Appendix H

Design Specifications

90054690

SECTION 00 01 10

TABLE OF CONTENTS

Section Title

DIVISION 00 - PROCUREMENT AND CONTRACTING REQUIREMENTS

00 01 10 Table of Contents
00 01 20 Seals

DIVISION 01 - GENERAL REQUIREMENTS

01 10 00 Summary
01 30 00 Administrative Requirements
01 33 00 Submittal Procedures
01 35 00 Temporary Traffic Controls
01 35 29 Health and Safety Requirements
01 40 00 Quality Requirements
01 50 00 Temporary Facilities and Controls
01 57 13 Temporary Soil Erosion and Sediment Controls
01 57 19 Temporary Environmental Controls
01 60 00 Product Requirements
01 70 00 Execution and Closeout Requirements
01 91 00 Water Treatment Consumables
01 91 20 Facility Testing and Commissioning

DIVISION 02 - EXISTING CONDITIONS

02 55 00 Waste Material Solidification
02 61 14 Material Handling and Transportation
02 61 16 Off-Site Transportation and Disposal

DIVISION 22 – PLUMBING

22 05 53 Pipe Data Sheet – PVDF Tubing and Carrier Piping

DIVISION 23 - HEATING, VENTALATING AND AIR-CONDITIONS (HVAC)

23 05 53 Identification for Piping and Equipment

DIVISION 31 – EARTHWORK

31 05 19.13 Geotextiles for Earthwork
31 10 00 Site Clearing
31 23 16 Excavation
31 23 19 Dewatering
31 23 23 Fill

31 35 26.16 Geomembranes
31 37 00 Riprap
31 41 16 Sheet Piles

DIVISION 32 - EXTERIOR IMPROVEMENTS

32 31 13 Chain Link Fences and Gates
32 92 19 Seeding

DIVISION 35 - WATERWAY AND MARINE CONSTRUCTION

35 49 25 Turbidity Curtain

DIVISION 40 - PROCESS INTERCONNECTIONS

40 05 13 Common Work Results for Process Piping
40 05 33 High Density Polyethylene Process Pipe
40 05 51 Common Requirements for Process Valves
40 70 00 Instrumentation for Process Systems

DIVISION 46 - WATER AND WASTEWATER EQUIPMENT

46 07 01 Water Treatment System (WTS)

ATTACHMENTS

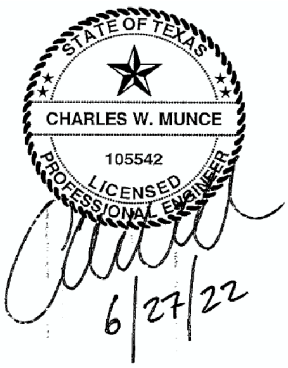
Attachment A Process Control Narrative

END OF SECTION

DOCUMENT 00 01 20

SEALS

Consultant for Civil:



Consultant for Structural:

Consultant for Process:

END OF SECTION

SECTION 01 10 00

SUMMARY

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. References.
2. Description of Project.
3. Location.
4. Access to the Work Site.
5. Scope of work.
6. Description of work.
7. Sequence of work.
8. Drawings.
9. CONTRACTOR use of the Work Site.
10. Work restrictions.

1.2 REFERENCES

A. Abbreviations and Acronyms:
1. NAVD88 – North American Vertical Datum of 1988.
2. USEPA -- United States Environmental Protection Agency.

1.3 DESCRIPTION OF PROJECT

A. The project is the Remedial Action (RA) for the Northern Impoundment of the San Jacinto River Waste Pits Superfund Site in Harris County, Texas, as described in the approved Final 100% Remedial Design for the Northern Impoundment (Northern Impoundment RD). The Northern Impoundment and associated locations at which the project will take place are referred to in these Specifications as the “Work Site.”

1.4 ACCESS TO THE WORK SITE

A. The Work Site is located directly north of the Interstate Highway 10 (I-10) bridge over the San Jacinto River. Access to the Work Site is available via Exit 786 off Highway I-10 (west of the I-10 bridge crossing), then heading east along the East Freeway Service Road which runs along the north side of I-10.

B. Make all necessary arrangements with the authorities having jurisdiction for the movement of CONTRACTOR material and equipment to and from the Work Site over public roadways.

1.5 SCOPE OF WORK

A. The Works to be performed consists of the RA, other than those elements of the RA that are expressly excluded.

1.6 DESCRIPTION OF WORK

A. The Works includes but is not limited to the following:
   1. Project startup.
   2. Development, implementation, and maintenance of required project plans, which may include plans included in the approved Northern Impoundment RD and/or the following:
      a. Temporary Traffic Control Plan (Section 01 35 00).
      b. Site-specific Health and Safety Plan (Section 01 35 29).
      c. Fall Protection and Prevention Plan (Section 01 35 29).
      d. Contingency and Emergency Response Plans (Section 01 35 29).
      e. Soil Erosion and Sediment Control Plan (Section 01 57 13).
      f. Dust Control Plan (Section 01 35 29).
      g. Storm Water Pollution Prevention Plan (Section 01 57 19).
      h. Flood Contingency Plan (Section 01 57 19).
      i. Hurricane and Severe Storm Plan (Section 01 57 19).
      j. Water Quality Control Plan (Section 01 57 19).
      k. Water Quality Monitoring Plan (Section 01 57 19).
      l. Water Treatment Plan (Section 46 07 01).
      m. Excavation Plan (Section 31 23 16).
      n. Material Handling and On-Site Transportation Plan (Section 02 61 14).
      o. Transportation Emergency Response Plan (Section 02 61 16).
   3. Mobilization to the Work Site.
   4. Installation and maintenance of temporary facilities and controls, including:
      a. Temporary access roads.
      b. Soil erosion and sediment controls.
      c. Staging pads.
      d. Temporary equipment decontamination pad.
      e. Water Treatment System (WTS).
   5. Work Site clearing, including removal, salvage, and storage of existing fence.
   6. Installation of a double steel sheet-pile wall approximately 3,300 feet in length around the entire perimeter of the Work Site, with a large portion of the sheet pile wall installed within the San Jacinto River. For that portion within the San Jacinto River, a turbidity curtain and oil boom will be installed only during installation and removal of the sheet pile wall.
   7. Removal of rock cover and geomembrane and/or geotextile.
   8. Excavation of impacted material.
   9. Excavation dewatering and conveying contact water from excavation(s) to the WTS for treatment and discharge to the river.
   10. Management of wet impacted material to remove free liquid (material must pass paint filter test prior to loading)
   11. Loading impacted material that passes the paint filter test for transportation and off-site disposal.
   12. Management of stockpiled materials awaiting off-site disposal.
   13. Reconstruction and restoration along shoreline.

14. Closeout including cleanup and demobilization; storage of materials; removal of equipment and material; and shutdown of WTS.
15. Restoration of work areas at the end of the Project.
16. Project closeout.

1.7 SEQUENCE OF WORK

A. Perform Works in an orderly and safe manner such that the movement and handling of materials, and potential exposure of personnel to Work Site-related contaminants and physical hazards are minimized.

1.8 CONTRACT TIMES

A. Perform the Works according to the following Contract Times:
   1. The Works at the Work Site shall be commenced after the date of notification from the OWNER to CONTRACTOR to proceed with the Works (Notice to Proceed).
   2. The Works shall be Substantially Completed on or before <_____>.
   3. The Works shall be fully completed and ready for final payment on or before <_____>.

1.9 DRAWINGS

A. Drawings issued with and forming part of the Contract Documents are provided under separate cover.

B. Perform the Works in accordance with the Drawings issued "Issued for Construction" (IFC) by ENGINEER. Such Drawings will be issued to CONTRACTOR with the Notice to Proceed and will consist of bid Drawings revised as required by ENGINEER and additional Drawings if required by ENGINEER.

C. Revised IFC Drawings may be issued from time to time by ENGINEER and such Drawings will supersede previous revisions.

1.10 CONTRACTOR USE OF THE WORK SITE

A. Limit use of the Work Site to allow:
   1. OWNER occupancy.

B. Construction Operations: Limited to areas noted on the Drawings.

C. Hours of Operation: Limit on-site hours of operation to the hours of 7 a.m. to 7 p.m. or as otherwise permitted under applicable access agreement(s), unless otherwise approved by ENGINEER.

D. CONTRACTOR employees working on the Work Site may be required to have a Transportation Worker Identification Credential (TWIC) issued by the United States Government. Any fees associated with obtaining and maintaining either certification card shall be borne by CONTRACTOR and not due reimbursement by OWNER. TWIC requires renewal every five (5) years.

E. When unfavorable weather or other unsuitable construction conditions exist, continue operations which will not be adversely affected by such conditions. Do not construct or cause to be constructed any portion of the Works under conditions which would adversely affect the quality of the Works, unless special means or precautions are taken to perform the Works in a proper and satisfactory manner.

1.11 WORK RESTRICTIONS

A. Monitor river levels daily. All work must be performed in compliance with the Health and Safety Plan.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

END OF SECTION

SECTION 01 57 19

TEMPORARY ENVIRONMENTAL CONTROLS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. References.
   2. Submittals.
   3. Regulatory requirements.
   4. Temporary Controls:
      a. Water quality monitoring.
      b. Dust and organic vapor control.
      c. Pollution control.
      d. Oil spill prevention and control.
   5. Construction equipment.
   6. Removal of temporary facilities and controls.

B. Related Requirements:
   1. Section 01 50 00 – Temporary Facilities and Controls.

1.2 REFERENCES

A. Abbreviations and Acronyms:
   1. BMPs: Best Management Practices.
   2. NOAA: National Oceanic and Atmospheric Administration.
   3. SDS: Safety Data Sheets.

B. Reference Standards:
   1. Section 01 40 00 - Quality Requirements: Requirements for references.
   2. EPA SWPPP Guide: Developing Your Stormwater Pollution Prevention Plan for Construction, EPA-833-R-06-004 May 2007.
   3. Texas Commission on Environmental Quality (TCEQ) Construction General Permit.

1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Submit a Storm Water Pollution Prevention Plan in accordance with EPA-833-R-06-004 and TCEQ SWPPP requirements. The plan shall be approved by ENGINEER and implemented prior to commencement of the Works.

C. Submit a Flood Contingency Plan.
   1. Include all necessary data related to actions to be taken in case of river elevation equals or exceeds 10 feet above NAVD88 at the San Jacinto River Gage in

Sheldon, Texas and the proposed measures to protect active work areas, remove stockpiled material from the flood area or backfill to stabilize open excavations, remove equipment and personnel from the flood area.
2. Identify material and equipment to be used to activate the plan.
3. Addresses emergency backfill capabilities such as availability of adequate fill material, type and availability of backfill equipment, and when emergency backfilling operations would be initiated during a high water period.

D. Submit a Hurricane and Severe Storm Plan. The Plan shall include, but not be limited to, the following:
1. What type of actions will be taken before storm strikes at the Work Site.
2. What weather conditions will require shutdown of the Works and removal of equipment and personnel.
3. Notes from continuous monitoring of NOAA marine weather broadcasts and other local commercial weather forecasts.
4. Equipment list with details on their ability to handle adverse weather conditions.
5. Methods which will be used to secure equipment left on-site during adverse weather conditions.
6. Evacuation or immediate reaction plans to be taken by personnel for sudden storm occurrences.
7. Operations procedures which will be used to secure critical equipment during adverse weather conditions.
8. Communications protocol with local law enforcement and fire and rescue agencies.

E. Submit a Water Quality Control Plan. At a minimum, the plan shall include the following information:
1. Methods and procedures of excavation and fill placement.
2. A description of contingency measures that will be implemented in the event water quality compliance criteria are exceeded during the performance of such activities.
3. A description of BMPs that will be implemented during shoreline construction activities to prevent adverse effects to water quality and to satisfy permit requirements and meet the Project goals.
    a. BMPs shall include a Work Site-specific Spill Prevention and Counter Measure or Pollution Control Plan that provides a Work Site plan; a spill containment plan; and measures to contain hazardous and non-hazardous materials.
    b. The spill containment control plan shall include the following information: notification procedures, specific cleanup and disposal instruction for different products, quick response containment and cleanup measures, proposed methods of disposal of spilled materials and employee training on spill containment.
4. The plan must be reviewed and approved by ENGINEER prior to the start of construction activity.

F. Submit a Water Quality Monitoring Plan in conformance with applicable requirements.

1.4 REGULATORY REQUIREMENTS

A. CONTRACTOR shall be fully familiar and comply with all applicable environmental acts, regulations and laws.

B. CONTRACTOR shall be responsible for water quality monitoring and environmental controls at the Work Site to ensure compliance with applicable Project requirements.

1.5 TEMPORARY CONTROLS

A. Water Quality Monitoring:
   1. CONTRACTOR is responsible for conducting water quality monitoring and for achieving water quality criteria throughout all construction activities as defined in the Field Sampling Plan (FSP), and applicable local, state and federal standards.
   2. If the results of the monitoring show that the water quality standards or Project performance standards are not being met, additional monitoring and mitigation action shall be taken.
   3. Any changes to the monitoring requirements must be approved in writing by ENGINEER.
   4. Excavation, stockpiling and filling activities shall be performed in a manner that does not adversely impact water quality.

B. Dust and Organic Vapor Control:
   1. Execute the Works by methods to minimize raising dust, odor, and organic vapor from construction operations.
   2. Implement and maintain dust, odor, and organic vapor control measures immediately during construction and in accordance with the State of Texas regulations and the action levels specified in the Air Monitoring Plan. Conduct and control activities to meet Work Site dust, odor, and organic vapor control limits as specified in the Air Monitoring Plan.
   3. Provide positive means to prevent airborne dust from dispersing into atmosphere. Use water from a source approved by ENGINEER for a water misting system for dust control.
   4. Do not use chemical means for a water misting system for dust control without ENGINEER's prior written approval.
   5. Do not apply vapor suppressing foam for odor and/or organic vapor control without ENGINEER's prior approval.
   6. As a minimum, use appropriate covers on trucks hauling fine, dusty, or vaporous material and use watertight vehicles to haul wet materials.
   7. Prevent dust and odor from becoming a nuisance to adjacent property owners or occupants.
   8. ENGINEER may stop work at any time when CONTRACTOR's control of dusts, odors, and organic vapor is inadequate for the wind conditions present at the Work Site, or when the air quality monitoring indicates that the release of fugitive dusts, odors, or organic vapor into the atmosphere equals or exceeds the specified levels.
   9. In the event that CONTRACTOR's dust, odors, or organic vapor control is not sufficient for controlling dusts, odor, or organic vapor into the atmosphere, work shall be discontinued, and a meeting held between ENGINEER and CONTRACTOR to discuss the procedures that CONTRACTOR proposes to resolve the problem. Make all necessary changes to operations prior to resuming any excavation, handling, processing, or any other work that may cause a release of dusts or organic vapors.
   10. Maintain and adjust odor and air emission control efforts as necessary to limit visible dust, dust above control limits of 5 mg/m3 in the work zone and 150 $\mu g/m^3$ at the Work Site perimeter, complaints of odors, or as directed by ENGINEER.

C. Pollution Control:
   1. Provide methods, means, and facilities to prevent contamination of soil, water, and atmosphere from discharge of pollutants produced by construction

operations.

2. Be prepared to intercept, clean up, and dispose of spills or releases that may occur, whether on land or water. Maintain materials and equipment required for cleanup of spills or releases readily accessible on Work Site.
3. Promptly report spills and releases to ENGINEER and OWNER. Examine SDS and contact the manufacturer of the pollutant, if known, and ascertain the hazards involved, precautions required, and best measures to be used in any cleanup or mitigating action.
4. Take immediate action using available resources to contain and mitigate the effects on the environment and persons from any spill or release.

D. Oil Spill Prevention and Control:
1. CONTRACTOR shall be responsible for prevention, containment, and cleanup of spilling of oil, fuel and other petroleum products used in CONTRACTOR's operations. All such prevention, containment and cleanup costs shall be borne by CONTRACTOR and shall be conducted in accordance with applicable regulations.
2. CONTRACTOR is advised that discharge of oil from equipment or facilities is not permitted.
3. CONTRACTOR shall, at a minimum, take the following measures regarding oil spill prevention, containment and cleanup:
   a. Fuel hoses, lubrication equipment, hydraulically operated equipment, oil drums, and other equipment and facilities shall be inspected regularly for drips, leaks, or signs of damage, and shall be maintained and stored properly to prevent spills. Proper security shall be maintained to discourage vandalism.
   b. Land-based oil and products storage tanks shall be diked or located so as to prevent spills from escaping. Diking and subsoils shall be lined with impervious material to prevent oil from seeping through the ground and dikes.
4. Maintain on the Work Site the following materials, as a minimum:
   a. Oil-absorbent pads or bulk material.
   b. Oil-skimming system.
   c. Hay bales.
   d. Oil dri-all gloves and plastic bags.

1.6 CONSTRUCTION EQUIPMENT

A. When heavy equipment is used, the equipment selected shall have the least adverse effects on the environment, e.g., minimally sized, low ground pressure.

B. The equipment operating with hydraulic fluid shall use only those fluids certified as non-toxic to aquatic organisms.

C. The equipment shall be free of external petroleum-based products.

D. Accumulation of soils or debris shall be removed from the drive mechanisms (wheels, tires, tracks, etc.) and undercarriage of equipment prior to its use. Check the equipment daily for leaks and complete any necessary repairs prior to commencing work activities near the water.

E. All stationary power equipment such as generators, cranes, or other stationary equipment, operated within 150 feet of any waterbody shall be diapered to prevent leaks unless suitable containment is provided to prevent potential spills for entering the water.

F. Refueling areas shall employ standard mitigations (e.g., a gently sloping area with compacted soils and three- sided containment berm) operator training, emergency response planning and equipment maintenance.

G. A refueling station shall be set up within the designated area so that any accidental leaks of petroleum products during equipment fueling and maintenance will be contained and managed within the refueling area. This station should have a liner/spill containment control features (e.g., collection systems, berms).

1.7 REMOVAL OF TEMPORARY FACILITIES AND CONTROLS

A. Comply with Section 01 50 00.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

END OF SECTION

SECTION 01 60 00

PRODUCT REQUIREMENTS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Basic product requirements.
2. Product options.
3. Product substitutions.
4. Product delivery and handling requirements.
5. Product storage and handling requirements.

