers, and anchorage.

E. Headloss criteria: The following headloss criteria shall be met by the combination of the drain block and the support gravel:

Flow Rate (gallons per minute/square foot)	Maximum Allowable Headloss (inches)
5	6
20	36

2.03 MATERIALS

A. General:
   1. Materials used in the filter underdrain system shall conform to specified requirements unless more stringent requirements are specified by the underdrain supplier.
   2. All materials shall, at the time of shop drawing submittal, have received current NSF 61 certification.

B. Grout:
   1. Nonshrink grout conforming to the applicable requirements as specified in Section 03_60_00 - Grouting.
   2. All grout associated with the installation of the underdrains shall be nonshrink grout.
   3. Underdrain manufacturer shall certify compatibility between the underdrain material and the nonshrink grout.

C. Structural concrete: As specified in Section 03_30_01 - Concrete Work, except that coarse aggregate shall not be larger than 1/2-inch maximum diameter in slabs 3 inches in depth or less, and shall not be larger than 3/4-inch maximum diameter in slabs greater than 3 inches in depth.

D. Concrete reinforcement: As specified in Section 03_30_01 - Concrete Work.

E. Metals:
   1. All exposed (not embedded in concrete) or partially exposed metals, including but not limited to anchor bolts and anchorage, fasteners, washers, etc., shall be Type 304 stainless steel.

F. Grout stops, cover plates, and concrete retaining strips shall be high-impact plastic, or polyvinyl chloride, properly keyed or mechanically restrained to prevent the strips from working loose with time.
   1. They shall also be completely sealed with caulking to prevent water, air, or grout from leaking around them.
   2. Plastics shall be high-strength, completely inert, resistant to erosion, corrosion, and degradation from chlorine up to 150 milligrams per liter, and suitable for use with backwash temperatures from 40 to 200 degrees Fahrenheit.

2.04 PLASTIC BLOCK UNDERDRAIN SYSTEM

A. System:
   1. The underdrain system for the filters shall be of the dual parallel lateral type with support gravel whereby feeder and compensating laterals are provided in a single block system.

2. The blocks shall be self-contained as regards to pressure loadings, and shall require only nominal anchorage in the filter cell to resist buoyant and dynamic forces during operation.
3. The cross-section of the underdrain shall be so arranged that the feeder (or primary) lateral is connected to the compensating (or secondary) laterals through a series of orifices provided at a density of at least 2 per square foot of filtration area.
4. The feeder laterals shall provide at least 43 square inches of cross-sectional area per block.
5. The size of the orifices shall be determined by the manufacturer to provide the headloss and flow distribution characteristics specified above.
6. The number and the size of the orifices shall be uniform throughout every filter.
    a. The compensating laterals shall provide the essentially uniform pressure and flow distribution from the top of the blocks.
    b. The discharge flow from the top of the blocks into the filter bed shall be accomplished by dispersion orifices.
    c. The orifices shall be not less than 11/64-inch diameter and shall be recessed from the surface by approximately 1/8 inch.

B. Blocks:
1. The individual blocks used in the system shall be impervious high strength, completely corrosion resistant high-density polyethylene material, having uniform smooth surfaces and all orifices properly deburred.
2. The blocks shall have ridges and pockets for structural rigidity and to key into surrounding grout.
3. The block dimensions and weight shall permit ease of handling and installation.
    a. The joints shall be of the tongue and groove style to prevent grout intrusion or any leakage of air or water.
    b. The tongue and groove joints and all other joining surfaces and features shall be intact and within the manufacturer's tolerance specifications and shall provide a watertight fit.
    c. Damaged or warped block shall be rejected.

C. Grout stops, retainers, and end plates:
1. The grout stops shall be designed and furnished by the FSS and installed by the Contractor to prevent grout intrusion into the center and make-up block flumes, and water and air leakage around the grout stops, as indicated on the Drawings.
2. The grout retainers shall be designed furnished by the FSS and installed by the Contractor onto the center and make-up flume blocks to prevent grout intrusion into the flumes between the blocks as indicated on the Drawings.
3. The end plates shall be designed and furnished by the FSS and installed by the Contractor to prevent grout intrusion into the laterals as indicated on the Drawings.
4. The grout stops, retainers, and end plates shall be designed supplied by the FSS and installed by the Contractor with Type 316 stainless steel hardware and NSF 61 approved caulking to affect a permanent watertight seal capable of withstanding the hydraulic forces stated.

PART 3 EXECUTION

3.01 EXISTING FILTER UNDERDRAIN REMOVAL

A. Contractor shall assume that two filters may be taken out of service for work at any time. Demolition, new work, disinfection, and testing shall be performed and the filter commissioned before the group of filter can be taken out of service for work.

B. Remove and dispose of the existing filter media, clay tile filter underdrains and related grout material, plastic end plates and grout stops, PVC bridging, and anchor bars as indicated on the Drawings. Care shall be exercised so that no damage occurs to the remaining filter basin walls, floor, washwater troughs, surface wash system, handrail, access ladders, level probes, stainless steel baffle plates, threaded rods, or flume. Contractor shall coordinate with the County prior to disposal of materials for approval.

C. Allow an inspection period of no less than 48 hours after the media has been removed and before demolition of the existing filter blocks.
   1. After the underdrain system has been removed, allow an inspection period of no less than 48 hours.
   2. Coordinate the inspection periods with the Engineer.
   3. Both inspection periods shall occur during working days only.

D. After removal of the underdrains and media, grind the filter floor and walls to a height of 18 inches above the floor to the original concrete providing an even surface for the new underdrain.
   1. The grinding shall remove all grout, latence, loose coatings, and foreign material.
   2. The resultant surface shall be clean, sound, and (for the plastic block underdrain system only) intentionally roughened to a full amplitude of plus or minus 1/8 inch.
   3. All necessary repairs shall be made by the Contractor after grinding is complete.
   4. The filter, including the filter flume and related backwash piping, shall be thoroughly cleaned; all grinding material and debris shall be vacuumed out of the filter before any filter underdrain installation can begin.
   5. The filters shall be kept clean during installation of the filter underdrain.
   6. Precautions shall be taken to prevent any foreign material from entering the filter flumes.

E. Before the new underdrains are installed, clean the flume of any debris.
   1. Do not allow the debris to enter the plant drain system.
   2. After the debris has been separated and removed, the water from the flume cleaning operations may then pass to the plant drain system.
   3. Control the drainage flow so that the plant drain system is not flooded.

F. Before the new underdrains are installed, remove or relocate the washwater troughs and make necessary structural modifications and repairs required.

G. Before the new underdrains are installed, remove surface wash sweeps and related piping, valves, and supports.

3.02 INSTALLATION

A. General:
   1. Install the filter underdrain systems in strict accordance with the manufacturer's installation drawings and printed recommendations, and as manufactured and indicated on the Drawings.
      a. Obtain from the underdrain supplier such written installation details, recommendations, and training required to acceptably interface the filter underdrain system with all surrounding structures.
      b. The Contractor is cautioned that such installation details are not indicated on the Drawings, as they will vary according to the underdrain supplier's specific requirements.

B. Physical requirements:
   1. Underdrain systems shall be arranged for central filtered water exit from, and backwash water entry into a central flume encased in the filter slab of each filter cell as indicated on the Drawings.

C. Cleaning and placement:
   1. Take all necessary precautions recommended by the underdrain manufacturer's published instructions and as specified to ensure the underdrain system and piping is completely clean and free of any debris, dirt, or other foreign materials which could clog the underdrain system or interfere with flow.
      a. Backwash water piping shall be thoroughly flushed clean.
      b. All loose debris and dirt within the filter cell and flume shall be removed by sweeping and vacuuming.
      c. Care shall be taken during installation to prevent grout from extruding into any of the flow passages or ports or into the underdrain system itself. Any evidence of grout intrusion witnessed during installation shall require that the affected section be removed and replaced.
   2. As installation progresses, underdrain sections partially completed shall be protected with heavy building paper, masking tape, or other acceptable means to maintain cleanliness and protect the underdrain from exposure to weather and UV.
   3. Cleanliness shall be maintained through final placement of filter media.

D. Plastic block underdrain system installation:
   1. Use tarps or other materials to keep the work area (underdrain) shaded at all times.
      a. Keep the underdrain materials cool at all times.
      b. At no time shall the temperature of the underdrains, the grout, and the water used to cure the grout or backwash the system differ by more than 5 degrees Fahrenheit.
   2. Prepare the filter base slab as necessary to enable installation within the required level of tolerance. Place the reinforcing dowels and anchor rods to accurately fit in place without bending the dowels or rods in the field.
   3. Set the filter underdrain sections in place.
      a. Grout such that the blocks are in a true and level plane within the lesser of plus or minus 1/8 inch or the tolerance specified by the supplier of the filter underdrain.

b. Flood the underdrain with water to the top of the underdrain system to ascertain this level tolerance is met. Utilize water from hoses connected to the plant water system, not from the backwash system.
c. Failure of the filter underdrain sections to meet the level tolerance shall require removal of the failed sections and replacement with new filter underdrain sections to within the tolerances specified.

4. After the underdrain sections of a filter half have been set in place and the installed system has passed the above-specified level tolerance requirement, all grouting spaces completely filled and finished off smooth.
5. Make certain that all end plates, grout retainers, and grout stops are securely in place and completely sealed to the blocks with caulking prior to grouting around the block rows and that they are not displaced by the grouting operation. Any evidence of grout flowing past a grout stop or cover plate witnessed during installation shall require that the affected section(s) be completely removed and replaced.
6. Any portion of the block underdrain system contaminated by grout or other foreign material, or damaged in any way, shall be replaced in strict accordance with the manufacturer's specifications.

3.03 FIELD QUALITY CONTROL

A. Tests:
1. Conduct all specified testing and provide all material, instrumentation, personnel, etc., for the tests specified. The Engineer shall be given sufficient advance notice of the testing to enable the Engineer to witness the tests.
2. A manufacturer's representative shall inspect and supervise at least 2 of each of the specified tests for a total of 6 tests.
3. All test set-ups, procedures, and instrumentation shall be designed by the underdrain manufacturer as required to provide data accuracy of plus or minus 2 percent.
4. Perform each test on every filter unless otherwise noted.

B. Preliminary structural integrity and flow distribution tests:
1. Perform this test prior to the placement of any filter media or support gravel.
2. After sufficient curing time, as defined by the underdrain manufacturer, has elapsed to permit the installation to develop adequate strength, test each filter underdrain system to verify underdrain integrity.
3. Backwash each underdrain installation at the maximum rate 20 gallons per minute/square foot for 15 minutes.
4. During this test, flow from each block as well as any sign of dead spots or boils shall be visually observed. Any evidence of flow maldistribution such as a water mounds or boils in any area of the filter will constitute a failed test.
5. After this initial test, the filter shall be drained and the underdrain system shall be inspected for any damage or leaks.
6. Correct and retest underdrain systems that fail to meet the test criteria.
7. Repeat test until all deficiencies are corrected.
8. Follow underdrain manufacturer’s specific instructions for repairing damage to the underdrain system caused by test procedure.

C. Underdrain flow distribution test:
1. Perform this test prior to the placement of any filter media or support gravel.

2. The filter underdrain system in each filter half shall be given a flow distribution test to verify that water flow from the installed system is distributed uniformly in the filter basin.
3. The test shall be conducted using methods specified by the manufacturer and approved by the Engineer.
4. Flood filter cells with clean water approximately 6 inches above the underdrain at the beginning of each test. Sustain test flow rates for approximately 3 minutes while making visual observations.
5. Extend or repeat test when additional time is needed to make observations, as directed by the Engineer.
6. Plastic block system:
    a. Test data shall be taken from both ends of each lateral run tested.
    b. At a minimum, on both sides of each flume, laterals at both ends of the flume and two evenly spaced between the ends shall be tested for a total of eight laterals in each filter half.
7. Correct and retest underdrain systems that fail to meet the test criteria.
8. Repeat test until all deficiencies are corrected.
9. Follow underdrain manufacturer's specific instructions for repairing damage to the underdrain system caused by test procedure.

D. Sand flow distribution tests:
1. After the underdrain system has been installed and has passed the underdrain flow distribution test, the support gravel and filter sand media may be placed.
2. Perform the sand flow distribution test after the media has been placed, washed, and skimmed, but before placement of antracite filter media.
3. Sand tests shall consist of at least 5 backwash cycles and shall be as follows:
    a. Flood filter cell approximately 6 inches above the sand media with clean water.
    b. Water backwash at 5,760 gallons per minute for 4 minutes (20 gallons per minute/square foot).
    c. Drain down to initial level and repeat.
    d. At the conclusions of the 5 backwash cycles, inspect the sand surface.
4. Results:
    a. Deviations more than plus or minus 1/4 inch from the average level plane indicates failure.
    b. Media boiling shall constitute a failed test.
    c. Media movement from one area of the filter to the other shall constitute a failed test.
5. Correct and retest underdrain systems that fail to meet the test criteria.
6. Repeat test until all deficiencies are corrected.

E. Final filter flow distribution tests: Follow underdrain manufacturer's specific instructions for repairing damage to the underdrain system caused by test procedure:
1. After the underdrain system has been installed and has passed the sand flow distribution tests, the filter anthracite media may be placed.
    a. After the media has been placed, washed, and skimmed, the final filter flow distribution test shall be performed.
    b. This test shall be conducted for each layer of media placed in each filter cell.