1.2 BASIC PRODUCT REQUIREMENTS

A. Do not use materials and equipment removed from existing premises, except as specifically permitted by the Contract Documents.

B. Provide interchangeable components of the same manufacturer for components being replaced.

1.3 PRODUCT OPTIONS

A. Products Specified by Reference Standards or by Description Only: Any approved product meeting those standards or descriptions.

B. Products Specified by Naming One or More Manufacturers With a Provision Not Prohibiting Substitutions: Products of manufacturers named and meeting specifications. Submit a request for substitution for any manufacturer not named in accordance with the following article.

C. Products Specified by Naming One or More Manufacturers With a Provision Prohibiting Substitutions: Products of manufacturers named and meeting specifications, no options or substitutions allowed.

1.4 PRODUCT SUBSTITUTIONS

A. Document each request with complete data substantiating compliance of proposed substitution with the Contract Documents.

B. A request for substitution constitutes a representation that CONTRACTOR:
1. Has investigated the proposed product and determined that it meets or exceeds the quality level of the specified product.
2. Will provide the same warranty for the substitution as for the specified product.

3. Will coordinate installation and make changes to other Works which may be required for the Works to be complete at CONTRACTOR's expense and at no additional cost to OWNER.
4. Waives claims for additional costs or time extension which may subsequently become apparent.

C. Substitutions will not be considered when they are shown or implied on Shop Drawings or product data submittals without separate written request.

D. Substitution Submittal Procedure after the Notice to Proceed:
1. Submit three copies of request for substitution for consideration. Limit each request to one proposed substitution.
2. Submit Shop Drawings, product data, and certified test results and other data as required by ENGINEER attesting to the proposed product equivalence. Burden of proof is on CONTRACTOR.
3. ENGINEER will notify CONTRACTOR in writing of decision to accept or reject request.
4. ENGINEER will be sole judge as to the acceptance or rejection of CONTRACTOR's request.
5. In the event CONTRACTOR obtains ENGINEER's approval for the use of products other than that shown or specified, CONTRACTOR shall, at CONTRACTOR's own expense and using methods approved by ENGINEER, make all changes to the Works, including structures, piping, electrical, equipment, and controls, that may be necessary to accommodate this product.

1.5 PRODUCT DELIVERY AND HANDLING REQUIREMENTS

A. Make all arrangements for transportation, delivery, and handling of products required for prosecution and completion of the Works.

B. Arrange delivery of products to the Work Site in accordance with work sequence and in ample time to facilitate inspection prior to installation. Schedule deliveries to limit requirement for storage at the Work Site to the practical minimum.

C. Do not have products delivered to the Work Site until related Shop Drawings or Samples have been approved by ENGINEER.

D. Do not have products delivered to the Work Site until required storage facilities have been provided.

E. Transport and handle products in accordance with manufacturers' instructions.

F. Immediately on delivery, inspect shipments to ensure that products comply with requirements of the Contract Documents and reviewed submittals, quantities are correct, and products are undamaged.

G. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage.

1.6 PRODUCT STORAGE AND HANDLING REQUIREMENTS

A. Limit on-site storage of products to areas shown on the Drawings or otherwise approved by ENGINEER.

B. Make all arrangements and provisions necessary for storage of materials and equipment.

C. Place all excavated materials, construction equipment, and materials and equipment to be incorporated into the Works so as not to injure any part of the Works or existing facilities and so that free access can be had at all times to all parts of the Works and to all utility service company installations in the vicinity of the Works.

D. Store and protect products in accordance with manufacturers' recommendations and instructions and requirements of Specifications, with seals and labels intact and legible.

E. Store sensitive products in weathertight, climate-controlled enclosures. Protect products subject to ultraviolet degradation from direct exposure to sunlight.

F. For exterior storage of fabricated products, place on sloped supports, above ground.

G. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to avoid condensation or potential degradation of product.

H. Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.

I. Furnish equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.

J. Arrange storage of products to permit easy access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

K. Store materials and equipment neatly and compactly, and in locations that will cause a minimum of inconvenience to Other Contractors, public travel, adjoining owners, tenants, and occupants.

L. Protect delivered products from contamination or damage.

M. Do not use lawns, grass plots, or other private property for storage purposes without written permission of OWNER or other person in possession or control of such premises.

N. CONTRACTOR shall be fully responsible for loss or damage to stored products, materials, and equipment.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

END OF SECTION

SECTION 01 70 00

EXECUTION AND CLOSEOUT REQUIREMENTS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Examination.
2. Field surveying.
3. Restoration.
4. Progress cleaning.
5. Final cleaning.
6. Final decontamination.
7. Removal and disposal.
8. Protection.
9. Closeout procedures.
10. Project record documents.
11. Warranties.

1.2 EXAMINATION

A. Prior to commencement of work at the Work Site, inspect the Work Site with ENGINEER to review and establish the condition of surface features including existing roads, parking areas, monitoring wells, trees and other plants, grassed areas, fencing and gates, service poles, wires, paving, and survey benchmarks or monuments on or adjacent to the Work Site which may be affected by the Works.

B. Photograph roads and immediate adjacent areas; submit copies to ENGINEER. This inventory shall be mutually agreed between ENGINEER and CONTRACTOR and shall not thereafter be subject to dispute. Such inventory as may be amended, from time to time, will be used by ENGINEER to check compliance by CONTRACTOR with the requirements of the Contract Documents.

C. Provide ongoing review, inspection, and attendance during performance of the Works to properly document conditions. Promptly inform ENGINEER of any existing condition at the Work Site affected by the Works which may require restoration, repair, or replacement. Do not cover up any of the Works without prior approval from ENGINEER.

D. Maintain and protect existing structures and facilities at the Work Site from damage which may be affected by the Works while work is in progress. Repair or replace damage resulting from the Works to ENGINEER's approval.

E. Examine and verify specific conditions described in individual Sections.

F. Verify that utility services are available, of the correct characteristics, and in the correct location.

1.3 FIELD SURVEYING

A. Quality Assurance:
1. Employ a land surveyor registered in the State of Texas and acceptable to ENGINEER to perform survey work of this Article. CONTRACTOR's registered land surveyor shall complete pre-construction, in-progress, final grade, and as-built topographic surveys, sheet pile monitoring survey, and other survey activities necessary for design verification, and quantity calculations. If initial and subsequent surveys are in whole or in part performed by means of GPS-equipped construction equipment, perform supplemental control surveys approved by ENGINEER.
2. Notify ENGINEER in advance of commencing work on any part of the construction to enable ENGINEER to establish benchmarks and base lines.
3. Unless otherwise specified, ENGINEER will establish and provide to CONTRACTOR reference benchmarks and base lines adjacent to the Works. CONTRACTOR shall be responsible for laying out the Works from established reference points.
4. ENGINEER may, at any time, check CONTRACTOR's survey and layout work but this shall not relieve CONTRACTOR of any of its responsibilities to carry out the Works to the lines and grades set out according to the Drawings and Project Specifications or as otherwise necessary for performance of the Works according to the Contract Documents.

B. Submittals:
1. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
2. Submit paper and digital copies of registered drawing(s) of the Work Site and certificate signed by the land surveyor engaged by CONTRACTOR that the elevations and locations of the Works are in conformance with Project documents. Information shall include surface (XML) files, point files, CAD drawings and PDF figures. Provide digital copy, on USB memory stick or electronic file transfer or Compact Disc (CD) compatible for use with Windows 10, 64-bit and AutoCAD 3-D Civil (2019).
3. On request, submit documentation verifying accuracy of survey work.

C. Survey Reference Points:
1. Locate, preserve, and protect survey control and reference points.
2. Control datum for survey is that shown on the Drawings.
3. Promptly report to ENGINEER the loss or destruction of any reference point or relocation required because of changes in grades or other reasons.
4. Make good any errors entering into the Works through CONTRACTOR failure to notify ENGINEER concerning lack of preservation of such survey reference points.
5. Accurately replace or relocate disturbed survey control points based on original survey control. Make no changes without prior written notice to and approval from ENGINEER.

D. Examination:
1. Verify locations of survey control points prior to starting work.
2. Verify set-backs, easements, and clearances, confirm Drawing dimensions and elevations.
3. Promptly notify ENGINEER of any discrepancies discovered.

E. Survey Requirements:
1. Utilize recognized engineering survey practices. Locate and lay out the Works using properly calibrated instrumentation.
2. Establish elevations, lines, and levels and mark out work zone.
3. Periodically verify layouts by same means and methods.
4. Establish a minimum of four temporary benchmarks on the Work Site, referenced to established control points. Record locations, with horizontal and vertical data, on Project record documents.

5. Provide reasonable and necessary opportunities and facilities for setting points and making measurements during construction.
6. Confirm and document locations of all utilities.
7. Develop and make such additional detailed surveys as are needed for construction, such as benchmarks, slope stakes, batterboards, stakes for establishing the design elevations of excavations and final grades, as-builts, and other working points, lines, and elevations. Maintain benchmarks and base lines established by ENGINEER, existing property boundaries, lines and grade hubs, and other references and construction or survey points.
8. Record sheet pile locations.
9. Monitor sheet pile deflection at designated locations.

F. Record Documents:
1. Maintain a complete and accurate log of control and survey work as it progresses.

1.4 RESTORATION

A. As a minimum, restoration shall mean replacement, repairs, or reconstruction to a condition at least as good as or better than the condition prior to commencement of the Works.

B. Except where specifically required otherwise by other Sections, restore areas of the Works and areas affected by the performance of the Works to conditions that existed prior to commencement of the Works and to match condition of similar adjacent, undisturbed areas.

C. Ensure that restored areas match existing grade and surface drainage characteristics, except as otherwise specified, and ensure a smooth transition from restored surfaces to existing surfaces.

D. Do not alter original conditions without prior written approval from ENGINEER.

E. Without limiting the generality of the foregoing or other requirements of the Contract Documents, preserve and protect existing features encountered at the Work Site during performance of the Works including, but not limited to buildings, wells, structures, curbs and gutters, fences, pavement, manholes and catch basins, utilities, railroad sidings, roads, streets, walks, grassed areas, and other graded or improved areas.

F. Utilize construction methods and procedures during performance of the Works which keeps disturbance and damage of whatever nature to existing conditions to the practical minimum. Where work necessitates root or branch cutting, do not proceed without ENGINEER's prior approval.

G. Ensure that quality, grades, elevations, and the extent of bedding, cover, and other backfill materials including subgrades, finish grades, and thickness of pavements for roadways and parking areas are properly documented during their removal to ensure reconstruction to at least their original and functional condition.

H. Restoration Material: New, except as otherwise specified, not damaged or defective, and of the best quality for the purpose intended. Furnish evidence as to type, source, and quality of materials or products furnished when requested by ENGINEER or specified in other Sections.

I. Should any dispute arise as to the quality or fitness of materials, whether obtained on or off the Work Site, whether previously inspected by ENGINEER prior to use or not, the decision to use any material or product in the finished Works will rest solely with ENGINEER.

J. Remove from the Work Site clean material not approved for reuse.

K. Handle and store products and materials in a manner to prevent damage, adulteration, deterioration, and soiling and according to manufacturers' instructions when applicable.

L. Prior to commencement of restoration work, inform ENGINEER of proposed material, methods, and procedures to repair, replace, or reconstruct disturbed, damaged, or suspected damage to the Works.

M. Perform cutting, fitting, remedial, and coordination work to make the several parts of the Works fit together.

N. Except as specified otherwise, dismantle and salvage materials for reuse where practicable. Exercise due care when removing material for salvage. Repair or replace materials damaged through improper handling or through loss after removal.

O. Store and protect removed material approved for reuse in approved locations. Beginning of restoration work means acceptance of existing conditions.

P. Unless otherwise specified, restore pavement by:
1. Removing and replacing the entire portions between joints or scores.
2. Saw cutting surfaces, curbs and gutters, and similar structures or surfaces.
3. Protecting adjacent joints and load transfer devices and underlying granular materials.

1.5 PROGRESS CLEANING

A. Execute cleaning during progress of the Works.

B. Requirements of Regulatory Agencies:
1. In addition to the requirements herein, maintain the cleanliness of the Works and surrounding premises within the Works limits to comply with federal, state, and local fire and safety laws, ordinances, codes, and regulations.
2. Comply with all federal, state, and local anti-pollution laws, ordinances, codes, and regulations when disposing of waste materials, debris, and rubbish.

C. Coordinate cleaning operations with disposal operations to prevent accumulation of dust, dirt, debris, rubbish, and waste materials on or within the Works or on the premises surrounding the Works.

1.6 FINAL CLEANING

A. Execute final cleaning prior to Substantial Completion of the Works.

B. Clean debris from drainage systems.

C. Clean the Work Site; sweep paved areas and rake clean landscaped surfaces.

D. Repair pavement, roads, sod, and all other areas affected by construction operations and restore them to original condition or to minimum condition specified.

E. Maintain cleaning until acceptance by OWNER.

1.7 FINAL DECONTAMINATION

A. Perform final decontamination of construction facilities, equipment, and materials which may have come in contact with potentially impacted materials prior to removal from the Work Site.

B. Perform decontamination as specified in Section 01 50 00 to the satisfaction of ENGINEER. ENGINEER will have the right to direct CONTRACTOR to perform additional decontamination if required.

1.8 REMOVAL AND DISPOSAL

A. Remove surplus materials and temporary facilities and controls from the Work Site.

B. Dispose of all waste materials, litter, debris, and rubbish off the Work Site.

C. Do not burn or bury rubbish and waste materials on the Work Site.

D. Do not dispose of volatile or hazardous wastes such as mineral spirits, oil, or paint thinner in storm or sanitary drains.

E. Do not discharge wastes into streams or waterways.

F. Dispose of the following materials at an appropriate off-site facility approved by OWNER:
   1. Debris including excess construction material, litter, and rubbish.
   2. Spent Tyvek and other disposable personal protective equipment worn during final cleaning.
   3. Water removed from water storage tank, water generated from final decontamination operations including water storage tank cleaning.
   4. Lumber from the decontamination pads.

G. Dispose of materials according to Section 02 61 16.

1.9 PROTECTION

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for protection of installed work.

B. Protect installed work and provide special protection where specified in individual Sections.

C. Provide temporary and removable protection for installed products. Control activity in the immediate work area to prevent damage.

D. Prohibit traffic on landscaped areas.

E. Maintenance of Flow: Maintain the flow of water in existing sewers, drains, and watercourses. In the event that any emergency or situation should arise which requires interruption of normal operation of any existing systems, restore normal operation as soon as possible even though permission for such planned shutdown was obtained.

F. Flotation: Take necessary precautions against the flotation of any structures during construction. Make good any damage caused by flotation.

1.10 CLOSEOUT PROCEDURES

A. Submit written certification that the Contract Documents have been reviewed, the Works has been inspected, and that the Works is complete according to the Contract Documents and in compliance with applicable laws and regulations including, but not limited to, the provision of all applicable federal, state, and local health, safety, and environmental laws and regulations, including OSHA, and ready for ENGINEER's review.

B. Complete and furnish submittals to ENGINEER that are required by the Contract Documents.

1.11 PROJECT RECORD DOCUMENTS

A. Maintain one set of the following Project record documents on-site; record actual revisions to the Works to include:
   1. Drawings.
   2. Specifications.
   3. Reviewed Shop Drawings, product data, and Samples.
   4. Manufacturer's instruction for assembly, installation, and adjusting.
   5. Decontamination records.
   6. Erosion and Sediment Control inspections.
   7. Transportation and Disposal records.

B. Ensure entries are complete and accurate, enabling future reference by OWNER.

C. Store Project record documents separate from documents used for construction.

D. Retain all documents relating to the Project on-site including, but not limited to, emails, paper, sketches, testing results, and communications.

E. Record information concurrent with construction progress.

F. Specifications: Legibly mark and record a description of actual products installed.

G. Project Record Documents and Drawings: Legibly mark each item to record actual construction including:

1. Field changes of dimension and detail.
2. Details not on original Drawings.
3. Provide AutoCAD 3-D Civil (2019) files of as-built drawings on USB memory stick or electronic file transfer or Compact Disc (CD) compatible for use with Windows 10, 64 bit.

H. Remove ENGINEER title block and seal from all documents generated by CONTRACTOR.

I. Submit documents to ENGINEER.

J. Work Site Records: CONTRACTOR shall keep a complete, current, and permanent record at the Work Site of all data required to be maintained by the Contract Documents, including, but not limited to, the dates of commencement and completion of all aspects of the Works, daily records of the number of workers, the number and type of equipment engaged on the Works and on each division of the Works, survey information, and test results, and make such data available to ENGINEER upon request.

1.12 PRODUCT WARRANTIES

A. Obtain product warranties executed in duplicate by responsible Suppliers and manufacturers upon completion of the applicable item of the Works. Except for products put into use with OWNER's permission, leave date of beginning of time of warranty open until the date of Substantial Completion is determined.

B. Fill out original warranty forms in OWNER's name and register with manufacturers. Include coverage for specified performance requirements. Verify that documents are in proper form, contain full information, and are notarized.

C. Execute any special warranties and guarantees as required by the Contract Documents and laws or regulations.

D. Retain warranties until time specified for submittal.

E. Ensure that documentation regarding the terms of applicable warranties and all technical specifications, owners' manuals, operating instructions, or other information relating to materials or equipment that are covered by warranties are compiled.

F. For equipment or component parts of equipment put into service during construction with OWNER’s permission, submit documents after acceptance.

PART 2 PRODUCTS – Not Used

PART 3 EXECUTION – Not Used

END OF SECTION

SECTION 01 91 00

WATER TREATMENT CONSUMABLES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Water Treatment Chemical Requirements.

B. Related Requirements:
   1. Section 46 07 01 – Water Treatment System.

1.2 REFERENCES

A. DEFINITIONS
   1. IBC Tote: Intermediate bulk container, a reusable container for transportation and storage of bulk liquid and granular materials.
   2. WTS: Water Treatment System.

1.3 PROGRESS SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Provide product data sheets and SDS for all provided chemicals.

1.4 SYSTEM DESCRIPTION

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Final treatment chemical selection and dosage shall be confirmed by CONTRACTOR during execution of jar testing on the Work Site.