2. The final flow distribution tests shall consist of at least 10 backwash cycles on each filter, and shall be as follows:
    a. Flood filter cell approximately 6 inches above the filter media with clean water.
    b. Water backwash at 1,440 gallons per minute for 4 minutes (5 gallons per minute/square foot).
    c. Water backwash at a rate sufficient to achieve 25 percent expansion. Consult Engineer for flow rate.
    d. Water backwash at 1,440 gallons per minute for 4 minutes (5 gallons per minute/square foot).
    e. Slow the backwash flow gradually, so as to allow the media to restratify.
    f. Slowly drain the filter down to the initial level and repeat.
    g. At the conclusion of the 10 backwash cycles, inspect the filter media surface.
3. Results: Deviations of more than 1/2 inch from the average level plane indicates failure.
4. At 5 places per filter designated by the Engineer, determine the sand layer thickness by means of hydraulic testing.
    a. Insert a probe into the media while backwashing at 4 gallons per minute/square foot.
    b. The sand height shall be within plus or minus 1/4 inch from the average level plane.
5. Correct and retest underdrain systems that fail to meet the test criteria.
6. Repeat test until all deficiencies are corrected.
7. Follow underdrain manufacturer's specific instructions for repairing damage to the underdrain system caused by test procedure.

3.04 MANUFACTURER'S FIELD SERVICES

A. Provide services of manufacturer's field representative to ensure proper installation, testing, and start-up of the filter underdrain.

B. The manufacturer's representative shall have 5 years of experience in the installation of similar underdrain systems and provide a list of 10 facilities at which he has inspected the installation and testing of underdrain systems.

C. The filter underdrain system manufacturer's representative shall be present at the jobsite for whatever period is necessary to ensure proper installation. At a minimum, the manufacturer's representative shall be present during all underdrain installation operations and testing.

END OF SECTION

SECTION 46_61_13

FILTER MEDIA

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Removal and disposal of the existing support gravel and filter media as indicated on the Drawings and as specified in this Section.
      a. At South County Regional Water Treatment Plant, media consisting of approximately 21 inches of anthracite, 9 inches of silica sand, 13 inches of support gravel shall be removed from six filters.
      b. Each filter has an approximate area of 288 square feet.
   2. Installation of new filter media in each of the filters indicated on the Drawings and as specified in this Section. The new media shall consist of 21-inches of anthracite, over 9-inches of sand, over 12-inches of support gravel.

B. This specification was written such that the FSS will furnish the items covered by this section for installation by the Contractor. All other items shall be furnished and installed by the Contractor.

1.02 REFERENCES

A. American Water Works Association (AWWA):
   1. B100 - Standard for Granular Filter Material.

B. ASTM International (ASTM):
   1. C33 - Standard Specification for Concrete Aggregates.
   2. C123 - Standard Test Method for Lightweight Particles in Aggregate.
   3. C128 - Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Fine Aggregate.
   4. D409 - Standard Test Method for Grindability of Coal by the Hardgrove-Machine Method.
   5. D3174 - Standard Test Method for Ash in the Analysis Sample of Coal and Coke from Coal.
   6. D3175 - Standard Test Method for Volatile Matter in the Analysis Sample of Coal and Coke.
   7. E11 - Standard Specification for Wire Cloth and Sieves for Testing Purposes.

C. Food Chemical Codex.

D. NSF International (NSF):
   1. Standard 61 - Drinking Water System Components - Health Effects.

1.03 DEFINITION

A. Determination of particle size distribution:
   1. Determine particle size distribution by screening through standard sieves, Tyler square root of 2 series or equivalent U.S. series.
   2. Determine percent sizes from a plot, on semilog or probability paper, of the percentages of the material passing each sieve against the rated opening of the sieve or the equivalent diameter of the grains. Sieve dimensions shall conform to ASTM E11 and Table B.1 of the Appendix to AWWA B100.
   3. Define percent size as the size of the theoretical opening of a sieve through which that percentage of the filter media, by weight, will pass. For example, if the size distribution of the filter media particles is such that 10 percent of the sample is finer than 0.50 millimeters, the filter media shall be said to have a 10 percent size of 0.50 millimeters.
   4. Define uniformity coefficient as the ratio of the 60 percent size to the 10 percent size of the filter media.

1.04 SUBMITTALS

A. All submittals shall be as specified in Section 01_33_00 - Submittal Procedures.

B. Submit the following:
   1. Filter underdrain gravel quality information:
      a. Sieve analysis (particle size distribution), effective size, and uniformity coefficient.
      b. Specific gravity.
      c. Weight of thin, flat or elongated pieces.
   2. Sand quality information:
      a. Sieve analysis (particle size distribution), effective size, and uniformity coefficient.
      b. Acid solubility.
      c. Specific gravity.
      d. Hardness based on the Mohs scale.
      e. Shape.
   3. Anthracite quality information:
      a. Sieve analysis (particle size distribution), effective size, and uniformity coefficient.
      b. Acid solubility.
      c. Specific gravity.
      d. Hardness based on the Mohs scale.
      e. Ash content in accordance with ASTM D3174.
      f. Volatiles content in accordance with ASTM D3175.
      g. Grindability Index in accordance with ASTM D409.
      h. Shape.
   4. Any other information as requested by the Engineer.

C. Samples:
   1. Submit all samples and certified test results to the Engineer not less than 14 days prior to shipment of the media from the point of manufacture.

2. Submit a representative sample of each type and size of new filter material along with certified test results from an independent laboratory for approval before each shipment of media from the point of manufacture.
3. Submit separate sets of samples from actual lots of material to be supplied to the County.
4. Submit additional samples and test results as required by the Engineer.
5. Quantities of samples:
    a. Support gravel: 1/2 gallon sealed in a properly labeled container.
    b. Sand: 1/2 gallon sealed in a properly labeled container.
    c. Anthracite: 1/2 gallon in a sealed, moisture proof container.

D. Submit qualifications of the independent testing laboratory for approval.

E. Submit on the proposed media disposal site for existing media.

F. Submit proper documentation showing current NSF-61 certification of all filter media to be supplied.

G. Submit media installation instructions from the media supplier including washing and skimming requirements and procedures.

1.05 QUALITY ASSURANCE

A. Perform certified material testing of new filter media by an County approved independent testing laboratory employed by the Contractor.

B. Certified test results shall cover all physical, gradation, size, and chemical characteristics specified in this Section. All tests shall be made in accordance with test procedures as described in AWWA B100.

C. After approval, all shipments shall meet the Specifications. Approved samples shall meet the requirements of AWWA B100 including any addenda.

D. Perform field samples and testing in accordance with the requirements of AWWA B100.

E. The supplier of the filter media shall supervise the media installation in all of the filters.

1.06 PRODUCT HANDLING, STORAGE, AND DELIVERY

A. Packaging: Package filter media in ultraviolet-resistant polyethylene bags (super sacks with bottom pour spout) on pallets. Clearly mark each bag of material with the following information: Effective size, uniformity coefficient, source, date of bagging, and the lot or stockpile identification.