C. Maintain sufficient quantity of consumables to ensure uninterrupted excavation operation and operation of the WTS.

D. Water Treatment System: The WTS processes shall require the following (or equivalent chemicals) to facilitate successful water treatment:
   1. Coagulant (Ferric Chloride or approved equal).
   2. Polymer for WTS.
   3. Polymer for sludge thickening (provisional)
   4. Organosulfide
   5. Sand Filter Media.
   6. Anthracite filter media.
   7. Absolute filters
   8. Granular Activated Carbon Media.
   9. Bag filters.

E. Health and Safety:
   1. Provide SDSs for all chemical used on the Work Site.
   2. Follow manufacturer's instructions for safe handling and use.
   3. Document proper procedures for storing and handling all chemicals in the Project Health and Safety Plan (HASP).
   4. Provide storage and secondary containment accessories/provisions per manufacturer recommendations.

PART 2 PRODUCTS

2.1 WATER TREATMENT SYSTEM CHEMICALS

A. Consumable chemicals are estimated based on anticipated 29 million gallons of contact water. This includes precipitation, mounded water, and existing water in excavation cells.

B. Coagulant:
   1. Service: Coagulation of suspended particles in the impacted water.
   2. Storage Container: IBC Tote or approved equal.
   3. Chemical Product: Poly aluminum chloride (PAC) or approved equal.
   4. Estimated Total Quantities: 24,200 lbs.
   5. Other Requirements: Provide secondary containment for chemical as per supplier recommendations.

C. Polymer for WTS:
   1. Service: Flocculation of Dredged Sediment/Sludge.
   2. Storage Container: Bulk or IBC tote or approved equal.
   3. Chemical Product: Nalco Polymer 7194 or equal approved by ENGINEER
   4. Estimated Total Quantities: 6,100 lbs.
   5. Other Requirements: Provide secondary containment for drums and provide all necessary equipment per supplier recommendations for preparation/activation and dosing of chemical. Polymer shall be activated/diluted prior to dosing into sediment/sludge.

D. Polymer for sludge thickening (provisional):
   1. Service: Flocculation of sludge coming from the bottom of the clarifier.
   2. Storage Container: Bulk or IBC tote or approved equal.
   3. Chemical Product: Nalco Polymer 7194 or equal approved by ENGINEER
   4. Estimated Total Quantities: TBD
   5. Other Requirements: Provide secondary containment for drum and provide all necessary equipment per supplier recommendations for preparation/activation and dosing of chemical. Polymer shall be activated/diluted prior to dosing into sediment/sludge.

E. .Acid or Caustic (provisional):
   1. Service: pH adjustment of WTS.
   2. Storage Container: 55 gallons drum or IBC Tote or approved equal.
   3. Chemical Product: Sulfuric acid, 93 percent (generic), 50% sodium hydroxide or approval equal.
   4. Estimated Total Quantities: TBD
   5. Other Requirements: Provide secondary containment for acid or caustic storage.

F. Organosulfide (provisional):
   1. Service: Metals precipitation in the impacted water. Organosulfide may be added depending on influent soluble metals concentrations.
   2. Storage Container: IBC Tote or approved equal.
   3. Estimated Total Quantities: TBD
   4. Other Requirements: Provide secondary containment for chemical as per supplier recommendations.

G. Filter Media:
   1. Service: Removal of particulates following coagulation/flocculation.
   2. Storage Container: 23 kg bags or 500 kg super sacs or approved equal.
   3. Chemical Product: Liquid phase sand (0.45-0.55 UC)/anthracite (0.8 x 1.2 mm) filter media.
   4. Estimated Total Quantities: Assume one media filter change out per month of operation of the water treatment system per vessel. However, media change out will depend on quality of the effluent or differential pressure of each vessel.
   5. Other Requirements: CONTRACTOR shall be fully responsible for media filter vessel loading and removal/disposal of spent filter media.

H. Bag/Cartridge Filters:
   1. Service: removal of suspended particles larger than 1 micron. Bag or cartridge filters (10 micron and 1 micron, both with minimum 95% removal efficiency) will be configured downstream of the multimedia filters. As the filters are fouled (with captured solids), they will need to be removed and replaced.
   2. Estimated Daily Quantities: Will depend on clarification efficiency. It is expected that filters will need to be replaced on a weekly basis.
   3. Other Requirements: CONTRACTOR shall be fully responsible for filter change out and removal/disposal of spent filters.

I. Granular Activated Carbon (GAC) Media:
   1. Service: Removal of remaining chemicals of concern.
   2. Storage Container: 20,000 lbs
   3. Chemical Product: Virgin coconut shell GAC media, 8 x 30 mesh.
   4. Estimated Daily Quantities: CONTRACTOR should assume a minimum of one GAC media change out every 2 months of operation of the water treatment system per vessel. However, media change out will depend on quality of the effluent or differential pressure of each vessel.
   5. Other Requirements: CONTRACTOR shall be fully responsible for GAC vessel loading and removal/disposal of spent GAC media.

J. Summary Table of estimated chemical quantities:

Chemicals	Estimate Dosage (mg/L)	Estimated Quantity (lbs)
Coagulant	100	24,200
Polymer for WTS	25	6,100
Organosulfide	TBD	TBD
Polymer for sludge thickening	TBD	TBD
Acid/Base	TBD	TBD

PART 3 EXECUTION – Not Used

END OF SECTION

SECTION 01 91 20

FACILITY TESTING AND COMMISSIONING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. References.
2. Submittals.
3. CONTRACTOR's testing and startup representative.
4. Equipment testing.
5. Facility startup and performance evaluation.

1.2 REFERENCES

A. Definitions
1. Facility: The entire Works, or an agreed upon acceptable portion, including all of its unit processes.
2. Field Quality Control: Term, as used in individual Specification Sections, which refers to the specified on-site functional and performance testing of equipment.
3. Functional Test: Test or tests performed in the presence of ENGINEER and OWNER to demonstrate that the installed equipment meets the manufacturer's installation, calibration, and adjustment requirements and any other requirements as specified in the Contract Documents.
4. Performance Test: A test performed in the presence of ENGINEER and after any required functional tests have been completed, to demonstrate and confirm that the individual equipment meets the performance requirements specified in the individual Specification Sections.
5. Source Quality Control: Term, as used in individual Specification Sections, which refers to the specified testing performed on specified equipment at the manufacturer's facility prior to shipment.
6. Unit Process: As used in this Section, a unit process is a portion of the facility that performs a specific process function.

1.3 SUBMITTALS

A. Section 01 30 00 - Administrative Requirements: Requirements for submittals.

B. Completed Manufacturer's Certificate of Proper Installation as required by any individual Specification Sections. Submit prior to beginning any facility startup procedures.

C. Equipment Test Report Form: Provide a written test report form for each item of equipment to be tested, to include the following information, at a minimum:
1. Project Name.
2. Equipment or item tested.
3. Date and time of test.

4. Type of test performed (functional or performance).
5. Test conditions.
6. Test results.
7. Signature space.

D. Testing Plan:
   1. Functional and performance test schedules, test plan, procedures, and log format.
   2. Facility Startup and Performance Evaluation Plan: Submit prior to the commencement of startup.

E. Certification of calibration for testing equipment.

1.4 CONTRACTOR'S TESTING AND STARTUP REPRESENTATIVE

A. Designate and provide one or more of CONTRACTOR's personnel to coordinate and expedite testing and facility startup. Such person or persons shall be present during all equipment testing and facility startup meetings and shall be available, at all times, during the testing and the facility startup and the performance evaluation period.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION

3.1 EQUIPMENT TESTING

A. Preparation:
   1. General:
      a. Complete the installation of each unit and related processes before testing, including all related manufacturer's representative services.
      b. Provide qualified manufacturer's representatives, when required by individual Specification Sections, to assist in testing.
      c. Obtain, from the equipment manufacturer's representative, the manufacturer's certificate of proper installation, when required by individual Specification Sections.
      d. Schedule equipment testing and facility startup meetings to discuss the test schedule, plan of test, materials, chemicals and liquids required.
      e. Provide temporary valves, gauges, piping, test equipment and other materials and equipment required in order to conduct testing.
      f. Unless otherwise indicated in the Contract Documents, provide water, power and chemicals as required for all testing and facility startup.
   2. Cleaning and Checking: Prior to beginning functional testing:
      a. Calibrate all testing equipment in accordance with the manufacturer's instructions.
      b. Inspect and clean all equipment, devices, connected piping, and structures to ensure that they are free of foreign material.
      c. Lubricate equipment in accordance with the manufacturer's instructions.
      d. Turn rotating equipment by hand when possible in order to confirm that the equipment is not bound.
      e. Open and close valves by hand and operate other devices to check for binding, interference, or improper functioning.

f. Check the power supply to electric powered equipment for the correct voltage.
g. Adjust clearances and torque.
h. Test piping for leaks.

3. The “ready to test” determination will be made by ENGINEER based on completion of the following, at a minimum:
   a. Notification by CONTRACTOR of the equipment’s readiness for testing.
   b. Acceptable testing plan.
   c. Acceptable Operation and Maintenance Manuals.
   d. Receipt of the Manufacturer’s Certificate of Proper Installation, if so specified in the Contract Documents.
   e. Adequate completion of the Works adjacent to, or interfacing with, the equipment to be tested.
   f. Availability and acceptability of the manufacturer’s representative, when specified in the Contract Documents, to assist in testing of the respective equipment.
   g. Fulfillment of all other manufacturers’ responsibilities as specified in the Contract Documents to the satisfaction of ENGINEER.
   h. Completion of the equipment and electrical tagging.
   i. Delivery of all spare parts and special tools.

B. Functional Testing:
   1. Conduct as specified in individual Specification Sections.
   2. Notify ENGINEER and the manufacturer’s representative in writing prior to the scheduled date of testing.
   3. When, in ENGINEER’s opinion, the equipment meets the functional requirements specified in the Contract Documents, such equipment will be accepted for the purpose of advancing to the performance testing phase, if so required by individual Specification Sections.

C. Performance Testing:
   1. Conduct as specified in individual Specification Sections.
   2. Notify ENGINEER prior to the scheduled date of the test.
   3. Performance testing shall not commence until the equipment has been approved by ENGINEER as having satisfied the functional test requirements specified in the Contract Documents.
   4. Follow the testing plan approved by ENGINEER and detailed procedures specified in the Contract Documents.
   5. Unless otherwise indicated in the Contract Documents, furnish all labor, materials, and supplies required for conducting the test and taking all samples and performance measurements.
   6. Prepare a performance test report summarizing the test method and results.
   7. When, in ENGINEER’s opinion, the equipment meets the performance requirements specified in the Contract Documents, such equipment will be accepted as conforming to the Contract requirements. Such acceptance will be evidenced by ENGINEER’s signature on the Equipment Test Report.

3.2 FACILITY STARTUP AND PERFORMANCE EVALUATION

A. General:
   1. Equipment shall be accepted by ENGINEER as having met the requirements for functional testing as specified in the Contract Documents prior to facility startup.

2. Sequence each unit process to the point that the complete facility is operational for the evaluation of unit process and facility performance.
3. Demonstrate the proper operation of required interfaces within and between the individual unit processes.
4. Provide the Subcontractors' and the equipment manufacturers' respective staff with adequate notice in order to prevent delays.
5. Schedule ongoing Works so as not to interfere with, or delay, the completion of facility startup.
6. After the facility is operating, complete the performance testing of those items of equipment which have not been previously tested.

B. Facility Startup and Performance Evaluation Plan:
1. Develop a plan detailing step by step instructions for the startup of each unit process and the complete facility.
2. Include a method of evaluation and an overall performance report for each unit process.
3. The plan shall consist of bound copies of the Startup and Performance Evaluation Forms. Use one form for each unit process; use the sample form attached as a supplement to this Section, or one designed by CONTRACTOR which is acceptable to OWNER.
4. The Startup and Performance Evaluation Form will include the following, at a minimum:
   a. Description of the unit process being started.
   b. All equipment and devices included in the unit process.
   c. Unit process startup procedures (including but not limited to, valves to be open/closed, order of equipment startup).
   d. Requirements for all water, power, and chemicals needed for startup.
   e. CONTRACTOR's certification that each unit process is capable of performing its intended function(s), including fully automatic operation.
   f. Space for evaluation comments.

C. ENGINEER's Responsibilities:
1. Assist CONTRACTOR in developing a Facility Startup and Performance Evaluation Plan.
2. Operate the process units and devices, with the support of CONTRACTOR.
3. Provide labor and materials as required for sampling and laboratory analyses.

D. Facility Startup Period:
1. Startup sequencing of unit processes shall be as determined by CONTRACTOR.
2. Make all adjustments, repairs, and corrections necessary to complete the facility startup.
3. Startup of the entire facility or any portion thereof shall be considered complete when, in the opinion of ENGINEER, the facility or a designated portion of the facility has operated in the manner intended for 7 continuous days without significant interruption. This period is in addition to any training, functional, or performance test periods specified elsewhere in the Contract Documents.
4. Significant Interruption: May include any of the following events:
   a. Failure of CONTRACTOR to provide and maintain qualified on-site startup personnel as scheduled.
   b. Failure to meet the specified performance for more than 2 consecutive hours.
   c. Failure of any critical equipment or unit process that is not satisfactorily corrected within 5 hours after the commencement of the failure.
   d. Failure of any noncritical equipment or unit process that is not satisfactorily corrected within 8 hours after the commencement of the

failure.

e. Any other event which ENGINEER, in its sole discretion, deems to be a significant interruption.

5. A significant interruption will require that the startup in progress be stopped and restarted after all corrections are made.

E. Facility Performance Evaluation:
1. During the facility startup period, CONTRACTOR shall conduct a performance evaluation for the purpose of evaluating the full capabilities of the facility.
2. Certify, on the Facility Performance Evaluation Form, that each unit process is capable of performing its intended function(s), including fully automatic operation.

3.3 ATTACHMENTS

A. The attachment listed below forms part of this Section:
1. Startup and Performance Evaluation Form.

END OF SECTION

STARTUP AND PERFORMANCE EVALUATION FORM

OWNER:_____ PROJECT:_____

Unit Process Description: (Include description and equipment number of all equipment and devices):

Startup Procedure (Describe procedure for sequential startup and evaluation, including valves to be opened/closed, order of equipment startup, etc.):

Startup Requirements (Water, power, chemicals, etc.):_____

Evaluation Comments:_____

CONTRACTOR Certification that Unit Process is capable of performing its intended function(s), including fully automatic operation:

Firm Name:_____

Startup Representative:_____ Date:_____, 20
(Authorized Signature)

SECTION 02 55 00

WASTE MATERIAL SOLIDIFICATION

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Dewatering of waste material.
   2. Solidification of excavated waste material by blending with dry waste material or by adding solidification additives, where necessary.
   3. Sampling and analysis (moisture content and unconfined compressive strength, as required by disposal facility) of solidified waste material to demonstrate achievement of performance criteria.

B. Related Requirements:
   1. Section 46 07 01 Temporary Water Treatment System.

1.2 REFERENCES

A. Definitions:
   1. Waste material: Non-hazardous excavated solids and associated solids from water treatment system.

B. Reference Standards:
   1. Section 01 40 00 - Quality Requirements: Requirements for references.

1.3 PRE-INSTALLATION MEETING

A. Section 01 30 00 - Administrative Requirements: Pre-installation meeting.

B. Convene 1 week prior to commencing work of this Section.

C. Purpose of the meeting is to:
   1. Define responsibilities of parties and individuals.
   2. Establish lines of authority and communication.
   3. Review schedules.
   4. Review sequence of operations.
   5. Review methods of measurement.
   6. Review Solidification Plan.
   7. Review Quality Assurance/Quality Control Plan.

1.4 SEQUENCING

A. Section 01 10 00 - Summary: Requirements for sequencing.

B. Sequence work of this Section to commence after the Temporary Water Treatment System is ready to receive wastewater and is operational.

C. Do not commence excavation and solidification activities prior to ENGINEER's review of submittals specified in PART 1, SUBMITTALS.

1.5 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Solidification Plan: Submit within 7 days after the date of the Notice to Proceed and prior to mobilization to the Work Site. Include mixing methods, description of additives, results of bench scale testing on at least five representative samples demonstrating compliance with disposal facility performance criteria, sequence of operations, access, lay down area requirements, and equipment to be used.

C. Daily Field Installation Report:
   1. Submit no later than 3 days following date covered by report. Include:
      a. Types and amounts of additives used.
      b. Estimated quantity of additive used per cubic yard of waste material.
      c. Number and identification of quality assurance/quality control samples taken.
      d. Results of quality assurance/quality control testing on waste material and solidified waste material.
      e. Volume of dewatering from waste material.

D. Quality Assurance/Quality Control Plan:
   1. Submit with the Solidification Plan. Include sampling and testing protocol to confirm compliance with requirements. Include:
      a. List of test methods.
      b. Frequency of sampling (see Paragraph 3.6 B).
      c. Manufacturer's quality control plan for solidification additives.
      d. Means to confirm that shipments of solidification additives are capable of achieving performance criteria in solidified waste material.
      e. Disposal facility solidification performance criteria for acceptance of waste material by the disposal facility.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products..

B. Protect solidification additive materials from wind, rain, and humidity and store according to manufacturer’s instructions. Handle in such manner as to minimize generation of dust and to control particle agglomeration.

1.7 AMBIENT CONDITIONS

A. Suspend operations whenever climatic conditions, as determined by ENGINEER, are unsatisfactory for meeting requirements of this Section.

B. Runoff Control:
   1. Keep work area dewatered during solidification activities. Direct surface runoff collected within work area during solidification of waste material to the Temporary Water Treatment System.
   2. Ensure runoff from work area does not flow into or over adjacent lands. Restore areas impacted as result of inadequate surface runoff control.

C. Dust Control: Transport, store, and mix specified solidification additives in such manner as to minimize generation of dust. Include in the Solidification Plan material handling procedures and dust control measures sufficient to minimize or eliminate dust generation.

D. Do not solidify waste materials under conditions that would cause excessive dust (such as heavy winds) or in temperatures that would prevent adequate performance of additives.