B. Place or store all filter media only in designated staging areas indicated on the Drawings and approved by the Engineer.

C. Store all filter media at the jobsite off the ground, protected from weather, and covered with a suitable membrane to prevent contamination of the media from windblown debris and soil.

D. Conveying of the new filter media by compressed air through ducts, pipes, or hose is not be permitted. Placement of filter media in the filters shall comply in all respects with AWWA B100, except as modified or supplemented in this Section.

PART 2 PRODUCTS

2.01 FILTER UNDERDRAIN GRAVEL (SUPPORT GRAVEL)

A. Filter underdrain gravel in accordance with AWWA B100 except as modified in this Section. Review and certify gravel size and layer thickness by the filter underdrain system manufacturer as specified in this Section before commencing any work on the filter underdrain gravel.

B. Physical characteristics:
1. Obtain gravel from uncrushed source consisting of hard, rounded stones with an average specific gravity of not less than 2.5. Not more than 1 percent by weight of the material shall have a specific gravity of 2.25 or less.
2. The gravel shall contain no more than 2 percent by weight of thin, flat, or elongated pieces in which the largest dimension exceeds 5 times the smallest dimension, determined by hand picking.
3. Gravel: Free of shale, mica, clay, sand, loam, and organic impurities of any kind.

C. Gravel size and layer thickness:
1. Screen the gravel to proper sizes and place in the filters in layers, as specified in the following table:

Gravel Layer	Layer Thickness (inches)	Size Limits (inches)
4 (Top)	3	1/8 to #10 mesh to #12 mesh
3	3	1/4 to 1/8
2	3	1/2 to 1/4
1 (Bottom)	3	3/4 to 1/2

2. The gravel within each layer shall be uniformly graded. Screen the gravel through wire screens with square openings. Not more than 8 percent of the weight of any layer shall be finer or coarser than the limits specified for that layer.

2.02 FILTER SAND

A. Quality:
1. Filter sand:
a. Silica sand composed of hard, durable, uncoated grains.

b. Thoroughly wash, screen, and free of clay, loam, dust, dirt, organic matter, and other foreign material from filter sand.
2. Acid solubility of the filter sand: Not to exceed 2.5 percent.
3. Specific gravity of the filter sand: Not to be less than 2.50.
4. Not more than 1 percent by weight of the filter sand shall be flat or micaceous particles. Define flat as a ratio of the longest axis to the shortest axis of the circumscribing rectangular prism for a particle of sand media that exceeds 5.

B. Size:
1. The silica sand shall meet the following requirements:
a. Effective (10 percent) size (millimeters) - 0.45 to 0.55.
b. Uniformity coefficient – 1.4
2. The installed filter sand shall be in compliance with the Specifications when, after hydraulic classification in place by backwashing and removal of the finer material by skimming, the media meets the physical, gradation and size characteristics specified in this Section.

C. Excess media:
1. Provide sufficient excess sand media to anticipate media settlement, compaction during installation, and skimming requirements.
2. The final media depth after skimming, backwashing, and testing is complete shall be 9 inches, as indicated on the Drawings.

2.03 FILTER ANTHRACITE

A. Quality:
1. The anthracite:
a. Composed of hard durable grains.
b. Processed from anthracite coal.
c. Free from any significant amounts of iron sulfides, clay, shale, dust, dirt, or other foreign matter.
2. The solubility of the filter anthracite in a 1:1 mixture of concentrated hydrochloric acid (approximately 37 percent) shall be less than 2.5 percent. The solubility of the filter anthracite shall be less than 5 percent by weight in 1 percent hot (190 degrees Fahrenheit) sodium hydroxide solution.
3. The filter anthracite shall have a hardness of not less than 2.7 on the Mohs scale.
4. Average apparent specific gravity shall be determined by the procedure set forth in ASTM C128, which provides for soaking the sample in water for 24 hours. The filter anthracite shall have a specific gravity of not less than 1.40, nor more than 1.70.
5. The filter anthracite shall not have more than 1 percent by weight flat and sliver-like (combined) particles. Flat and sliver-like shall be defined as a ratio of the longest axis to the shortest axis of the circumscribing rectangular prism for a particle of anthracite media that exceeds 5.
6. The filter anthracite shall have an ash (dry) content of less than or equal to 15 percent as determined by ASTM D3174.
7. The filter anthracite shall have a volatiles (dry ash free) content of less than or equal to 7 percent as determined by ASTM D3175.
8. The filter anthracite shall have a Hardgrove grindability index of between 35 to 45 as determined by ASTM D409.

B. Size:
   1. The anthracite shall meet the following requirements:
      a. Effective (10 percent) size (millimeters) - 0.95 to 1.05.
      b. Uniformity coefficient - less than 1.40 before and after skimming.
      c. Maximum particle diameter (millimeters) - 2.00.
      d. Minimum particle diameter (millimeters) - 0.65.
   2. The installed filter anthracite shall be in compliance with the Specifications when, after hydraulic classification in place by backwashing and removal of the finer material by skimming, the media meets the physical, gradation and size characteristics specified in this Section.

C. Excess media:
   1. Provide sufficient excess anthracite media to anticipate media settlement, compaction during installation, and skimming requirements.
   2. The final media depth after skimming, backwashing, and testing is complete shall be 21 inches, as indicated on the Drawings.

D. Packaging: Package filter anthracite in 1-ton ultraviolet-resistant polyethylene bags (super sacks with bottom pour spout) on pallets. Each bag of material shall be clearly marked with the following information: Effective size, uniformity coefficient, source, date of bagging, and the lot or stockpile identification.

2.04 SUPPLIERS

A. Support gravel One of the following or equal:
   1. Unifilt Corporation
      P.O. Box 88
      Fombell, PA 16123
      Telephone:(800) 223-2882
      Fax: (724) 758-3870
      Website: www.unifilt.com
   2. Northern Gravel Company
      P.O. Box 307
      Muscatine, IA 52761
      Telephone:(800) 962-7190
      Fax: (563) 263-2857
      Website: www.northernfiltermedia.com
   3. Red Flint Sand and Gravel
      615 Short St
      Eau Claire, WI 54701
      Telephone: (800) 238-9139
      Website: https://www.redflint.com/

B. Filter sand: One of the following or equal:
   1. Unifilt Corporation
      P.O. Box 88
      Fombell, PA 16123
      Telephone:(800) 223-2882
      Fax: (724) 758-3870
      Website: www.unifilt.com

2. Northern Gravel Company
   P.O. Box 307
   Muscatine, IA 52761
   Telephone:(800) 962-7190
   Fax: (563) 263-2857
   Website: www.northernfiltermedia.com
3. Red Flint Sand and Gravel
   615 Short St
   Eau Claire, WI 54701
   Telephone: (800) 238-9139
   Website: https://www.redflint.com/

C. Filter anthracite: One of the following or equal:
1. Unifilt Corporation
   P.O. Box 88
   Fombell, PA 16123
   Telephone:(800) 223-2882
   Fax: (724) 758-3870
   Website: www.unfilt.com
2. F.B. Leopold Company, Inc.
   227 S. Division Street, Zelienople, PA 16063
   Telephone:(724) 452-6300
   Fax: (724) 452-1377
   Website: www.fbleopold.com

PART 3 EXECUTION

3.01 FILTER MEDIA REMOVAL

A. Remove existing gravel, sand, and anthracite from the filters. Methods used shall not damage the existing filter units, handrail, access ladders, level probes, nor any other structural, electrical, instrumentation, architectural, and mechanical appurtenances of the filters.