E. Solidification shall not be performed during periods of heavy rainfall if this will result in the addition of excess water to the mixture.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. The treated waste material shall meet the solidification performance criteria of the disposal facility (i.e., pass paint filter test and have sufficient strength for acceptance at the landfill) based on samples collected and analyzed by CONTRACTOR.

B. Emission Controls: Include control apparatus necessary to meet local, state, and/or federal regulations for air emissions and dust.

C. Noise Control: System shall meet state and local noise pollution control regulations at any Site boundary.

D. Mixing Equipment: Minimum capacity adequate to meet performance criteria and schedule requirements and shall be equipped with positive means for controlling the mix proportions, maintaining the time of mixing constant, and maintaining the appropriate speed of rotation of the mixer.

E. Reagent Feed Units: Provide satisfactory means, incorporating weighing, metering, or volumetric measurement to separately batch the required amount of each reagent. Provision shall be made so that each reagent can be easily sampled.

F. Accuracy of Measurement Equipment: Scales, meters, and volumetric measuring devices used for measuring waste material, reagents, and water for waste material processing shall be accurate to plus or minus 0.1 percent of the quantity being measured. Perform a check of calibration of measuring equipment once every 5 working days.

G. Mix Design: Select a mix design. Data from solidification treatability tests can be made available upon request.

2.2 SOLIDIFICATION ADDITIVES

A. Solidification additives may include, but are not limited to:
   1. Portland Cement.
   2. Lime.
   3. Fly Ash.

B. Waste material from drier portions of the excavation, where present, should be used prior to the addition of solidification additives.

2.3 SUMPS

A. Weighted, perforated, filter-cloth-wrapped, 55-gallon drums, or system of equivalent effectiveness as proposed by CONTRACTOR.

2.4 SOURCE QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Testing, inspection, and analysis requirements.

B. Required product and test data according to accepted Quality Assurance/Quality Control Plan.

C. Solidification additives data sheets and Safety Data Sheets (SDSs).

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 70 00 - Execution and Closeout Requirements: Verification of existing conditions before starting work.

B. Verify that Temporary Water Treatment System is ready to receive water.

C. Verify that surfaces and Site conditions are ready to receive work.

3.2 EQUIPMENT

A. Capable of mixing and solidifying waste material in an efficient manner.

3.3 DEWATERING

A. Dewater waste material on constructed dewatering pad(s) as necessary prior to further solidification.

B. Provide pumps, piping, hoses, screens, fittings, valves, sumps, and appurtenances as required for removal of water from the dewatering pad.

C. Equip pump suctions with flotation devices, screens, and/or place within sumps to prevent removal of debris and sediment or sludge

3.4 WASTE MATERIAL SOLIDIFICATION

A. Following dewatering of waste material as necessary, prepare and mix solidification additives with waste material to ensure uniform physical properties, in accordance with accepted Solidification Plan. This may be conducted in situ prior to excavation of material, or ex situ on a prepared dewatering pad.

B. Collect and analyze samples of solidified material to confirm adequate solidification, according to disposal facility performance criteria. Collect and analyze samples in accordance with the requirements of the disposal facility. If mixed waste materials do not meet performance criteria, modify mix design and remix material until performance criteria are met.

C. Modifications to mix design to meet performance criteria shall be at no additional cost to OWNER.

3.5 TRANSPORTATION OF SOLIDIFIED WASTE MATERIAL

A. Load and transport solidified waste material into transport vehicles for off-site disposal in accordance with Section 02 61 16 Off-Site Transportation and Disposal.

3.6 FIELD QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Field inspecting and testing.

B. CONTRACTOR shall sample solidified waste material for waste characterization analysis at a frequency to be determined by the disposal facility.

3.7 CLEANING

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for cleaning.

B. Remove equipment and surplus raw materials.

END OF SECTION

SECTION 02 61 14

MATERIAL HANDLING AND TRANSPORTATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Loading, handling, and transportation of waste materials excavated from work areas using CONTRACTOR-constructed access roads.

B. Loading and transportation of imported structural fill, topsoil, and aggregate from off-site source.

1.2 REFERENCES

A. Section 01 40 00 - Quality Requirements: Requirements for references.

B. Environmental Protection Agency (EPA): SW-846 Method 9095B - Paint Filter Liquids Test.

1.3 SYSTEM DESCRIPTION

A. This Section applies to planning, and providing equipment and services necessary to load, transport, unload and stockpile (as necessary), and handle the following materials, and to decontaminate the equipment.
   1. Soil fill (for between double sheet pile walls).
   2. Topsoil (general restoration).
   3. Coarse aggregate (access roads/ramps)
   4. Structural fill (base material for temporary access roads/ramps, and construction of restored south embankment).
   5. Sand (temporary dewatering facility and containment areas).
   6. Clear stone (treated water discharge to river and dewatering facility sump).
   7. Riprap (river discharge and south embankment restoration).
   8. Liquids (dewatering).
   9. Construction materials (impacted and non-impacted materials).

B. Refer to Section 02 61 16 for Off-Site Transportation and Disposal.

1.4 PROGRESS SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Material Handling and On-Site Transportation Plan:
   1. Submit within 14 days after the date of the Notice to Proceed and prior to mobilization to the Work Site.
   2. Before beginning any excavation, finalize the Material Handling and On-Site Transportation Plan based on comments received.

3. The Plan shall describe how consolidated materials will be handled, staged, loaded, transported on the Work Site and on public roads, and how equipment will be decontaminated, including list of type and size of transport vehicles. The Plan shall be designed so that handling and transportation measures prevent the spread of contamination and ensure compliance with local restrictions.
4. The Plan shall be designed with traffic controls which comply with applicable traffic regulations with respect to public roads. As a minimum, the Plan shall consider including the use of flagpersons and appropriate signage at all times when vehicles are utilizing entrances to public roads.
5. The Plan shall include local permits, if needed, to transport materials on public roads.

1.5 ENVIRONMENTAL REQUIREMENTS

A. Safeguards and Protective Barriers:
   1. Provide protective barriers to minimize the spread of contamination during handling. Items may include tarpaulin on a wooden frame to protect the side of the truck during loading, plastic sheeting on the ground during loading and unloading, and dump ramps during unloading to protect the undercarriage.
   2. Provide appropriate safeguards (e.g., bump guards, signs) as necessary.

PART 2 PRODUCTS

2.1 VEHICLES AND CONTAINERS

A. Motor Vehicles and containers designated for use only for specific materials in the Material Handling and Transportation Plan shall be so labeled or identified.

B. Motor Vehicles: Refer to Section 02 61 16.

C. Containers, Truck Beds and Roll on/Roll off Boxes:
   1. Free from drain holes, cracks, or other conditions that might allow leakage of liquids or solids.
   2. Free from conditions that might allow waste to accumulate.
   3. Fully lined to prevent leakage when transporting waste material off-site.
   4. Covers to prevent accumulation of rain water or release of dust.

2.2 WATER STORAGE TANKS

A. Refer to Section 46 07 01.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 70 00 - Execution and Closeout Requirements: Verification of existing conditions before starting work.

B. Verify that surfaces and the Work Site conditions are ready to receive work.

3.2 MATERIAL HANDLING AND TRANSPORTATION

A. General:
   1. Take necessary precautions for safe operation of the equipment and protection of the public, workers, and the environment from injury and damage from equipment. Operators shall be properly licensed and insured.
   2. Equipment and tools associated with impacted materials shall be used exclusively for that purpose until released. Items shall be decontaminated in accordance with Paragraph 3.2 E and the Material Handling and On-Site Transportation Plan.
   3. Keep a log in each truck recording the following information for each trip:
      a. Date and time of loading.
      b. Area within the Work Site from which the material was obtained.
      c. Destination.
      d. Quantity (e.g., approximate cubic yards, approximate weight, or specific number of containers).
      e. Date and time of unloading.
   4. When not in use, secure vehicles in the secured excavation support areas, with keys removed and doors locked. Security shall be solely the responsibility of CONTRACTOR.

B. Loading:
   1. Inspect vehicles/containers before loading of excavated material (to be disposed of off-site) at the excavation areas to verify that no water or liquid has been introduced and the vehicle/container has not been damaged. Test seals on watertight containers on a weekly basis to confirm seals are watertight. Maintain a log of seal testing.
   2. Use protective barriers around transport vehicles and take care to prevent spread of excavated materials to the ground surface beyond the excavation limits.
   3. Install and secure truck bed covers over non-containerized material. Secure tailgates during transit.
   4. Decontaminate vehicles before leaving the work area as required by the Material Handling and Transportation Plan. Collect and transport sediments removed from vehicles and equipment for off-site disposal in accordance with Section 02 61 16.

C. Transportation:
   1. Control free water from the waste materials. Do not track material onto clean areas or transportation routes.
   2. Collect, pump, and/or transport contact water to Temporary Water Treatment System. This includes water pumped from excavations, stockpile pads, and decontamination pad(s). Control water handling to prevent accidental spills in accordance with Section 01 50 00 – Temporary Facilities and Controls.
   3. Do not deviate from the on-site transportation routes approved by ENGINEER without prior written approval from ENGINEER.
   4. In the event of accidents, spills, or releases, comply with Paragraph 3.2 F.

D. Dewatering and Solidification of waste material: Dewater and solidify (as necessary) waste materials that fail the Paint Filter Liquids Test. Dewater by drainage, aeration, or other methods, including construction of dewatering pad at the CONTRACTOR's option. Transport collected water to temporary Water Treatment System. If natural dewatering is not successful, solidify waste material according to Section 02 55 00.

E. Decontamination:
   1. Decontaminate equipment that has been in impacted areas. Complete gross decontamination by removing soil, waste material, and debris from the exterior, underbody, and between tires before leaving an impacted area. Remove soil, waste material, and debris using scrapers, brushes, rags, or similar means.
   2. Collect materials removed from vehicles/containers and dispose off-site.
   3. Use decontamination areas only for light and final decontamination and not for gross decontamination (e.g., removal of bulk visible materials). Perform gross decontamination, if required, as part of earthwork at the area where trucks are loaded or unloaded. Repeat decontamination as needed.
   4. Visually inspect decontaminated vehicles and maintain log of inspections at the Work Site. Provide decontamination inspection log to ENGINEER on a monthly basis.

F. Spills and Accidents: Perform spill control and cleanup in accordance with Section 02 61 16. Notify ENGINEER and implement the appropriate response immediately upon learning of an accident, spill, or release of impacted material.

3.3 TEMPORARY STOCKPILES

A. Temporary stockpiles for excavated waste material will be allowed, however CONTRACTOR shall propose containment methods for both waste material and surface water.

B. Obtain ENGINEER's approval for locations of temporary stockpiles. Obtain ENGINEER's approval prior to placing material in such stockpiles.

C. Construct stockpile sites so that they are level, well drained, free of foreign materials, and of adequate bearing capacity to support the weight of the materials to be placed thereon.

D. Provide and maintain access to stockpiles.

E. Separate differing materials with substantial dividers or stockpile apart to prevent mixing.

F. Prevent intermixing, contamination, or segregation of soil types.

G. Direct surface water away from stockpile site to prevent erosion or deterioration of materials.

H. Maintain temporary stockpile slopes not steeper than 2.5 horizontal to 1 vertical. In no instance shall stockpiles be greater than 12 feet in height above original surrounding grade, unless otherwise approved by ENGINEER. Place hay or straw bales or other soil erosion and sediment control fencing at the base of and around each temporary stockpile to contain soil that may be washed off the stockpile.

I. Maintain area surrounding stockpiles in neat and tidy condition.

END OF SECTION

SECTION 02 61 16

OFF-SITE TRANSPORTATION AND DISPOSAL

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Supply, operation, and maintenance of transport vehicles/containers.

B. Preparing transport vehicles/containers for off-site transportation.

C. Loading and securing materials in transport vehicles/containers.

D. Decontaminating vehicles/containers prior to leaving the Work Site.

E. Transporting materials from the Work Site to OWNER-selected TSDF.

F. Preparation of shipping documents including manifests and bills of lading.

G. Maintaining transportation records as required by regulatory agencies.

H. Obtaining documents from TSDF.

1.2 REFERENCES

A. DEFINITIONS
1. DOT: Department of Transportation.
2. Non-Hazardous Materials: Materials not regulated by 40 CFR 261, 40 CFR 273, 40 CFR 279, and 49 CFR 761, or equivalent state regulation.
3. TSDF: Treatment, storage, or disposal facility.

B. REFERENCE STANDARDS
1. Section 01 40 00 - Quality Requirements: Requirements for references.
2. United States Federal Government - Code of Federal Regulations (CFR):
   a. 40 CFR 261 - Identification and Listing of Hazardous Waste.
   b. 40 CFR 262 - Standards Applicable to Generators of Hazardous Waste.
   c. 40 CFR 263 - Standards Applicable to Transporters of Hazardous Waste.
   d. 49 CFR 171 - General Information, Regulations, and Definitions.
   e. 49 CFR 172 - Hazardous Materials Table, Special Provisions, Hazardous Materials Communications, Emergency Response Information, and Training Requirements.
   f. 49 CFR 173 - Shippers - General Requirements for Shipments and Packaging.
   g. 49 CFR 177 - Carriage by Highway.
   h. 49 CFR 178 - Specifications for Packagings.
   i. 49 CFR 383 - Commercial Driver’s License Standards; Requirements and Penalties.

j. 49 CFR 385 - Safety and Fitness.
k. 49 CFR 387 - Minimum Levels of Financial Responsibility for Motor Carriers.
l. 49 CFR 390 - Federal Motor Carrier Safety Regulations.
m. 49 CFR 391 - Qualifications of Drivers.
n. 49 CFR 392 - Driving of Motor Vehicles.
o. 49 CFR 393 - Parts and Accessories Necessary for Safe Operation.
p. 49 CFR 395 - Hours of Service of Drivers.
q. 49 CFR 396 - Inspection, Repair, and Maintenance.
r. 49 CFR 397 - Transportation of Hazardous Materials; Driving and Parking Rules.

1.3 PROGRESS SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Transportation and Disposal Plan: Submit for review and approval a plan for transportation and disposal of materials 14 days prior to transportation and disposal of materials from the Work Site, allowing time for review and approval prior to removing any material from the Work Site. Include relevant transporter and TSDF identification and regulatory classification and status, methods of transportation and disposal, contingency plans for spills during transportation, and schedule for transportation and disposal. Identify TSDF-specific requirements for waste profiling sampling and analyses to determine acceptance.

C. Transportation Emergency Response Plan addressing:
1. Instructions for compliance with 49 CFR 171.15 and 49 CFR 172, Subpart G.
2. All aspects and considerations arising from transport incidents involving impacted materials.
3. Procedures for incident response.
4. Methods to contain and clean up releases in accordance with Section 01 35 29 – Health and Safety.
5. Details of manpower and equipment available.
6. Coordination necessary to mobilize in an emergency.
7. Traffic maintenance and warning procedures.
8. List of emergency numbers for information and notification for each applicable state.
9. List of name and telephone number of the contact at the pickup and destination facilities.
10. Name and telephone number of CONTRACTOR's Emergency Response Coordinator and the Transportation Representative.
11. Accident/incident reporting requirements.
12. A current copy of the Federal Motor Carrier Safety Rating assigned by the Federal Highway Administration (FHWA) to transportation provider. Provider receiving notification by the FHWA of a "conditional" or "unsatisfactory" rating will be ineligible to transport impacted materials.
13. A copy of the TSDF permit, including both USEPA and state identification numbers.
14. A copy of the certificate of insurance, location of the TSDF facility, process description, and impacted materials packaging requirements.
15. Qualifications of motor vehicle operators:
16. Statement that motor vehicle operators meet the requirements of 49 CFR 383, 49 CFR 391, 49 CFR 392, and 49 CFR 395.
17. A listing of storage time limits for all material designated for off-site transportation, and methods for ensuring compliance with these limits.

D. TSDF Requirements:
   1. For each TSDF accepted by OWNER, provide TSDF requirements to ENGINEER including:
      a. Any TSDF-specific packaging requirements for shipments.
      b. TSDF restrictions by wastestream which may cause rejection of transported materials.
      c. Any wastestream-specific pre-approvals required by federal or state agencies prior to acceptance of wastestream by TSDF.
      d. Restrictions on delivery schedules.
      e. Type and frequency of routine additional sampling and analysis of materials by wastestream which are required during transport and disposal activities prior to delivery to TSDF.
      f. Additional sampling and analysis of materials that will be conducted by TSDF during receipt of shipments to verify waste profiles.
   2. Each TSDF shall disclose the name and telephone number of the contact at the lead agency responsible for TSDF primary permits who has knowledge of and can verify the existence of existing corrective action programs which may impact the ability of TSDF to accept materials from the Work Site.

E. Operating Licenses and Permits:
   1. Include letter from each proposed TSDF stating that it is in compliance with its federal, state, and local permits and that permits are current for the duration of the off-site disposal activities from the Work Site.
   2. Include copies of valid operating licenses and permits from each transporter for each proposed transport vehicle/container.

F. Transportation Routes: Submit plans showing transportation routes or alternate routes which will be used to transport materials to OWNER-selected TSDF prior to commencing transportation of materials from the Work Site. Comply with applicable federal, state, and local regulations.

G. Qualifications of Motor Vehicle Operators:
   1. Signed affidavit stating that all vehicle operators handling hazardous waste are HAZMAT trained in accordance with 49 CFR Part 172, Subpart H.
   2. Statement that motor vehicle operators meet the requirements of 49 CFR 383, 49 CFR 391, 49 CFR 392, 49 CFR 395, 49 CFR 397, 49 CFR 172 Subpart H, and 49 CFR 177.

H. Shipping and Disposal Documents:
   1. Include blank sample forms of proposed shipping and disposal documents.
   2. Include complete copies of waste profiles.
   3. Include completed copies of shipping and disposal documents including manifests and/or bills of lading on standard approved forms, including a copy of each form signed by the transporter prior to leaving the Work Site and a copy of each form signed by TSDF accepting the shipment.
   4. Use shipping and disposal documents of consignment state where so required. Obtain shipping documents from consignment state prior to shipment from the Work Site.

I. Supplemental Indemnifications: For each TSDF which provides a supplemental indemnification (e.g., Superfund Indemnification), obtain such indemnification for the benefit of OWNER.