3.02 FILTER MEDIA INSTALLATION

A. Filter media washing:
1. Plant staff shall operate all filter backwash controls when washing the new filter media installed in the filter basins.
2. The Contractor is responsible for coordinating the scheduling of filter media washing through the Engineer with plant operations. Plant operations shall govern scheduling the use of the backwash system. The Contractor is responsible for this coordination to avoid delays to his schedule.
3. Filter media washing will be allowed as determined by the Engineer so as not to interrupt operation of the plant. At no time shall the plant's washwater ponds overflow from the media washing operations. Filter media washing shall be terminated before reaching a liquid level that would affect plant operations regardless of the status of the media washing operation.
4. Make certain that water from the media washing operation does not flow to the storm drain.

5. Verify separation of the media washing residuals from the backwash water sufficient for returning the water to the treatment plant. Remove and dispose of the residuals from the media washing operation.

B. Before placing filter media:
   1. Verify that all underdrain blocks are open and free of obstructions, and that the area around the filter underdrains is swept clean and vacuumed.
   2. Remove all debris from filters.
   3. Thoroughly wash down all parts of the filter units with clear water.
   4. Maintain the cleanliness of the filters throughout the media placement operation.
   5. The underdrain system shall have passed the specified structural integrity and flow distribution testing before any media is placed. The underdrain is considered to have passed these tests upon the Engineer's acceptance of the test results.

C. Prevent contamination during transporting and placing the filter media. Any filter media which has become contaminated, either before or after placement in the filters, shall be removed and replaced with new or washed and cleaned material in a manner approved by the Engineer.

D. Each layer of filter media shall be brought up to the required elevation and made level over the entire filter bed area. The placement of each layer of sand and anthracite shall be accepted by the Engineer before the next layer is placed.

E. Do not damage any equipment or piping in the filter units.

F. Workers shall not stand or walk directly on the filter materials. The workers shall walk on plywood mats that will sustain their weight without displacing the material (minimum dimensions 2 feet by 2 feet by 1/2 inch thickness).

G. The filter may be flooded with water to use as a leveling gauge for each layer of material.

H. Each media level shall be thoroughly washed, and have passed the specified in-place media tests before the next layer is placed. The media is considered to have passed these tests upon the Engineer's acceptance of the test results.

I. Place each layer evenly throughout the filter. Do not place in one area and then spread to the rest of the filter.

J. Support gravel:
   1. The support gravel shall be placed carefully by hand to avoid damage to the underdrain system and to allow free passage for water from the underdrain blocks.
   2. The workmen shall not stand or walk directly upon the underdrain blocks nor the support gravel, but upon plywood panels which will sustain the weight of the workmen without displacing the gravel (minimum dimensions 2 feet by 2 feet by 1/2 inch thickness).

3. The correct thickness of the support gravel layer shall be obtained as follows:
    a. Before the support gravel is placed, the top of the layer shall be marked on the filter wall.
    b. The top of the support gravel shall then be leveled against a water surface held at that mark.
    c. None of the particles shall be less than half submerged, and there shall be no places where additional gravel can be placed without the particles extending more than 1/2 of their diameter above the water surface.
4. After all the support gravel is placed and before any filter sand or anthracite is placed, the filter shall be washed for a minimum of 5 minutes at the maximum available rate not exceeding 20 gallons per minute/square foot of filter area.

K. Filter sand:
1. Before placing the sand, remove all plywood panels used by the construction personnel to walk on the media support system or on the filter media. Fill the filters to a water depth 12 to 15 inches above the surface of the filter media support system. The sand shall then be placed into the water in a uniform manner over the entire surface area of the filter. This may require hand placement of the initial layer of filter sand.
    a. Transport and place the sand carefully to prevent contamination of any sort, and replace sand made dirty before or after placing with clean sand.
    b. Any indication during sand placement that the underdrain has been displaced or damaged shall require the sand to be removed and the underdrain replaced in accordance with the underdrain manufacturers specific instructions for repairing damage.
2. The final depth of filter sand shall be as indicated on the Drawings.
3. After placing the filter sand, backwash the filter at an initial rate of not more than 2 gallons per minute/square foot of filter area (approximately 3 inches per minute rate of rise), and increase the rate gradually over a period of 3 minutes to a maximum rate of 20 gallons per minute/square foot, (approximately 27 inches per minute rate of rise). Maintain this maximum rate for a minimum of 5 minutes. Close the filter backwash rate valve slowly to allow for hydraulic media segregation.
4. Scrape the fine-grained materials from the top surface to remove all material passing a No. 50 sieve (0.295 millimeters). Dispose of the sand particles removed by scraping.
5. After the scraping operation is finished, add additional filter sand as necessary to bring the top surface to the finished elevation.
6. Repeat steps 3 through 5 as necessary until a minimum of 1/2 inch of sand has been scraped and removed, and the filter sand is within the size limits specified, as determined by the testing specified in this Section, and no further discoloration of the backwash water occurs when backwashing the filter.
7. The installed sand must pass the specified gradation test before the anthracite layer is installed. The media is considered to have passed these tests upon the Engineer's acceptance of the test results.

L. Filter anthracite:
   1. Remove all plywood panels used by the construction personnel to walk on the media before placing any anthracite. Transport and place the anthracite carefully to prevent contamination of any sort, and replace anthracite made dirty before or after placing with clean anthracite. Do not place anthracite filter media in any filter cell until the filter sand in that cell has been skimmed and the final grain size distribution has been accepted by the Engineer.
   2. The final depth of filter anthracite shall be as indicated on the Drawings.
   3. After placing the filter anthracite and soaking it in clean water in the filter basin for 24 hours, backwash the filter at an initial rate of not more than 2 gallons per minute/square foot of filter area (approximately 3 inches per minute rate of rise), and increase the rate gradually over a period of 3 minutes to a maximum rate of 17 gallons per minute/square foot (approximately 27 inches per minute rate of rise). Maintain this maximum rate for a minimum of 5 minutes. Close the filter backwash rate valve slowly to allow for hydraulic media segregation.
   4. Scrape the fine-grained and flat anthracite particles from the top surface to remove all material passing a Number 30 sieve (0.594 millimeters). Dispose of the anthracite particles removed by scraping.
   5. After the scraping operation is finished, add additional filter anthracite as necessary to bring the top surface to the finished elevation.
   6. Repeat steps 3 through 5 as necessary until a minimum of 1/2 inch of anthracite has been scraped and removed, and the filter anthracite is within the size limits specified, as determined by the testing specified in this Section, and no further discoloration of the backwash water occurs when backwashing the filter.

3.03 DISINFECTION

A. As specified in Section 01_75_18 - Disinfection.

3.04 FIELD QUALITY CONTROL

A. Tests:
   1. Acid solubility tests, specific gravity tests, and sieve analysis tests shall be made in accordance with Test Procedures as described in AWWA B100.
   2. Media with a particle size distribution not meeting the specified size and quality values will be subject to rejection.
   3. Conduct all specified testing and furnish all material, instrumentation, and personnel for conducting tests as specified in this Section. Give the Engineer sufficient advance notice of the testing to enable the Engineer to witness the tests.
   4. Do not place filter media in any filter basin before the Engineer has reviewed the media's test results and completed a visual inspection of the media. Any media placed in the filter without the Engineer's acceptance shall be subject to rejection.
   5. Furnish an independent commercial testing laboratory, acceptable to the Engineer, to sample, conduct, and certify the tests specified in this Section.

3.05 CLEANING

A. Backwashing: At all times. The Contractor shall utilize plant operators, in coordination with the Engineer, to operate all filter controls.

B. Filter structure cleaning: Once all filter testing and skimming operations are completed, remove all debris and media from all backwash drain conduits, troughs, pipelines, and structures.

END OF SECTION

SECTION 46_61_16

FILTER SURFACE WASH AGITATORS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Filter surface wash agitators.

B. This specification was written such that the FSS will furnish the items covered by this section for installation by the Contractor. All other items shall be furnished and installed by the Contractor.

1.02 SUBMITTALS

A. Submit as specified in Section 01_33_00 - Submittal Procedures and Section 46_05_10 - Common Work Results for Mechanical Equipment.

B. Product data:
   1. Performance data for flow and pressure.
   2. Manufacturer's installation instructions.

C. Shop drawings.

D. Calculations.

E. Commissioning submittals:
   1. Provide Manufacturer's Certificate of Installation and Functionality Compliance as specified in Section 01_75_17 - Commissioning.

F. Project closeout documents:
   1. Provide vendor operation and maintenance manual as specified in Section 01_78_24 - Operation and Maintenance Manuals.

1.03 WARRANTY

A. Provide warranty as specified in Section 01_78_36 - Warranties and Bonds.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. One of the following or equal:
   1. F.B. Leopold Co., Inc.
   2. De Nora, Inc.

2.02 GENERAL

A. Design: The filter surface wash agitators is to be a self-propelled revolving units, each consisting of a center bearing assembly, lateral arms, end caps, and nozzles designed in such a way as to agitate and scour the filter media.

B. Provide filter surface wash agitators as indicated on the Drawings and as described in the table below:

Parameter	Value
Number of Filter Cells	6
Agitators per Filter Cell	2
Total Number of Agitators	12
Filter Cell Box Dimensions	24’-0” x 12’-0”
Minimum Flow Rate at 70 psi	116

2.03 COMPONENTS

A. Center bearing assembly:
   1. Ball bearing type central housing stabilized for vertical and horizontal bearing pressure.
   2. Stainless steel companion flange to connect to surface wash supply piping.

B. Lateral arms:
   1. Constructed of stainless steel.
   2. Drilled and tapped to accommodate agitator nozzles.

C. Agitator nozzles:
   1. Angled downward and designed to effectively cover the entire surface area of the filter media.
   2. Nozzle caps are to open under pressure and close automatically to exclude filter media from the agitator arms when surface wash valve for the filter is closed.

2.04 SPARE PARTS AND SPECIAL TOOLS

A. Spare parts:
   1. Furnish, tag, and box for shipment and storage of the following spare parts.
      a. Agitator nozzles for one complete filter.
      b. 1 complete center bearing assembly.
      c. 1 complete set of all special tools required for complete assembly or disassembly of the system components.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install agitators to maintain the sweeps as level as possible:
   1. Variation in elevation of an agitator not to exceed 1/4 inch.

B. Install all agitators in a filter at the same elevation:
   1. Variation in agitator elevations within a filter not to exceed 1/4 inch.

C. Agitators are to be installed after the filter media has been placed, washed, and skimmed, and prior to filter disinfection.

D. Prevent foreign material from entering agitators to avoid plugging the nozzles.

3.02 DISINFECTION

A. Disinfect agitators during disinfection of filters as specified in Section 01_75_18 - Disinfection.

3.03 COMMISSIONING

A. As specified in Section 01_75_17 - Commissioning and this Section.

B. Manufacturer services:
   1. Provide certificates:
      a. Manufacturer's Certificate of Installation and Functionality Compliance.
   2. Manufacturer's Representative onsite requirements:
      a. Installation: 1 trip, 1 day minimum.
      b. Functional Testing: 1 trips, 1 day minimum each.
   3. Training:
      a. Maintenance: 2 hours per session, 2 sessions.
   4. Process operational period:
      a. As required by Owner or Contractor.

C. Functional testing:
   1. Filter surface wash agitator:
      a. Test witnessing: Witnessed.
      b. Operate agitators at rated flow and pressure for 15 minutes.
      c. Confirm that equipment is properly assembled and equipment rotates in the proper direction.
      d. Confirm that bearing and shafting are installed and lubricated in accordance with proper tolerance, all nozzles are spraying water, and agitator spray covers entire filter surface area.
      e. Adjust equipment as necessary.

END OF SECTION

SECTION 46_61_20

FIBERGLASS FILTER TROUGHS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Removal and disposal of the existing fiberglass reinforced plastic troughs, weir plates, and support systems from the six filters. Each filter has four fiberglass reinforced plastic troughs.
   2. Installation of new fiberglass reinforced plastic troughs, weir plates, and support systems for the six filters. Each filter will have four new fiberglass reinforced plastic troughs placed. In total, there will be twenty four fiberglass troughs furnished for installation by the Contractor.

B. This specification was written such that the FSS will furnish the items covered by this section for installation by the Contractor. All other items shall be furnished and installed by the Contractor.

1.02 REFERENCES

A. American Water Works Association (AWWA):
   1. F101 - Standard for Contact-Molded, Fiberglass-Reinforced Plastic Wash Water Troughs and Launders.

B. ASTM International (ASTM):
   1. D256 - Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics.
   2. D570 - Standard Test Method for Water Adsorption of Plastics.
   3. D638 - Standard Test Method for Tensile Properties of Plastics.
   4. D790 - Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
   5. D2583 - Standard Test Method of Indentation Hardness of Rigid Plastics by Means of Barcol Impresser.