J. Weigh Tickets: Submit weigh tickets generated at off-site weigh scale in accordance with PART 3, OFF-SITE IN-TRANSIT WEIGHING (BULK SHIPMENTS).

K. Weigh Scale Calibration: Submit prior to commencing transport of materials off-site, a calibration chart, completed within the previous 6 months, for the weigh scale. The weigh scale shall be calibrated by the State of Texas registered agency.

1.4 QUALITY ASSURANCE

A. ENGINEER will perform waste profiling analyses of Non-Hazardous waste materials scheduled for off-site disposal prior to the date of the Notice to Proceed. This information will be made available to the CONTRACTOR in coordination with transport of waste to TSDF.

1.5 QUALIFICATIONS

A. Motor Vehicle Operators:
   1. Before off-site transportation services are rendered, motor vehicle operators (drivers) shall meet the requirements defined in the Transportation Emergency Response Plan.
   2. Have available the following information before any off-site transportation activity:
      a. A medical examiner's certificate, or a legible photographic copy of a certificate, or a statement attesting to a record on file with CONTRACTOR of a medical examiner's certificate on each motor vehicle operator's physical qualifications to operate a motor vehicle in accordance with 49 CFR 391.43 and 49 CFR 391.41.
      b. A statement certifying that CONTRACTOR, at least once every 12 months, reviews the driving record of each motor vehicle operator it employs, in accordance with 49 CFR 391.25. Include in this statement a list of any violations of motor vehicle traffic laws in accordance with 49 CFR 391.27.
      c. A valid commercial driver's license for each motor vehicle operator.

B. Replace any motor vehicle operator deemed unacceptable for transporting impacted materials.

1.6 ENVIRONMENTAL REQUIREMENTS

A. Do not spill, leak, or otherwise release materials from transport vehicles and containers during loading and unloading operations or while in transit from the Work Site to TSDF.

B. Do not generate dusting conditions when loading bulk solids.

C. Clean up any and all spills or leaks in transit.

PART 2 PRODUCTS

2.1 POLYETHYLENE SHEETING

A. Continuous sheeting, minimum 0.006 inch (6 mil) thick, fabricated from a single ply of construction-grade polyethylene plastic.

2.2 TUB LINER

A. Tub Liners for Bulk Solid Shipments: Pre-manufactured fitted polyethylene tub liner or continuous single sheet of polyethylene sheeting.

2.3 CONTAINERS, PACKING MATERIAL, AND LABELS

A. Comply with DOT, federal, state, and local regulations.

B. Transport vehicles (e.g., tractors and roll off containers) that meet the requirements of 49 CFR.

C. Securement systems, especially tiedown assemblies (e.g., chains, cables, steel straps, and fiber webbing); load binders and hardware (e.g., hooks, bolts, welds, or other connectors); and winches or other fastening devices that are without visual damage from wear or misuse and that meet the requirements of 49 CFR 393, Subpart I.

D. Weatherproof tarpaulins that are without visual damage from wear or misuse; are of a quality highly resistant to tears, rips, snags, punctures, abrasion, cracking, peeling, and weathering; and are suitable for use as an external cargo wrap.

E. Side boards that are suitable as a frame for use with tarpaulins to form a closed transport vehicle.

F. Motor vehicle operators who meet the requirements of 49 CFR 383, 49 CFR 391, 49 CFR 392, 49 CFR 395, 49 CFR 397, 49 CFR 172 Subpart H, and 49 CFR 177.

2.4 MOTOR VEHICLES

A. Provide equipment that is appropriate for accomplishing successful transportation of impacted materials from the Work Site to the TSDF. Maintain and operate motor vehicles in accordance with the manufacturer's recommendations; Occupational Safety and Health Administration requirements; federal regulations specified in 49 CFR 393 and 49 CFR 396; and applicable federal, state, and local regulations. Take all precautions necessary for safe operation of equipment and vehicles to safeguard the public and the environment from injury or accidental release of impacted materials.

B. Inspect all vehicles in accordance with 49 CFR 393, and comply with all applicable local, state, and federal requirements for registration, insurance, inspection, certification, and performance.

C. Motor vehicle inspections shall be performed by qualified inspectors, as required by 49 CFR 396.19. Have available a copy of the current certificate of commercial motor vehicle inspection before any transportation activities (or a statement certifying that all motor vehicles have been inspected in accordance with the requirements of 49 CFR 396.17, 49 CFR 396.19, and 49 CFR 396.23). Brake inspections shall be performed by a certified brake inspector for commercial motor vehicles, as described in 49 CFR 396.25.

D. The motor vehicle operator shall perform a safety inspection of each motor vehicle before it is used and at least once each day, in accordance with the requirements of 49 CFR 396.11 and 49 CFR 396.13.

E. Remove from the Work Site any motor vehicles determined to be potentially unsafe and/or unsuitable for their intended use. Reinspect repaired or replaced motor vehicles to determine whether they meet inspection standards.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 70 00 - Execution and Closeout Requirements: Verification of existing conditions before starting work.

B. Notify ENGINEER sufficiently in advance of intention to commence activities at the Work Site that require attendance by ENGINEER as provided hereinafter.

C. Activities requiring attendance by ENGINEER include:
   1. Final securement of loaded materials prior to transport from the Work Site.
   2. Decontamination of transport vehicles/containers prior to leaving the Work Site.

D. Do not cover up loaded material prior to ENGINEER's inspection.

3.2 TSDF SELECTION

A. OWNER may contract directly with the TSDF and ENGINEER will obtain the necessary approvals to dispose of Non-Hazardous Materials.

3.3 WASTE PROFILING

A. ENGINEER will conduct waste profile sampling and analysis.

B. ENGINEER will classify materials for off-site disposal according to waste stream based on waste profile analytical results and other pertinent data/information.

C. Select and submit proposals to ENGINEER for the appropriate disposition of all determined waste streams to be removed from the Work Site in accordance with applicable regulations for each wastestream. CONTRACTOR shall be responsible for disposition of materials to OWNER-selected TSDFs.

D. Waste profile will be signed by OWNER or an authorized agent of OWNER except for materials brought on the Work Site by CONTRACTOR that are not incorporated in the Works or impacted by performance of the Works.

3.4 SEGREGATION OF MATERIALS

A. Segregate and prepare materials for transportation and disposal in accordance with the delivery acceptance requirements of the transporter and TSDF and governing regulations, as appropriate based on waste characterization.

3.5 LOADING AND UNLOADING OPERATIONS

A. The motor vehicle operators shall remain inside the tractor cab at all times during loading and unloading.

B. Provide motor vehicles that are non-contaminated and free of mud, dirt, grease, or other accumulations. Motor vehicles shall arrive at the work area sufficiently clean to allow inspection.

C. Conduct loading and unloading operations in a highly controlled manner that prevents contamination of motor vehicles. Verify that CONTRACTOR motor vehicles are free of contamination before releasing them from the loading/unloading area.

D. Load for on-site transportation in accordance with Section 02 61 14.

E. Load for off-site transportation as follows:
   1. Decontaminate motor vehicles that become impacted during loading or unloading operations. After decontamination, check the motor vehicle again to verify that it is free of contamination before releasing it for transport.
   2. After loading and before leaving the Work Site or TSDF, the motor vehicle operator shall inspect and verify that the load is arranged and secured properly (based on experience and training, and in accordance with 49 CFR 392.9 and 49 CFR 393, Subpart I). Motor vehicle shall be weighed using built-in scales on the vehicle and the estimated weight of the vehicle will be recorded. Ensure compliance with applicable load restrictions.
   3. Upon acceptance of the load for transport, maintain the integrity of the load, the load arrangement, and any security seals. The motor vehicle operator shall examine and periodically reexamine the load and its load securing devices as necessary to maintain the integrity of the load and the load arrangement in accordance with 49 CFR 392.9. (Load inspections during transit do not apply to sealed trailers, only to the inspection of security seals.) Comply with the requirements of PART 3, ACCIDENT INVOLVING TRANSPORT VEHICLES upon discovery of any change in the load condition, load arrangement, or security seals (e.g., change caused by equipment/packaging failure, motor vehicle accident, adverse weather conditions, vandalism, or theft) that involves release of impacted materials.

3.6 PREPARATION AND SECUREMENT OF TRANSPORT VEHICLES/CONTAINERS

A. Do not load materials for transport for disposal without ENGINEER's approval.

B. Comply with applicable federal, state, and local regulations concerning shipping vehicles, containers, and materials.

C. Visibly display number for each transport vehicle/container.

D. Secure materials in transport vehicles/containers in accordance with regulations governing transportation of materials.

E. Bulk Solid Shipments:
   1. Clean the receiving box of the transport vehicle/container of loose debris or foreign material. Line the receiving box or container with a tub liner or polyethylene liner. Place

the liner on the floor, run up the sides, and drape over the sideboards. Neatly push the liner into corners to prevent tearing during loading and transport.

2. Load bulk materials into transport vehicles or containers in a manner which will not damage the placed tub liner. Limit the freefall of bulk materials being loaded. Place cushioning materials under and around each container for shipments of drummed/containerized materials.
3. Replace damaged liner which is incapable of providing containment.
4. Following loading, fold the liner over the loaded materials and place an overliner of polyethylene sheeting over the materials prior to securing with an approved tarpaulin in a manner to prevent loss of materials or fugitive dust emissions.

F. Perform packaging, labeling, marking, and placarding in compliance with 49 CFR 173 and 49 CFR 178. The motor vehicle operator(s) shall perform an inspection to verify that packaging, labeling, marking, and placarding are in accordance with the requirements listed above and the accompanying shipping documents. Maintain the integrity of packaging, labeling, marking, placarding, and the accompanying shipping documents in compliance with 49 CFR 177.800, Subpart A.

3.7 DECONTAMINATION

A. Decontaminate transport vehicles and containers at on-site equipment decontamination pad after loading and prior to leaving the Work Site. Remove material on the tires and axles of trucks and material on the vehicle resulting from loading operations. See Section 02 61 14 – Material Handling and Transportation: Decontamination.

3.8 DOCUMENTATION FOR THE TRANSPORTATION OF MATERIALS

A. Document the transport and disposal of materials to TSDFs on appropriate state and/or federal manifests or bills of lading, as prepared and provided by ENGINEER. Maintain shipping documents from the time the materials leave the Work Site to the time of release to TSDFs. Shipping documents for the transportation and disposal of materials will be signed by OWNER or an authorized agent of OWNER, except for materials brought on the Work Site by CONTRACTOR that are not incorporated in the Works or impacted by performance of the Works.

B. Inspect each truck before leaving the Work Site and maintain a log. Trucks shall not leave the Work Site until inspected.

3.9 NOTIFICATION

A. Notify applicable federal, state, and local representatives, or authorities having jurisdiction over the route and mode of transport, in advance of commencing transportation.

3.10 OFF-SITE IN-TRANSIT WEIGHING (BULK SHIPMENTS)

A. Weigh transport vehicles without loaded materials at certified off-site weigh scale facility approved by ENGINEER prior to entry to the Work Site.

B. Submit copy of weigh ticket for loaded vehicle to ENGINEER within 48 hours of weighing.

Ensure weigh scale receipts agree with the verbally reported weight.

3.11 TRANSPORTATION TO OFF-SITE TSDF

A. Comply with applicable requirements of regulations including, but not limited to 49 CFR 171, 49 CFR 172, 49 CFR 173, 49 CFR 177, 40 CFR 262, 40 CFR 263, and 40 CFR 761.

B. Transport material removed from the Work Site directly to TSDF approved by OWNER. Do not change either the route or mode of transport after commencing off-site operations without ENGINEER's prior written approval.

C. Mark and placard shipments in accordance with federal, state, and local regulations as applicable.

D. Employ transport vehicle operators trained in conformance with federal, state, and local regulations for hazardous materials haulers.

E. Materials shall be transported using vehicles licensed for the waste stream being transported.

3.12 DISPOSAL

A. Make all arrangements with TSDFs for the receipt and acceptance of materials removed from the Work Site.

B. Ensure that materials removed from the Work Site are properly prepared and will be accepted by TSDF selected by OWNER.

C. Weigh transport vehicles/containers at receiving TSDF weigh scales both before and after discharging their contents.

D. Such measurements will be used by ENGINEER to verify proper delivery of materials which have been removed from the Work Site and for payment purposes.

E. Immediately return to the Work Site any transported material delivered to a TSDF which is rejected by the TSDF.

3.13 ACCIDENT INVOLVING TRANSPORT VEHICLES

A. In the event of an accident, follow the procedures outlined in CONTRACTOR's Transportation Emergency Response Plan and comply with the requirements of 49 CFR 390.15 Subpart E and 49 CFR 172, Subpart G.

B. In the event of an accident involving a release of materials being transported, promptly notify ENGINEER via telephone, and prepare a written report within 5 days. The report shall include but not be limited to:
   1. Location, date, and time of the accident.
   2. Resultant damage or injury.
   3. Person(s) involved.
   4. Condition of the load.

5. Amount of materials released and amount recovered.
6. Any other pertinent information.

C. If applicable, weather conditions, distance to water sources, government agencies on the scene, and telephone number where communications can be maintained.

D. Copies of any accident/incident reports required or prepared by state or other governmental entities.

END OF SECTION

SECTION 22 05 53

PIPE DATA SHEET- PVDF TUBING AND CARRIER PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Polyvinylidene fluoride (PVDF) Tubing for chemical feed systems.

B. Carrier pipe for PVDF tubing and chemical feed systems.

1.2 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Product Requirements: Requirements for transporting, handling, storing, and protecting products.

C. Inspect each shipment of tubing, pipe and fittings and make provisions for the timely replacement of damaged material. Unload by hand or use canvas slings to avoid scratching the pipe. Do not drop, slide, or drag pipe over an abrasive surface. Pipe with deep scratches and tubing with kinks and/or other signs of damage shall be removed from the Work Site and replaced with new stock.

D. Stack pipe no higher than 5 feet and provide support for the pipe barrel to prevent bending of the pipe. Cover stockpiled pipe and tubing to protect it from sunlight.

1.3 WARRANTY

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for warranties.

B. Warranty: Include coverage for defects in material and workmanship.

1.4 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for closeout submittals.

B. If specialized system or tools are used for installation, provide a complete set of required cutters, crimpers, etc., to allow for future maintenance or modification of the system to OWNER.

PART 2 PRODUCTS

2.1 GENERAL

A. All piping system components shall be products of the same manufacturer.

2.2 PVDF TUBING

A. NSF 61 Certified, Polyvinylidene fluoride (PVDF) tubing.

B. Opaque PVDF tube, nominal OD as required for service/selected by CONTRACTOR. Nominal working pressure of up to 150 psig.

C. Temperature Range: Minus 5 degrees C to plus 65 degrees C.

D. Fittings shall be compatible with tubing and with chemicals in use.

E. No tubing fittings shall be hidden/concealed within carrier pipe.

2.3 CARRIER PIPE

A. Carrier pipe shall be Schedule 80 CPVC piping.

B. Connections and fittings in the carrier pipe shall be long-radius bends and use wyes in place of tees to facilitate installation of PVDF tubing by pulling through assembled pipe.

C. Carrier pipe shall not be buried

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 70 00 - Execution and Closeout Requirements: Verification of existing conditions before starting work.

B. Execution Requirements: Verification of existing conditions before starting work.

C. All aboveground carrier pipe shall be installed and supported per manufacturer requirements with general slope towards open drainage points.

END OF SECTION

SECTION 23 05 53

IDENTIFICATION FOR PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Nameplates.
   2. Plastic pipe markers.
   3. Plastic tape pipe markers.

1.2 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Submit list of wording, symbols, letter size, and color coding for mechanical identification.

C. Samples: Submit two labels.

D. Manufacturer's Instructions: Indicate special procedures and installation.

1.3 FIELD SAMPLES

A. Provide field Samples of labels.

B. Locate where directed by ENGINEER.

C. Accepted Sample may remain as part of the Work.

PART 2 PRODUCTS

2.1 EQUIPMENT NAMEPLATES

A. Provide name plates in accordance with the schedule at end of this Section.

B. Manufacturers standard nameplate.

C. Minimum Tag Size: 1 ½-inch tall and 3-inch wide minimum with minimum 1-inch tall lettering.

D. Indicate at a minimum the following:
   1. Manufacturer name.
   2. Model number.
   3. Serial number.
   4. Equipment size/capacity.

2.2 PLASTIC PIPE MARKERS

A. Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.

2.3 PLASTIC TAPE PIPE MARKERS

A. Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings. Minimum information indicating flow direction arrow and identification of fluid being conveyed.

PART 3 EXECUTION

3.1 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

3.2 INSTALLATION

A. Plastic Markers:
   1. Install plastic pipe markers in accordance with manufacturer's instructions.
   2. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.

3.3 APPLICATION

A. Apply in accordance with manufacturer's instructions.

B. Apply after painting.

3.4 CLEANING

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for cleaning.

B. Clean excess paint and adhesive.

3.5 PROTECTION

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for protection of installed work.

B. Protect finished work using clear plastic and tape.

3.6 MECHANICAL SCHEDULE

Service	**Marking Type**	**Letter/Symbol Color**	**Color**	**Background Location**	**Required Markings**
Process Piping	Adhesive Tape	Black	Blue	Terminations and every 12 feet	Service, Flow Direction(1)
Chemical Piping	Adhesive Tape	Yellow	White	Terminations and every 12 feet	Service, Flow Direction(1)
Valves	Nameplate	Manufacturer Standard	Manufacturer Standard	Manufacturer Standard	(2)
Equipment	Nameplate	Manufacturer Standard	Manufacturer Standard	Manufacturer Standard	(2)
Pumps	Nameplate	Manufacturer Standard	Manufacturer Standard	Manufacturer Standard	(2)

(1) As noted in PART 2, PLASTIC TAPE PIPE MARKERS
(2) As noted in PART 2, EQUIPMENT NAMEPLATES

END OF SECTION

SECTION 31 05 19.13

GEOTEXTILES FOR EARTHWORK

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Placement of woven geotextile material for the construction of temporary access roads.
2. Placement of non-woven geotextile material for the construction of temporary equipment decontamination pad, temporary dewatering facility, and temporary excavated material stockpiles.
3. Placement of non-woven geotextile material for the construction of temporary seasonal cover.