C. NSF International (NSF):
   1. Standard 61 - Drinking Water System Components - Health Effects.

1.03 SUBMITTALS

A. Submit as specified in Section 01_33_00 - Submittal Procedures and the following requirements.

B. Contractor’s field measurements of existing filters.

C. Shop drawings:
   1. Construction and erection details showing dimensions, attachments, support system details, and anchor bolt locations. Provide certified drawings.
   2. Complete description of components including troughs, weirs, anchoring materials, resins, catalysts, promotors, ultraviolet light inhibitors, and reinforcing materials.
   3. Instructions for handling, storage, and installation.
   4. Affidavit of compliance stating that material was manufactured, sampled, and inspected in accordance with AWWA F101.
   5. Certified for use within potable water in accordance with NSF Standard 61.

D. Calculations: Provide calculations sealed and signed by a professional structural engineer registered in the state of Florida for the following:
   1. Wind design calculations for troughs, trough support system, and anchorage system for troughs-to-supports connections, supports-to-concrete connections, specified in Section 01_81_50 - Design Criteria.
   2. Calculations for trough stress and deflection under loadings in accordance with AWWA F101, and as specified.

E. Quality control submittals:
   1. Provide representative laminate samples. Samples shall be taken from plant production and shall be representative of actual construction, workmanship, appearance, and surface hardness.
   2. Copies of laminate glass content test results from representative laminate samples including glass content and tensile/flexural test results.
   3. Qualifications and experience of the filter trough manufacturer.
   4. Inspection reports as specified under Source Quality Control.

F. Extended warranty.

1.04 QUALITY ASSURANCE

A. Manufacturer: Manufacturer of similar fiberglass-reinforced plastic washwater troughs for a minimum of 5 years on a minimum of 10 projects of similar applications.

B. References:
   1. Provide references from a minimum of 3 installations currently operating with similar washwater troughs in continuous service for a minimum of 3 years under similar operating conditions.
   2. Reference information shall include location, service, contact person, and contact phone number.

1.05 DELIVERY, STORAGE AND HANDLING

A. Delivery, storage, and handling shall be in accordance with manufacturer’s instructions.

B. Package, ship, and store products to prevent warpage or distortion.

1.06 WARRANTY

A. Manufacturer shall provide a full limited warranty against defects in workmanship and materials, deflection, or defects in excess of standards specified, and in accordance with AWWA F101.
   1. The warranty shall be provided for no less than 3 years and shall not be pro-rated.

PART 2 PRODUCTS

2.01 DESIGN AND PERFORMANCE CRITERIA

A. Trough manufacturer shall be responsible to design and provide the washwater troughs to be installed in each filter bay as indicated on the Drawings.

B. Trough manufacturer shall be responsible to design and provide the entire support system for the troughs including structural support members, connections from troughs to supports, connections from troughs to concrete filter structure, lateral bracing, and all other support system accessories and connections required for a complete installation.

C. Install washwater troughs in each filter as indicated on the Drawings.

D. Prior to fabrication of washwater troughs and support systems, take measurements for installation of troughs and verify dimensions indicated on the Drawings. Ensure troughs and ancillary appurtenances fit within the available space.

E. No part of the support system, including lateral supports, shall contact the filter media.
   1. Support systems shall be designed to not trap or hold water when the filter is drained.

F. Provide open-end connection at gullet wall and closed end at opposite end.

G. Filters use low- and high-rate water backwash cycles.

H. Trough flow capacity:
   1. Capacity shall be a minimum of 1440 gallons per minute at the discharge gullet (with free discharge at the gullet).
   2. Trough shall have uniform weir water loading per linear foot of length.
   3. Maintain a minimum of 2 inches freeboard below the weir edge in the trough under maximum flow conditions.

I. Design ambient temperature conditions (wetted or dry): 35 to 100 degrees Fahrenheit.

J. Filter media will be anthracite over silica sand and support gravel.
   1. Filter troughs will be intermittently exposed to chlorinated water up to 20 parts per million free chlorine.
   2. Filter backwashing will be completed with chloraminated water.

K. Filters are fully exposed to sunlight and the weather and require UV resistance.

L. All materials shall be for use in drinking water applications and materials shall comply with NSF 61 or other acceptable standards per F.A.C. 62-555.

2.02 MANUFACTURERS

A. One of the following or equal:
   1. F.B. Leopold Co., Inc., Zelienople, PA.
   2. Warminster Fiberglass, Southampton, PA.
   3. De Nora, Colmar, PA.
   4. Enduro Composites, Huston, TX

2.03 MATERIALS

A. Troughs:
   1. Fabricated of premium grade fiberglass-reinforced polyester resin, with fiberglass constituting a nominal 30 percent by weight.
   2. Inside surface of each trough shall have a smooth resin rich surface.
   3. Outside surface of trough shall be resin sealed with no exposed glass fibers.
      a. Outside surface shall have smooth finish.
   4. Color: White or Green, molded-in with ultraviolet inhibitor.
   5. Glass reinforcement: In accordance with AWWA F101.
   6. Resin:
      a. Resin shall contain no fillers or additives except as follows:
         1) Fillers up to 2 percent by weight of a thixotropic agent may be used for viscosity control in the parafinated top coat provided it does not interfere with visual inspection or chemical resistance of the laminate.
         2) Resin may contain pigments, dyes, or colorants which have been determined by at least 5 years previous service to be acceptable for the service condition without fading or chalking from original color standard.
      b. The cure system used for the resins shall be in accordance with the resin manufacturer's current recommendations. All products shall be cured to at least 90 percent of the minimum Barcol hardness specified by the resin manufacturer.
      c. A separately cured, unreinforced gel coat shall not be used.
         1) No surface shall be acetone sensitive.
   7. An ultraviolet stabilizer, 5 percent by weight, shall be added to all exposed surfaces.

B. Integral longitudinal stiffening ribs: Materials shall be free of rust, oil, and any foreign matter and shall be either epoxy coated steel or 316 stainless steel.

C. All support systems and hardware complete, including structural steel, bolts, nuts, washers, straps:
   1. Type 316 stainless steel.
   2. Anchor bolts and concrete epoxy anchors: As specified in Section 05_05_24 - Mechanical Anchoring and Fastening to Concrete and Masonry and Section 03_21_17 - Adhesive-Bonded Reinforcing Bars and All Thread Rods in Concrete.

2.04 TROUGH CHARACTERISTICS

A. Troughs shall be manufactured as follows:
   1. Round bottoms and vertical sides, unless otherwise indicated on the Drawings.
   2. Top edges of trough before addition of weir plates shall be level, straight, and parallel with a tolerance of no more than 1/8-inch deviation from true plane measured when the trough is unloaded.
   3. Laminate construction and design: In accordance with AWWA F101 and the following:
      a. Minimum thickness of structural layer:
         1) As required to meet the design requirements specified, or 3/8-inch minimum (whichever is thicker).
         2) Fabricate within a tolerance of 1/16 inch. In no cases shall the thickness be less than 3/16 inch.
   4. Thickness of laminate at all supports such as saddles shall be at least 150 percent of the nominal thickness of the trough.
   5. End flanges and blind ends shall be minimum of 1.5 times the nominal thickness of the trough.
   6. Where troughs are grouted into or passes through a wall, provide integrally molded water stop.
   7. Provide longitudinal stiffening ribs shall be integrally molded on the outside of the troughs to ensure rigidity.
      a. Longitudinal stiffening ribs shall be constructed of either epoxy coated steel or 316 stainless steel metal reinforcing materials completely encapsulated with a minimum of 1/8-inch thick laminate extending a minimum of 2 inches beyond the metal reinforcing material.
   8. Laminate cuts, slots, and holes for attachment of weir plates: Resin sealed in accordance with AWWA F101.

B. Minimum physical properties for 3/8-inch laminate thickness at 73 degrees Fahrenheit:
   1. Tensile strength (ASTM D638): 12,000 pounds per square inch.
   2. Flexural strength (ASTM D790): 19,000 pounds per square inch.
   3. Flexural modulus (ASTM D790): 900,000 pounds per square inch.
   4. Barcol hardness (ASTM D2583): 35 minimum.
   5. Izod notched impact (ASTM D256): 13 foot-pounds per inch.
   6. Water absorption (24 hour) (ASTM D570): 0.2 percent maximum.

C. Troughs shall be certified for use in potable water in accordance with NSF Standard 61.

D. Troughs shall be in accordance with AWWA F101.

E. Spacer rods:
   1. Sufficient plastic spacer rods shall be included to maintain a uniform width over the length of trough.
   2. Spacer rods shall be spaced to prevent buckling and to provide maximum resistance to water loading on the sidewall of the trough.

2.05 TROUGH AND SUPPORT SYSTEM DESIGN

A. Support system:
   1. Design to allow minimum 1-inch vertical and horizontal adjustment of the trough.

B. Troughs:
   1. Design end flanges and blind ends to be a minimum of 1.5 times the nominal thickness of the trough, conforming to the fiber stress limitations as specified, and designed for anchorage loadings.
   2. Fiber stress limitations:
      a. Design troughs for maximum wall stress under the most severe loading conditions to be less than or equal to 1,500 pounds per square inch in accordance with AWWA F101.
      b. Stress shall be calculated for the fiberglass only and shall not include any additional embedded reinforcing materials.
      c. This stress criterion is equivalent to an 8:1 safety factor as applied to the tensile and flexural properties of contact-molded troughs and launders.
   3. Deflection under load: Maximum upward or downward vertical deflection under full buoyant or gravity loads shall be less than or equal to L/1,000 where L is defined as the unsupported trough length in inches. Maximum vertical deflection, measured at mid-point between trough supports, shall not exceed 3/16 inches.
   4. Maximum trough sidewall horizontal deflection under full lateral load shall be less than or equal to D/100, where D is defined as the trough depth in inches.
      a. Under no circumstances shall the maximum sidewall deflection exceed 3/16 inches.
   5. Trough bottom deflection (oil canning) under full buoyant or gravity load shall be less than or equal to W/100, where W is defined as the tough width, in inches.
      a. Under no circumstances shall the maximum bottom deflection exceed 3/16-inch.

C. Design troughs, support systems, and anchors in accordance with the following loadings, and in accordance with specified stress and deflection limitations:
   1. Gravity load: Downward vertical loads shall include the weight of the trough and appurtenant attachments, such as weir plates and the spreader bars, together with the weight of water to fill and submerge the trough to the water surface elevation indicated on the Drawings.
      a. Any additional loads, such as surface wash piping, etc., shall also be considered.
   2. Buoyant load:
      a. The buoyant load shall act vertically upward, its magnitude equal to the weight of displaced water (trough weight neglected).
      b. The line of action passes through the centroid of the submerged cross-sectional area.
   3. Lateral load:
      a. Loads acting against the trough side walls, specifically those induced by differential water levels on either side of the trough walls.

b. The maximum possible differential, existing when the tough is empty and the tank is full, or when the trough is full and the tank is empty, shall be used when calculating deflection fiber stress.
c. Include sloshing load due to seismic forces on both the trough and the support system.

4. Thermal stresses:
   a. Design troughs to accommodate thermally induced stresses resulting from differences in coefficients of thermal expansion (and contraction) between the trough and tank/support materials.
   b. Design the troughs and support systems to accommodate no less than 1/8-inch trough movement per 20 feet length of trough over temperature range as specified, without exceeding the deflection or strain limitation set forth in referenced standards, and as specified.

D. Torsional stability:
   1. The trough system shall be designed to resist torsional oscillations induced by the flow of water over trough edges.
   2. The maximum torsional oscillation shall be in accordance with AWWA F101.
   3. Provide trough-to-trough and wall-to-wall stabilizers as required to prevent torsional oscillation, and at a minimum in accordance with AWWA F101.
   4. Any or all of the following trough stabilization techniques shall be considered:
      a. Trough-to-trough stabilization (or trough-to-support truss bracing).
      b. Torsional stiffeners within trough.
      c. Support spacing and rigidity.
      d. Internal baffles and/or flow straighteners.

2.06 SOURCE QUALITY CONTROL

A. Trough and weir plates finish and appearance shall meet requirements in accordance with AWWA F101.
   1. Furnish inspection reports for finish and appearance for fabricated trough and weir laminates.

B. Furnish affidavit that material was manufactured, sampled, and inspected in accordance with AWWA F101.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that dimensions are correct and project conditions are suitable for installation.
   1. Submit field measurements. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install products in accordance with manufacturer’s instructions.

B. Protect filter media, underdrain system, appurtenance, and existing concrete coatings from damage during trough installation.

C. All holes, and other cut surfaces shall be sanded smooth and resin sealed.

D. Ensure that products are installed plumb and true, free of warp or twist, within tolerances specified by the manufacturer, and as indicated in the Contract Documents.

E. Set in place with weir edges to elevations indicated on the Drawings.

F. Troughs shall be aligned and leveled, free of warp or twist, with no greater than 1/32-inch variation between any 2 points on the weir edge.
   1. Across individual filter basins, align trough weirs to within plus or minus 1/16 inch of each other.

G. Grout in place after leveling.

H. Filter boxes shall be individually filled with water to check trough elevation tolerances.

I. During backwashing, observe and inspect troughs for deflection, oscillation, cracks, blisters, surface porosity, chips, delamination, or other defects.
   1. Correct any deficiencies.

3.03 ADJUST AND CLEAN

A. Clean all trough surfaces after installation in accordance with manufacturer's instructions.

B. Remove trash and debris, and leave the site in a clean condition.

END OF SECTION