B. Related Requirements:
1. Section 31 23 23 - Fill.

1.2 REFERENCES

A. Definitions:
1. Geotextile: Synthetic fabric for use in geotechnical filter, separation, stabilization, or erosion control applications.
2. Minimum Average Roll Value: Average value for a specified parameter less two standard deviations.
3. TCEQ: Texas Commission on Environmental Quality.
4. TxDOT: Texas Department of Transportation.
5. USEPA: United States Environmental Protection Agency.

B. Reference Standards:
1. Section 01 40 00 - Quality Requirements: Requirements for references.
2. ASTM International:
a. ASTM D4355 - Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon Arc-Type Apparatus.
b. ASTM D4491 - Standard Test Methods for Water Permeability of Geotextiles by Permittivity.
c. ASTM D4533 - Standard Test Method for Trapezoid Tearing Strength of Geotextiles.
d. ASTM D4595 - Standard Test Method for Tensile Properties of Geotextiles by the Wide-Width Strip Method.
e. ASTM D4632/D4632M - Standard Test Method for Grab Breaking Load and Elongation of Geotextiles.
f. ASTM D4751 - Standard Test Methods for Determining Apparent Opening Size of a Geotextile.
g. ASTM D4873 - Standard Guide for Identification, Storage, and Handling of Geosynthetic Rolls and Samples.
h. ASTM D4884/D4884M - Standard Test Method for Strength of Sewn or Bonded Seams of Geotextiles.

i. ASTM D5199 - Standard Test Method for Measuring the Nominal Thickness of Geosynthetics.
j. ASTM D5261 - Standard Test Method for Measuring Mass Per Unit Area of Geotextiles.
k. ASTM D6241 - Standard Test Method for Static Puncture Strength of Geotextiles and Geotextile-Related Products Using a 50-mm Probe.
l. ASTM D6706 - Standard Test Method for Measuring Geosynthetic Pullout Resistance in Soil.
m. ASTM D6767 - Standard Test Method for Pore Size Characteristics of Geotextiles by Capillary Flow Test.

1.3 COORDINATION

A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.

B. Coordinate installation of geotextile after satisfactory surface preparation.

1.4 PRE-INSTALLATION MEETING

A. Section 01 30 00 - Administrative Requirements: Pre-installation meeting.

B. Convene minimum 1 week prior to commencing work of this Section.

C. Purpose of Meeting:
1. Define Work Site-specific quality control and monitoring procedures.
2. Discuss pre-installation submittals.
3. Identify daily schedule.

1.5 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit no later than 10 days prior to ordering.

C. Samples: Submit a representative sample at least 6 feet by roll width for each type of geotextile no later than 10 days prior to ordering.

D. Manufacturer's Instructions: Submit at least 14 days prior to installation. Include installation, handling, storage, and repair instructions.

E. Manufacturer's Certificates:
1. Deliver each roll to the Work Site accompanied by manufacturer's certificate.
2. Identify each roll by unique manufacturing number.
3. Include results of at least the tests specified for each respective product in PART 2, GEOTEXTILE.
4. Provide manufacturer's records for storage, handling, and shipping of geotextile.
5. Quality control certificates signed by manufacturer and notarized.

F. Daily Field Installation Report. Submit no later than 1 day following date covered by report. Include:
   1. Total amount and location of geotextile placed.
   2. Identifiers of rolls.
   3. Changes in layout drawings.
   4. Record of defects caused during transportation and handling.
   5. Observations of weather conditions, and results.
   6. Observations of anchor trench excavation, backfilling, and compaction.
   7. Observations of repairs, including locations and name of repairer.

G. Layout Drawings: Submit drawings of proposed geotextile placement patterns. Provide no later than 14 days prior to installation.

H. Qualification Statements:
   1. Installer: Submit copy of manufacturer's approval letter or license no later than 14 days prior to installation.
   2. Manufacturer: Submit no later than 14 days prior to ordering, list of previous projects totaling 3 million sq ft of installation, and five projects including name of project, description of project, area, client's name and address, contacts, and telephone numbers; engineer's name, address, contact, and telephone number; installer's name, address, contact, and telephone number; and date installed.

1.6 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for closeout submittals.

B. Project Record Documents: Record actual locations of all placed geotextile that is to remain in place at the completion of the project.

C. Warranties: Completed original warranty forms filled out in OWNER's name and registered with manufacturer in accordance with Section 01 70 00.

1.7 QUALITY ASSURANCE

A. Perform work of this Section according to, and in conformance with, applicable codes and standards of TCEQ, USEPA, and TxDOT.

B. Certifications: Obtain certificate of compliance from authority having jurisdiction.

1.8 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum 20 projects, 10 million sq ft of manufacturing, and 3 years of documented experience.

B. Installer: Company specializing in performing work of this Section and approved by the manufacturer.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Deliver geotextile bearing manufacturer's seals and labels intact. Clearly label each roll to show geotextile identification, date of manufacture, lot number, analysis of contents, and special instructions.

C. Store and handle geotextile according to manufacturer's recommendations and ASTM D4873, in manufacturer's original covers. Protect from moisture, dust, light, and heat.

D. Notify ENGINEER 3 days in advance of delivery to the Work Site. Perform joint inspection with ENGINEER upon delivery. Defects or damage from shipping and handling will be grounds for rejection of a portion of geotextile or of the entire geotextile roll at ENGINEER's discretion. Remove rejected material from the Work Site and replace with new material.

1.10 AMBIENT CONDITIONS

A. Install geotextile according to manufacturer's instructions.

B. Suspend installation operations whenever climatic conditions, as determined by ENGINEER, are unsatisfactory for placing geotextile to the requirements of this Section.

1.11 EXISTING CONDITIONS

A. See the Drawings and Design Report.

PART 2 PRODUCTS

2.1 GEOTEXTILE

A. General:
1. Rot-proof, mildew-proof, and not subject to attack by insects or rodents.
2. Capable of retaining its structure during handling, placement, and long-term service.

B. Geotextile G1:
1. Description:
a. Non-woven, needle-punched geotextile made of polypropylene that meets or exceeds the following values:

Test	*Unit*	*Test Method*	*Minimum Average Roll Value*
Unit Weight	ounce/yd^2	ASTM D5261	8
Tensile Strength	pound	ASTM D4632/4632M	220
Elongation at Break	percent	ASTM D4632/4632M	50
Static CBR Puncture	pound	ASTM D6241	575
Trapezoid Tear Strength	pound	ASTM D4533	90
AOS(1)	US Sieve	ASTM D4751	80

Test	*Unit*	*Test Method*	*Minimum Average Roll Value*
Permittivity	sec^{-1}	ASTM D4491	1.26
Permeability	cm/s	ASTM D4491	0.30
Water Flow Rate	gpm/ft^2	ASTM D4491	95
Ultra Violet Resistance	percent retained/ 500 hours	ASTM D4355	70
(1) Maximum average roll value			

C. Geotextile G2:
   1. Description:
      a. Non-woven, needle-punched geotextile made of polypropylene that meets or exceeds the following values:

Test	*Unit*	*Test Method*	*Minimum Average Roll Value*
Unit Weight	$ounce/yd^2$	ASTM D5261	12
Tensile Strength	pound	ASTM D4632/4632M	320
Elongation at Break	percent	ASTM D4632/4632M	50
Static CBR Puncture	pound	ASTM D6241	900
Trapezoid Tear Strength	pound	ASTM D4533	125
AOS(1)	US Sieve	ASTM D4751	100
Permittivity	sec^{-1}	ASTM D4491	0.80
Permeability	cm/s	ASTM D4491	0.29
Water Flow Rate	gpm/ft^2	ASTM D4491	60
Ultra Violet Resistance	percent retained/ 500 hours	ASTM D4355	70
(1) Maximum average roll value			

D. Geotextile G3:
   1. Description:
      a. Woven geotextile weaved with polypropylene filaments to provide reinforcement strength, soil interaction, and water flow capabilities.
   2. Product:
      a. Mirafi® RS380i, as manufactured by Tencate Geosynthetics, or approved equal.
      b. Substitutions shall be made in accordance with Section 01 60 00.
      c. Proposed substitute shall meet or exceed the following performance criteria:

Mechanical Properties	*Unit*	*Test Method*	*Typical Roll Value*	*Minimum Average Roll Value*
Tensile Strength @ 2 percent strain (MD)	lbs/ft	ASTM D4595	720	600
Tensile Strength at 2 percent Strain (CD)	lbs/ft	ASTM D4595	1200	1020
Tensile Strength @ 5 percent strain (MD)	lbs/ft	ASTM D4595	2100	1800
Tensile Strength @ 5 percent strain (CD)	lbs/ft	ASTM D4595	2580	2256
Flow Rate	$gal/min/ft^2$	ASTM D4491	85	75[1]
Permittivity	sec^{-1}	ASTM D4491	1.2	0.9[1]
			Typical Roll Value	
Pore Size O_{95}	microns	ASTM D6767	365	

Mechanical Properties	*Unit*	*Test Method*	*Typical Roll Value*	*Minimum Average Roll Value*
Pore Size O_{50}	microns	ASTM D6767	185	
Index Properties			Maximum Opening Size	
Apparent Opening Size (AOS)	U.S. Sieve	ASTM D4751	50	40
			Minimum Test Value	
Interaction Coefficient	--	ASTM D6706	0.89	
Factory Sewn Seam	lbs/ft	ASTM D4884/D4884M	2700	
UV Resistance (at 500 hours)	% strength retained	ASTM D4355	90	

[1] Minimum Roll Value

2.2 SOURCE QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Testing, inspection, and analysis requirements.

B. Manufacturer Quality Control:
1. Sample and test geotextile material at a minimum once every 100,000 sq ft for tests specified for each respective product in PART 2, GEOTEXTILE, to demonstrate that the material conforms to requirements as specified. Test for UV stability and apparent opening size at a minimum once every month.
2. Perform samples on sacrificial portions of material so that repair of material is not required.
3. If geotextile sample fails to meet the quality control requirements of this Section, sample and test each roll manufactured in the same lot, or at the same time, as the failing roll. Continue sampling and testing of rolls until a pattern of acceptable test results is established.
4. At geotextile manufacturer's discretion and expense, additional testing of individual rolls may be performed to more closely identify the non-complying rolls and/or to qualify individual rolls.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 70 00 - Execution Requirements: Verification of existing conditions before starting work.

B. Verify that surfaces and Work Site conditions are ready to receive work.

3.2 PREPARATION

A. Prior to geotextile placement, provide necessary equipment and personnel to maintain an acceptable supporting surface during fabric installation.

B. Examine geotextile for defects including rips, holes, flaws, deterioration, or damage incurred during manufacture, transportation, or handling.

C. Remove defective or damaged geotextile from the Work Site.

3.3 INSTALLATION

A. Notify ENGINEER at least 24 hours in advance of intention to commence placement of geotextile.

B. Do not permit placement of overlay materials until ENGINEER has inspected and approved installation of geotextile.

C. Obtain approval of ENGINEER prior to installation of geotextile.

D. Place geotextile on a prepared base as shown on the Drawings.

E. Unfold or unroll geotextile according to manufacturer's instructions, directly on prepared base, in conditions which will prevent damage to both geotextile and base grade. Unsuitable conditions include, but are not limited to, moderate to high wind conditions.

F. Overlap dimensions and method of joining adjacent sheets shall be performed in accordance with manufacturer's instructions.

G. Do not entrap stones in geotextile during placement.

H. Do not expose geotextiles to sunlight for more than 14 days, or as recommended by manufacturer.

I. Position and deploy geotextile to minimize handling. Lay smooth and free of tension, stress, folds, or creases. Protect properly placed geotextile from displacement, contamination by surface runoff, or damage, until and during placement of overlaid materials.

J. Place geotextile on sloping surfaces in one continuous length.

K. Do not permit passage of vehicular traffic directly on geotextile at any time.

L. Place geotextile by unrolling onto graded surface and retain in position as specified.

M. Remove and replace damaged or deteriorated geotextile as directed by ENGINEER.

N. Protect installed geotextile material from dust, fine particles, and debris prior to placing overlying layer.

3.4 FIELD QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Field inspecting and testing.

B. ENGINEER will inspect geotextile in place for tears, overlaps, and consistency before placement of materials thereon. Damaged sections, as judged by ENGINEER, will be

marked and their removal from the work area recorded. Repair minor damage and minor defects as specified in manufacturer's procedures, when approved by ENGINEER, to ENGINEER's satisfaction.

C. ENGINEER will verify that weather conditions (appropriate air temperature, non-excessive wind, and lack of precipitation) are acceptable for panel placement.

D. Conformance Testing:
   1. Samples of geotextiles may be removed by ENGINEER and sent to laboratory for testing to ensure conformance with the requirements of this Section.
   2. This testing will be carried out prior to installation of geotextile.
   3. ENGINEER may collect additional samples in the event that initial test results do not comply with requirements of PART 2. This additional testing will be performed at CONTRACTOR's expense.
   4. As a minimum, the following conformance tests will be performed on the geotextile sample: mass per unit area; tensile strength; grab strength; tear strength; and puncture strength, AOS and permittivity test.
   5. Geotextile material that is not certified according to PART 1, or that conformance testing indicates does not comply with PART 2, will be rejected by ENGINEER. Replace rejected material with suitable material, at no additional cost to OWNER.

END OF SECTION

SECTION 31 10 10

SITE CLEARING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Removal and disposal of surface debris.

B. Clearing and grubbing, including tree/shrub removal.

C. Removal, salvage, and storage of existing fence.

1.2 DEFINITIONS

A. Clearing: Felling, trimming, and cutting of trees into sections and the satisfactory disposal of trees and other vegetation designated for removal, including down timber, snags, brush, and rubbish occurring in the areas to be cleared.

B. Grubbing: Removal and disposal of stumps, roots larger than 3 inches in diameter, and matted roots from the designated grubbing areas.

1.3 ENVIRONMENTAL REQUIREMENTS

A. Control the amount of dust resulting from operations to avoid creation of a nuisance in the surrounding area.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 70 00 - Execution and Closeout Requirements: Verification of existing conditions before starting work.

B. Verify that existing surface features designated to remain are tagged or identified.

C. Notify ENGINEER of intention to commence soil removal activities.

3.2 PREPARATION

A. Protect utilities and surface features designated to remain from damage resulting from construction operations by the erection of barriers or by such other means as circumstances require.

3.3 CLEARING AND GRUBBING

A. Clear areas required for access to the Work Site and execution of the Works.

B. Cut off trees, stumps, roots, brush, and other vegetation in areas to be cleared, flush with or below the original ground surface.

C. Remove debris, rock, and extracted plant life.

D. Dispose of trees, logs, stumps, roots, brush, rotten wood, and other refuse from the clearing and grubbing operations off-site.

3.4 REMOVALS

A. Remove existing fencing as required to access excavation areas.
   1. Store salvaged fence and posts, so that they are protected from damage during Works. Replace materials damaged by CONTRACTOR at no additional cost to OWNER.
   2. Dispose fence and posts not suitable for reuse off site, as determined by ENGINEER.
   3. Reinstall fence in accordance with Section 32 31 13.

B. Continuously clean up and remove waste materials from the Work Site; do not allow waste materials to accumulate.

END OF SECTION

SECTION 31 23 16

EXCAVATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Excavating impacted soil.

1.2 REFERENCES

A. DEFINITIONS
   1. Excavation: Removal of materials of whatever nature encountered, whether wet, or otherwise, including dense tills, hardpan, cemented materials, concrete fragments, asphalt pavement, boulders or rock fragments, and weathered rock which can be removed by ripping or excavating with heavy duty mechanical construction equipment without drilling and blasting.
   2. Excavation Limits: Areal excavation limits shown on the Drawings to specified depth or as directed by ENGINEER.
   3. Additional Excavation: Excavation beyond initial excavation limits either areally or in depth, as directed by ENGINEER.
   4. Rock: Material from solid masses of igneous, sedimentary, or metamorphic rock which, prior to its removal, was integral with its parent mass, and boulders or rock fragments having individual volume in excess of 1 cu yd.

B. Reference Standards:
   1. Section 01 40 00 - Quality Requirements: Requirements for references.
   2. ASTM International:
      a. ASTM D4397 - Standard Specification for Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications.

1.3 PROGRESS SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Excavation Plan: 14 days prior to mobilization to the Work Site, submit a detailed Excavation Plan demonstrating compliance with specified requirements and to permit ENGINEER to schedule testing and measurement activities. Include written procedures, schedules, and drawings as applicable and, at a minimum, address each of the following items:

   1. Methods and procedures which will be used to perform excavation.
   2. Sequencing and scheduling of excavation activities.
   3. Location of temporary decontamination facility.
   4. Sequencing and layout of access routes to and from excavation areas.

5. Methods and procedures which will be used to perform additional excavation in open excavations, if required.
6. Anticipated crew sizes, worker hours, types of equipment, and equipment hours on a weekly basis.
7. Sloping of excavation faces and slope stability issues.
8. Methods of monitoring movement of adjacent structures (i.e., I-10 bridge).

1.4 ENVIRONMENTAL REQUIREMENTS

A. Protect open excavations against damage due to surface water runoff and runon. Take necessary precautions to prevent erosion of excavated or disturbed surfaces.

B. Suspend operations whenever climatic conditions, as determined by ENGINEER, may detrimentally affect the excavation work.

C. After occurrence of heavy rains, refrain from operating equipment on approved excavations until the material has dried sufficiently to prevent occurrence of excessive rutting.

D. Decontaminate equipment involved in excavation activities which may have come in contact with potentially impacted material before being removed from the Work Site or being relocated to clean areas of the Work Site.

1.5 SCHEDULING

A. Section 01 30 00 - Administrative Requirements: Requirements for scheduling.

B. Coordinate sequencing and scheduling of excavation activities with work of other Sections.

C. Do not allow or cause any of work performed to be covered up or enclosed prior to required inspections, tests, or approvals.

PART 2 PRODUCTS

2.1 PLASTIC SHEETING

A. In accordance with ASTM D4397.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 70 00 - Execution and Closeout Requirements: Verification of existing conditions before starting work.

B. Verify that survey benchmarks and existing and design elevations for the Works are as shown on the Drawings.

3.2 PREPARATION

A. Identify required lines, levels, contours, and datum locations.

B. Stake limits of excavation areas.

C. Arrange for utility company to identify and relocate utilities, if necessary.

D. Protect plant life, and other features remaining as a portion of final landscaping.

E. Maintain and protect from damage utilities, surface features, and structures encountered (not designated for demolition or removal). In the event of disturbance of or damage to any such well, utility, surface feature, or structure, immediately notify ENGINEER. Repair or replace, as directed by ENGINEER.

F. Protect existing facilities, surface features, and structures where temporary unbalanced earth pressures or uplift are liable to develop utilizing bracing, shoring, or other approved methods to counteract unbalance.

G. Employ procedures for excavation such that uplift and displacement or disturbance of lines, utilities, surface features, and structures is avoided.

H. Protect excavations from contamination.

I. Obtain direction from ENGINEER before moving or otherwise disturbing monitoring wells, utilities, surface features, and structures.

3.3 SHORING AND BRACING

A. Do not allow the sides of the excavation to become unsafe. Maintain sides and slopes of excavations in safe condition by appropriate methods as verified by CONTRACTOR’s registered engineer.

3.4 EXCAVATION

A. Excavate to lines, grades, elevations, and dimensions shown on the Drawings or as directed by ENGINEER.

B. Excavate to elevations and slopes, as shown on Drawings.

C. Remove debris and other obstructions encountered.

D. Notify ENGINEER of unexpected subsurface conditions and discontinue affected work in area until notified to resume work.

E. Open excavations shall be CONTRACTOR's sole responsibility.

3.5 OVER-EXCAVATING

A. Should unauthorized excavation be carried below the lines and grades shown on the Drawings and in excess of specified limits and tolerance because of CONTRACTOR's operations including errors, methods of construction, or to suit his convenience, correct unauthorized excavation as follows:

B. Excavations beyond the lines and grades shown on the Drawings not authorized in writing by the ENGINEER or additional excavation to remove weakened or disturbed soil caused by CONTRACTOR's error, unsuitable construction methods or procedures, or to suit CONTRACTOR's convenience and subsequent additional backfill and compaction to correct deficiencies shall be at no additional cost to OWNER.

3.6 PROTECTING CLEAN SOIL FROM CONTAMINATION

A. Prevent contamination of clean soil adjacent to the excavation.

B. Place plastic sheeting and/or plywood, as needed, under excavation equipment and alongside the excavation to prevent impacted soil from being mixed with surrounding clean soil. Use other means of preventing contamination subject to approval by ENGINEER. Do not mix excavated soil with imported materials.

C. Where possible, load soil and materials to be disposed of off-site directly into transport vehicles for on-site staging for dewatering and potential solidification prior to off-site disposal. ENGINEER may direct clean or non-characterized excavated soils to be handled as waste.

D. Decontaminate excavation equipment after handling excavated materials and prior to handling clean backfill materials or traveling on clean areas of the Work Site. ENGINEER will direct additional decontamination as necessary in the opinion of ENGINEER.

3.7 EXCAVATING IMPACTED MATERIALS

A. Identify excavated areas by survey stakes, or other appropriate method. Excavate each area by first removing the overlying TCRA cap (reusable) prior to removal of underlying materials.

B. Verify excavation depths using Topcon 3DXi/GPS, indication system, or equivalent grade control system, for excavation control. Enter 3D topographic data into the machine’s computer system prior to start of excavation activities. Ensure accuracy of GPS is within the machine’s typical +/-0.10 inch range or equivalent.

C. No personnel shall enter the excavation, when possible.

D. Excavate soils to depths and dimensions as shown on the Drawings and as directed by ENGINEER. Use GPS-based controls to remove materials to designated elevations.

E. Where possible. perform excavation in such a manner that only the excavation bucket and boom contacts materials from depth intervals to be excavated.

F. Keep limits of excavation undisturbed and free of loose, soft, or organic matter.

G. Maintain excavation depth tolerances. Unless directed by ENGINEER, excavation in excess of specified limits shall be considered unauthorized over-excavation.

H. Should unauthorized excavation be carried below the lines and grades shown on the Drawings and in excess of specified limits and tolerance because of CONTRACTOR's operations including errors, methods of construction, or for sake of convenience, correct unauthorized excavation as described in PART 3, OVER-EXCAVATING.

I. Use methods and equipment that result in minimal disturbance to areas outside the excavation limits.

J. Upon completion of excavation, confirm removal to the required elevations for each seasonal area, in accordance with the Drawings, by survey or grade control system data.

K. Keep excavations open until directed by ENGINEER to be covered pending receipt and review of survey results from the excavated surface. Following receipt of survey results, ENGINEER may direct CONTRACTOR to horizontally extend the limits of the excavation, excavate an additional depth of soil, or commence cap replacement. For the duration of an open excavation, maintain the excavation reasonably free from water and adequately mark the open excavation with temporary fencing to restrict access until the excavation is properly backfilled.

L. Schedule excavation activities in such a manner that access is available to any excavation area for additional excavation as directed by ENGINEER. When returning to an area for additional excavation, comply with previously specified access route restrictions.

M. Decontaminate excavation equipment periodically and as directed by ENGINEER. Decontaminate equipment when visibly contaminated. ENGINEER will direct additional decontamination when required in the opinion of ENGINEER.

3.8 TOLERANCES

A. Section 01 40 00 - Quality Requirements: Requirements for tolerances.

B. Within 2 inches greater or less than specified depth but not uniformly greater or less.

3.9 FIELD QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Field inspecting and testing.

B. Survey and provide grade control system data to confirm vertical and horizontal limits of excavation. Submit surveying data to ENGINEER immediately to confirm the limits of removal.

3.10 CLEANING

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for cleaning.

B. Clean and reinstate work areas and areas affected by equipment outside areas specified to be excavated, to specified restoration condition.

3.11 PROTECTION

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for protection of installed work.

B. Protect bottom of excavations from disturbance, and recontamination by soils to be excavated and removed.

END OF SECTION

SECTION 31 23 19

DEWATERING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Design, installation, operation, and maintenance of a Dewatering System.

B. Related Requirements:
   1. Section 01 57 13 – Temporary Soil Erosion and Sediment Controls.
   2. Section 01 57 19 – Temporary Environmental Controls.
   3. Section 31 23 16 – Excavation.

1.2 REFERENCES

A. Abbreviations:
   1. TSS: Total Suspended Solids.

B. Definitions:
   1. Dewatering System: A system to allow construction activities to be carried on in areas relatively free of standing water that will inhibit excavation activities, including but not limited to: lowering of groundwater table, surface water control, storm water and precipitation control, and seepage control.
   2. Surface Water Control: Removal of surface water within open excavations.
   3. Seepage Control: Removal of water originating from seepage, including seepage through any embankment and upward seepage from the bottom of excavations. Seepage control consists of the collection or control of seepage, preventing or controlling it from entering the construction area and directing the seepage to collection and treatment systems.

1.3 SYSTEM DESCRIPTION

A. Provide Dewatering System to maintain stability of the base of excavations, to keep the excavation reasonably dry and free of standing water to allow excavation of waste material.

B. The Dewatering System shall consist of sumps, sump pumps, ditches, trenches, dikes, berms, cofferdams and combinations thereof and all necessary appurtenances. The system may also include construction methods that divert the flow of water away from the construction area.

C. System capacity shall be continuously reviewed during operation and, if necessary, increased or otherwise modified to ensure that the installed capacity is adequate to provide the required removal of water to allow excavation activities to continue. Any required increases in system capacity shall be added at no additional cost to OWNER.

1.4 PRE-INSTALLATION MEETING

A. Section 01 30 00 - Administrative Requirements: Pre-installation meeting.

B. Convene minimum 1 week prior to commencing work of this Section.

1.5 COORDINATION

A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.

B. Coordinate work to permit construction to be completed on dry stable substrate.

C. Coordinate the work of this Section with relevant utility companies and authorities having jurisdiction.

1.6 SEQUENCING

A. Section 01 10 00 – Summary: Requirements for sequencing.

B. Sequence work to obtain required permits before start of dewatering operations.

C. Sequence work to install and test monitoring systems minimum 7 days before operating dewatering systems.

D. Sequence work to install and test dewatering and surface water control systems minimum 7 days before starting excavation.

1.7 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Dewatering Plan: The plan shall contain all supporting calculations and the following details:
   1. The planned location and layout, sizes, and capacities of the Dewatering System components.
   2. Proposed locations of collection sumps pipelines, and transfer pumps.
   3. Plan of normal operation.
   4. Capacities of power-supply facilities, backup power, and description of standby components and spare parts.

C. Shop Drawings:
   1. Indicate Dewatering System layout, sump locations and depths, bottom grade of excavation, pump locations, discharge piping and hose pathway locations, and location of any vertical or horizontal intake screens to be used.
   2. Indicate equipment location and capacity.
   3. Indicate layout of discharge hoses or pipe, including road crossing details where required.
   4. Include detailed description of Dewatering System capacity, operating procedures and maintenance of equipment.
   5. Include description of emergency procedures to follow when problems arise.
   6. Details of screens and filter media, if any proposed.

D. Product Data: Submit data for each of the following:
   1. Dewatering Pumps: Indicate sizes, capacities, priming method, motor characteristics.
   2. Other Equipment: Indicate sizes, capacities of any other equipment used in the dewatering system.

E. Design Data
   1. Indicate design values, analyses, and calculations to support design of equipment to be used.

1.8 QUALITY ASSURANCE

A. CONTRACTOR is responsible to prepare and implement a contingency plan should water overwhelm the specific work area within the BMP.

PART 2 PRODUCTS

2.1 DESIGN REQUIREMENTS

A. Design Dewatering System to reduce groundwater pressure and lower groundwater levels for stable undisturbed and substantially dry subgrade.

B. Design Dewatering System so that settlement is not caused by extraction of fine particles from soil during dewatering. Demonstrate to acceptance of ENGINEER that will meet TSS requirements 12 hours after commencement of pumping.

C. Design surface water control systems to collect and remove surface water and seepage entering excavation.

2.2 DEWATERING EQUIPMENT

A. Pumps: Suited for this application and actual field conditions. Pumping equipment for dewatering of the excavations to facilitate waste material removal shall be properly sized to maintain a dry excavation.

B. Pipes:
   1. Leak free with fittings of compatible materials and of corresponding weight and quality.
   2. Size, length, and type as required to accommodate flow from the pumps.
   3. Standpipe: Sufficient size to accommodate the flow.

C. Accessories:
   1. Furnish valves, fittings, and other necessary accessories of compatible material and of required strength and quality for application.

D. Keep available sufficient standby equipment to ensure continuous operation of the Dewatering System. The number of standby components and spare parts shall be determined by CONTRACTOR in consideration of known reliability and availability.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 70 00 - Execution and Closeout Requirements: Verification of existing conditions before starting work.

B. Examine Work Site to establish locations for dewatering equipment and related piping.

3.2 PREPARATION

A. Protect existing adjacent structures and improvements from damage caused by dewatering operations.

B. Intercept and direct surface water away from excavations and monitoring equipment by use of dikes, curb walls, ditches, pipes, sumps, or other means to ENGINEER's acceptance.

3.3 INSTALLATION

A. Install Dewatering System in accordance with approved Dewatering Plan.

B. During duration of operation, maintain Dewatering System safely in accordance with regulations and requirements of authorities having jurisdiction.

C. Clearly identify location of Dewatering System installations and install barricades and signs necessary to ensure safety to workers and to pose no hazard.

D. Prior to excavation for Dewatering System, locate existing underground utilities and make provisions in Dewatering System installation to accommodate such utilities.

3.4 DEWATERING

A. Operate Dewatering System in accordance with accepted Dewatering Plan and Shop Drawings.

B. Provide and maintain pumps, sumps, suction mains, and other Dewatering System components necessary to convey water away from excavations.

C. Keep precipitation and drainage water away and clear of the Works area. Keep excavation dry.

D. Operate dewatering sumps continuously until standing and free water has been removed from excavation area. Maintain operation of each sump in each work area to remove free water which accumulates in sump until sump is removed. Do not remove sumps from operation without approval of ENGINEER.

E. Maintain continuous and complete effectiveness of installation. Supply and install sufficient backup pumping and power equipment to maintain uninterrupted operation.

F. Design and operate dewatering systems to:
   1. Prevent loss of ground as water is removed.

2. Avoid inducing settlement or damage to completed work.
3. Relieve uplift pressures at bottom of excavation.

G. Provide standby equipment to ensure continuity of dewatering operations.

H. Transport water removed by Dewatering System to Water Treatment System.

3.5 OPERATION AND MAINTENANCE OF DEWATERING SYSTEM

A. Inspect Dewatering System on a daily basis in the presence of ENGINEER.

B. Operate Dewatering System continuously until excavation and restorations are completed or otherwise directed by ENGINEER.

C. Provide continuous supervision of Dewatering System by personnel skilled in operation, maintenance, and replacement of system components.

D. Conduct daily observation of Dewatering System and monitoring system. Make required repairs and perform scheduled maintenance.

E. Refill fuel tanks in a safe and environmentally sound manner.

F. Start emergency generators at least twice each week to check operating condition.

G. When Dewatering System cannot control water within excavation, notify ENGINEER and stop excavation work.
1. Supplement or modify Dewatering System and provide other remedial measures to control water within excavation.
2. Demonstrate Dewatering System operation complies with performance requirements before resuming excavation operations.
3. Modify Dewatering System when operation causes or threatens to cause destabilization of excavation.

H. Do not discontinue dewatering operations without ENGINEER's approval.

I. Route discharge lines and provide vehicle crossing over pipes or hoses without damage.

J. Flows from the Dewatering System shall be discharged to the Water Treatment System, unless otherwise authorized by ENGINEER.

3.6 REMOVAL OF DEWATERING SYSTEM

A. Remove Dewatering System after dewatering operations are discontinued.

B. Repair damage caused by Dewatering System or resulting from failure of Dewatering System to protect property.

3.7 FIELD QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Field inspecting and testing.

B. Where critical structures or facilities existing immediately adjacent to areas of proposed dewatering, reference points shall be established and observed twice daily to detect any settlement which may develop.

END OF SECTION

SECTION 31 23 23

FILL

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Stockpiled material from existing berms for potential reuse.

B. Common Fill for construction of berms for temporary facilities.

C. Topsoil for restoration.

D. Structural Fill as base material for temporary access roads/ramps and construction of restored south embankment.

E. Soil Fill For between double sheet pile walls

F. Sand for temporary dewatering facility and containment areas.

G. Coarse Aggregate for temporary access road/ramps and raised bench.

H. Clear Stone for use at treated water discharge to river and dewatering facility sump.

I. Filling and grading prior to final restoration.

1.2 SUPPLIED MATERIALS FROM OFF-SITE SOURCES

A. General:
   1. From accepted commercial source, as accepted by ENGINEER.
   2. Free of unsuitable materials including:
      a. Trees, stumps, branches, roots, noxious weeds or other wood or lumber.
      b. Rocks larger than 2 inches.
      c. Wire, steel, cast iron, cans, drums, or other foreign material.

B. Common Fill:
   1. Well graded.
   2. Free of rocks larger than 2 inches, loam, organic matter, very soft clays, swelling clays, or fine uniform sands that may be difficult to compact.
   3. A liquid limit of not more than 35 and plasticity index of not more than 12 in accordance with ASTM D4318.
   4. ASTM D2487 Group Symbol: Any except those described as poorly graded and except CH, MH, OL, and OH.

C. Topsoil:
   1. Friable loam neither of heavy clay nor of very light sandy nature.

2. Reasonably free of roots, fragments larger than 3 inches in size, rocks or lumps larger than 1 inch in diameter, debris, weeds, plants or their roots, vegetation, seeds of noxious weeds, stolons, seeds; salts; soil sterilants; chemical contaminants; invasive species; or other materials detrimental to plant growth.
3. Acidity Range (pH): 5.5 to 7.5, determined in accordance with ASTM D4972.
4. Containing minimum 2 percent and maximum 10 percent organic matter determined in accordance with ASTM D2974.
5. Containing salt less than 2.0 ms/cm (millisiemens/cm) total salts.
6. Capable of supporting growth of grass.

D. Sand:
1. Sand: Natural river or bank sand; washed; free of silt, clay, loam, friable or soluble materials, and organic matter.

E. Soil Fill For Between Sheet Pile Walls, Structural Fill, Coarse Aggregate, and Clear Stone as specified in PART 2.

1.3 REFERENCES

A. Section 01 40 00 - Quality Requirements: Requirements for references.

B. Definitions:
1. SMDD: Standard Maximum Dry Density and in the context of this Contract means the maximum dry unit weight determined according to ASTM D698.

C. ASTM International (ASTM):
1. C117 - Standard Test Method for Materials Finer than 75 µm (No. 200) Sieve in Mineral Aggregates by Washing.
2. C136/C136M - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
3. D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 (600 kN-m/m^3))
4. D2487 - Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System).
5. D2974 Standard Test Methods for Determining the Water (Moisture) Content, Ash Content, and Organic Material of Peat and Other Organic Soils.
6. D3740 - Standard Practice for Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction.
7. D4318 - Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
8. D4972 - Standard Test Methods for pH of Soils.
9. D6913/D6913M - Standard Test Methods for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis.
10. D6938 - Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).
11. D7928 - Standard Test Method for Particle-Size Distribution (Gradation) of Fine-Grained Soils Using the Sedimentation (Hydrometer) Analysis.

D. Texas Department of Transportation (TxDOT): Standard Specification for Construction and Maintenance of Highways, Streets, and Bridges.

E. United States Environmental Protection Agency (USEPA): Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, EPA publication SW-846, Third Edition, Final Updates I (1993), II (1995), IIA (1994), IIB (1995), III (1997), IIIA (1999), IIIB (2005), IV (2008), V (2015), VI (2019), and VII (2020).

1.4 PROGRESS SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Submit evidence for each imported material, in form of chemical analysis for parameters specified in Paragraph 2.9 G-H, that material is free of hazardous substances. If fill materials will be obtained from a state-certified quarry, chemical characterization specified in 2.9 G-H may not be required.

C. Samples: Submit, in airtight bag or container, 5-pound sample of each type of imported fill to ENGINEER.

D. Independent Geotechnical Testing Firm: Submit the name and qualifications of the independent geotechnical testing firm proposed by CONTRACTOR to provide geotechnical testing services for work of this Section.

E. Independent Testing Laboratory: Submit the name and qualifications of the independent testing laboratory proposed by CONTRACTOR to provide chemical analysis for work of this Section.

F. Suppliers' Certificates: Submit certificate indicating that each type of imported fill meets or exceeds specified requirements.

G. Test Reports: Submit test reports certifying compliance with specified requirements prior to commencing transport to the Work Site.

H. Analytical Results: Submit chemical analytical results for each type of imported fill prior to commencing transport to the Work Site.

I. Geotechnical Data: Submit geotechnical data for materials prior to commencing transport to the Work Site. Submit grain size distribution curves, density, and moisture content for each type of aggregate material. Show average distribution and minimum and maximum variation in gradation for each grain size distribution curve.

J. Weigh Tickets: Submit at the start of the work day following delivery weigh tickets generated at Supplier's weigh scale of imported fill delivered to the Work Site.

K. Weigh Scale Calibration: Submit a calibration chart, completed within the previous 6 months, for weigh scale. Weigh scale shall be calibrated by State of Texas agency.

1.5 QUALIFICATIONS

A. Geotechnical Testing Firm: Company specializing in performing work of this Section and complying with ASTM D3740 to perform testing of fill materials including density, moisture content, permeability, and particle size analysis for both soil and aggregate samples.

B. Independent Testing Laboratory: Company specializing in performing work of this Section to perform chemical analysis of fill material samples for parameters specified in Paragraph 2.9 G-H.

1.6 QUALITY ASSURANCE

A. Perform work of this Section in accordance with TxDOT Standard Specification for Construction and Maintenance of Highways, Streets, and Bridges.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Deliver, handle, and transport fill materials at all times in a manner and with equipment that will prevent intermixing of aggregate types, segregation, or contamination.

C. Minimize stockpiling requirements. Transport material from source directly to final position where possible.

D. Stockpile fill materials on-site in locations accepted by ENGINEER.

1.8 ENVIRONMENTAL REQUIREMENTS

A. Suspend operations whenever climatic conditions, as determined by ENGINEER, are unsatisfactory for placing fill to the requirements of this Section.

B. After occurrence of heavy rains, do not operate equipment on previously placed material or on accepted surfaces until the material has dried sufficiently to prevent occurrence of excessive rutting.

C. Where surfaces or previously placed material have been softened or eroded, remove soft and yielding material or otherwise objectionable or damaged areas and replace with compacted fill as specified by ENGINEER.

D. Decontaminate equipment involved in grading activities which may have come in contact with potentially impacted material before being removed from the Work Site or being relocated to clean areas of the Work Site.

1.9 SEQUENCING AND SCHEDULING

A. Section 01 30 00 - Administrative Requirements: Requirements for scheduling.

B. Coordinate and sequence filling operations to minimize the need for double handling.

C. Coordinate and sequence filling operations to minimize open excavations at all times.

PART 2 PRODUCTS

2.1 GENERAL

A. Imported fill to be from an accepted source.

B. Fill material to be free of unsuitable materials including:
   1. Trees, stumps, branches, roots, vegetation, or other wood or lumber.
   2. Wire, steel, cast iron, cans, drums, or other foreign material.
   3. Materials containing hazardous or toxic constituents at hazardous or toxic concentrations.

C. Compactable to specified density at specified moisture content.

2.2 EXISTING BERM MATERIAL

A. Existing berm material to be excavated and stockpiled pending analysis in accordance with PART 2, SOURCE QUALITY CONTROL.

B. Reuse of stockpiled berm material to be determined pending analysis. Decisions regarding reuse of excavated material will be made by OWNER.

2.3 SOIL FILL FOR BETWEEN SHEET PILE WALLS

A. Soil Type S1:
   1. Unit weight = 130 pounds per cubic foot or less.
   2. Non-cohesive material.
   3. Gradation to allow self-compaction:

Sieve Size	**% Passing**
3/8”	100
#4	95-100
#16	45-80
#50	10-30
#100	0-10
#200	0-5

2.4 STRUCTURAL FILL

A. Soil Type S2: Sandy clay (CL) or clayey sand (SC)
   1. Liquid limit (LL) no greater than 35
   2. Plasticity indices (PI) between 8 and 18
   3. No less than 30 percent retained on the U.S. Standard No. 200 Sieve.

2.5 COMMON FILL

A. Soil Type S3: According to requirements for common fill (see PART 1, SUPPLIED MATERIALS FROM OFF-SITE SOURCES).

2.6 SAND

A. Soil Type S4: According to requirements for sand (see PART 1, SUPPLIED MATERIALS FROM OFF-SITE SOURCES).

2.7 COARSE AGGREGATE

A. Aggregate Type A1: #610 Limestone of the following gradation:

Sieve Size	**% Passing**
1 1/2”	100
1”	90-100
3/4”	70-95
3/8”	50-80
#4	35-65
#10	25-50
#40	10-26
#200	4-12

2.8 CLEAR STONE

A. Aggregate Type A2: Clear stone of gradation according to AASHTO #57:

Sieve Size	**% Passing**
1 1/2”	100
1”	95-100
1/2”	25-60
#4	0-10
#8	0-5
#200	0-2

2.9 SOURCE QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Testing, inspection, and analysis requirements.

B. Testing and Analysis of Existing Berm Material:
   1. Particle Size, ASTM D6913/D6913M and D7928: One sample per 2,500 cu yd of material required.
   2. Soil Classification, ASTM D2487: One sample per 2,500 cu yd of material required.
   3. Chemical Analysis: One sample per 2,500 cu yd of material required, with analysis only for dioxins/furans in accordance with Paragraph 2.9 G-H.

C. Testing and Analysis of Aggregate Types A1 and A2 (Coarse Aggregate and Clear Stone):
   1. Grain Size, ASTM C117 and C136/C136M: 1 sample per 2,500 cu yd of aggregate required.
   2. Chemical Analysis: 1 sample per source. In accordance with Paragraph 2.9 G-H.

D. Testing and Analysis of Soil Types S1 and S2 (Fill for Between Sheet Pile Walls and Structural Fill):
   1. Particle Size, ASTM D6913/D6913M and D7928: One sample per 2,500 cu yd of material required.
   2. Soil Classification, ASTM D2487: One sample per 2,500 cu yd of material required.
   3. Chemical Analysis: 1 sample per source. In accordance with Paragraph 2.9 G-H.

E. Testing and Analysis of Soil Type S3 (Common Fill) and Sand:
   1. Chemical Analysis: 1 sample per source. In accordance with Paragraph 2.9 G-H.

F. Testing and Analysis of Topsoil:
   1. Particle Size, ASTM D6913/D6913M and ASTM D7928: 1 sample per 2,500 cu yd, or portion thereof, of topsoil required.
   2. pH, ASTM D4972: 1 sample per 2,500 cu yd, or portion thereof, of topsoil required.
   3. Organic Matter, ASTM D2974: 1 sample per 2,500 cu yd or portion thereof, of topsoil required.
   4. Phosphorus, potassium, calcium, and magnesium, in accordance with state-accredited method: 1 sample per 2,500 cu yd, or portion thereof, of topsoil required.
   5. Chemical Analysis: 1 sample per source. In accordance with Paragraph 2.9 G-H.

G. Chemical characterization in the laboratory in accordance with the following methods:

Analytical Parameters	*Analytical Methods(1)*
TAL(3) Metals	SW-846 6020A/7471A
Hexavalent Chromium	SW-846 7196A
Cyanide	SW-846 9010/9012
TCL(2) Volatiles	SW-846 8260B
TCL Semi-Volatiles	SW-846 8270D
TCL Pesticides	SW-846 8081B
Polychlorinated Biphenyls	SW-846 8082A
Herbicides	SW-846 8151A
Dioxin/Furans	SW-846 1613B
Total Petroleum Hydrocarbons	TX 1005/1006(4)

Notes:
(1) EPA SW 846.
(2) TCL: Target Compound List.
(3) TAL: Target Analyte List.
(4) Texas Commission on Environmental Quality Methods 1005 and 1006

H. Test and analyze all imported, non-virgin material to demonstrate compliance with EPA Class I criteria (residential).

I. If tests indicate materials do not meet specified requirements, change to appropriate material or change material source and retest.

J. Provide materials of each type from the same source throughout the Works.

K. In the event of changes to accepted sources of materials during the performance of the Works, immediately advise ENGINEER of revised locations and obtain acceptance of such locations and materials prior to use in the Works.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 70 00 - Execution and Closeout Requirements: Verification of existing conditions before starting work.

B. Do not allow or cause any of the work performed or installed to be covered up or enclosed by work of this Section prior to required inspections, surveys, measurements, tests, or approvals.

C. Submit required survey data to ENGINEER and obtain acceptance from ENGINEER for completed subgrade and previously placed material prior to placement of successive lifts.

D. Obtain acceptance from ENGINEER prior to placing fill against structures or around exposed buried utilities.

E. Ensure areas to be backfilled are free from trash, debris, snow, ice, water, soft soils, organic materials, or frozen ground.

3.2 PREPARATION

A. Remove debris, water, soft soils, organic materials, or frozen ground from areas to be filled.

B. Where not filling on previously worked area, scarify subgrade surface to a depth of 6 inches.

C. Compact subgrade to requirements for subsequent fill material.

D. Cut out soft areas of subgrade not capable of compaction in place. Backfill with appropriate fill and re-compact to meet requirements for subsequent fill material.

3.3 STOCKPILING

A. If necessary, stockpile fill materials at temporary stockpile areas according to the accepted Material Handling and On-Site Transportation Plan and as accepted by ENGINEER.

B. Segregate temporary stockpiles by material type and analytical results.

C. Provide and maintain access to temporary stockpiles.

D. Prevent contamination of stockpiled fill.

E. Direct surface water away from stockpile locations to prevent erosion or deterioration of materials.

F. Maintain stockpile slopes not steeper than 2 horizontal to 1 vertical. In no instance shall stockpiles be greater than 12 feet in height above original surrounding grade. Place berms and soil erosion and sediment control features around stockpiles as per the Drawings.

G. Maintain area surrounding stockpiles in safe, neat, and tidy condition.

H. Cover stockpiled fill at the end of each day with robust tarpaulin, or similar measures, to withstand adverse weather, wind, and other detrimental forces. Provide protection of stockpiled material from rain and other adverse weather effects.

3.4 FILLING

A. Load and transport fill from off-site sources in accordance with the accepted Material Handling and On-Site Transportation Plan.

B. Place and compact material according to specified requirements.

C. Employ a placement method that does not disturb or damage other work.

D. Slope grade away from structures at minimum 2 percent to match existing grade.

E. Make gradual grade changes. Blend slope into level areas.

F. Do not operate heavy compaction equipment closer than 5 feet to structures, underground utilities, or monitoring wells.

3.5 PLACEMENT OF TOPSOIL

A. Spread topsoil to a minimum settled depth of 6 inches over area to be seeded. Rake until smooth.

B. Place topsoil during dry weather and on dry subgrade.

C. Remove vegetable matter and foreign non-organic material from topsoil while spreading.

D. Grade topsoil to eliminate rough, low, or soft areas, and to ensure positive drainage.

E. Till topsoil to incorporate materials to adjust soil pH, phosphorus fertilizers if recommended by soil test, and soil amendments to improve the soil structure.

F. Install edging at periphery of seeded areas in straight lines to consistent depth.

G. Obtain ENGINEER's acceptance of topsoil grade and depth before starting seeding.

3.6 PLACEMENT OF AGGREGATE A1 AND SOIL TYPES S2, S3, AND S4

A. Verify subgrade has been inspected, gradients and elevations are correct, and is dry.

B. Correct irregularities in substrate gradient and elevation by scarifying, reshaping, and recompacting.

C. Place material in maximum 6-inch thick layers.

D. Level and contour surfaces to elevations and gradients to match existing adjacent areas.

E. Add water to assist compaction. If excess water is apparent, remove material and aerate to reduce moisture content.

F. Use mechanical tamping equipment in areas inaccessible to compaction equipment.

3.7 PLACEMENT OF SOIL TYPE S1

A. Placement of soil fill between sheet pile walls varies in location along the sheet pile wall alignment. CONTRACTOR to follow specific instructions presented on structural sheet pile wall Drawings.

3.8 COMPACTION

A. Soil Type S1: No compaction (self-compacting).

B. Soil Type S2: Compact to at least 95 percent SMDD at ±2% optimum moisture content. Obtain in-place density measurements in accordance with ASTM D6938.

C. Soil Types S3 and S4: Compact to at least 90 percent SMDD at ±2% optimum moisture content. Obtain in-place density measurements in accordance with ASTM D6938.

D. Aggregate Type A1: Compact to at least 95 percent SMDD at ±2% optimum moisture content. Obtain in-place density measurements in accordance with ASTM D6938.

E. Apply water from an accepted source as necessary during compaction to obtain desired density. If material to be compacted is excessively moist, aerate with suitable equipment and methods until the moisture content is corrected. In areas not accessible to rolling equipment, compact material to specified density with mechanical tampers.

F. Do not direct jets of water at fill with such force that finer materials will be washed out.

G. Compaction Equipment: The type, size, and efficiency of compaction equipment shall be capable of achieving desired degree of compaction. When operating equipment adjacent to and immediately above structures, exercise care so as not to cause damage or displacement of the structure.

3.9 TOLERANCES

A. Section 01 40 00 - Quality Requirements: Requirements for tolerances.

B. Top Surface of Fill: Plus or minus 1 inch, but not uniformly high or low, from required elevations.

3.10 FIELD QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Field inspecting and testing.

B. Select samples of uncompacted fill intended for the Works and samples of compacted fill in the Works.

C. Test installed materials to confirm compliance with Specifications.

D. Submit copies of test reports to ENGINEER.

E. Verification Testing by ENGINEER:
   1. ENGINEER may select samples of uncompacted fill intended for the Works and samples of compacted fill in the Works.
   2. Testing by ENGINEER will in no way relieve CONTRACTOR of his responsibility to test all material prior to notifying ENGINEER of materials' suitability for the work involved.

F. Methods of Testing:
   1. Particle size analysis shall be performed in accordance with ASTM D6913/D6913M and ASTM D7928 or ASTM C117 and ASTM C136/C136M, whichever is appropriate to material being tested.

G. Frequency of Testing: according to requirements stated in PART 2.

H. The methods used and the frequency of tests may be modified by ENGINEER.

I. Failure to Meet Specified Requirements: If tests indicate that material specifications have not been achieved or cannot be obtained with equipment in use, procedure being followed, or material being incorporated, remove and replace work, and modify operations so that the equipment, procedures, and materials will produce the required results. Additional testing required by ENGINEER will be to CONTRACTOR's account.

3.11 ADJUSTING

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for adjusting.

B. Finish fill surfaces to within 1 inch of grades as shown on the Drawings but not uniformly high or low. Correct surface irregularities by loosening and adding or removing material until the surface is within specified grade.

C. Leave work areas in a properly graded condition sloped as required to permit proper drainage and free of depressions that will pond or collect water or debris that will restrict flow.

3.12 PROTECTION

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for protection of installed work.

B. Reshape and recompact fills subjected to vehicular traffic or areas disturbed by other Works prior to installing finish topsoil layer.

END OF SECTION

SECTION 31 35 26.16

GEOMEMBRANES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Linear-low density polyethylene (LLDPE) geomembrane for construction of impermeable cover system for construction of temporary equipment decontamination pad, temporary dewatering facility, and water storage tank containment pad.

1.2 REFERENCES

A. Abbreviations and Acronyms:
1. IAGA: International Association of Geosynthetic Installers.
2. LLDPE: Linear-Low Density Polyethylene.

B. Definitions:
1. Conform to ASTM D4439 for interpretation of terms used in this Section.
2. Minimum Average Value: Average of test values calculated in accordance with specified standard at minimum frequency specified in GRI GM17.
3. Wrinkles: Corrugations in geomembrane that will fold over during placement of materials overlying geomembrane.

C. Reference Standards:
1. Section 01 40 00 - Quality Requirements: Requirements for references.
2. ASTM International:
a. ASTM D792 - Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement.
b. ASTM D1004 - Standard Test Method for Tear Resistance (Graves Tear) of Plastic Film and Sheeting.
c. ASTM D1238 - Standard Test Method for Melt Flow Rates of Thermoplastics by Extrusion Plastometer.
d. ASTM D1505 - Standard Test Method for Density of Plastics by the Density Gradient Technique.
e. ASTM D1603 - Standard Test Method for Carbon Black Content in Olefin Plastics.
f. ASTM D4218 - Standard Test Method for Determination of Carbon Black Content in Polyethylene Compounds by the Muffle Furnace Technique.
g. ASTM D4437/D4437M - Standard Practice for Nondestructive Testing (NDT) for Determining the Integrity of Seams Used in Joining Flexible Polymeric Sheet Geomembranes.
h. ASTM D4439 - Standard Terminology for Geosynthetics.
i. ASTM D4833/D4833M - Standard Test Method for Index Puncture Resistance of Geomembranes and Related Products.
j. ASTM D5199 - Standard Test Method for Measuring the Nominal Thickness of Geosynthetics.
k. ASTM D5323 - Standard Practice for Determination of 2 % Secant Modulus for Polyethylene Geomembranes.

l. ASTM D5596 - Standard Test Method for Microscopic Evaluation of the Dispersion of Carbon Black in Polyolefin Geosynthetics.
m. ASTM D5617 - Standard Test Method for Multi-Axial Tension Test for Geosynthetics.
n. ASTM D5721 - Standard Practice for Air-Oven Aging of Polyolefin Geomembranes.
o. ASTM D5885/D5885M - Standard Test Method for Oxidative Induction Time of Polyolefin Geosynthetics by High-Pressure Differential Scanning Calorimetry.
p. ASTM D6370 - Standard Test Method for Rubber—Compositional Analysis by Thermogravimetry (TGA).
q. ASTM D6392 - Standard Test Method for Determining the Integrity of Nonreinforced Geomembrane Seams Produced Using Thermo-Fusion Methods.
r. ASTM D6497 - Standard Guide for Mechanical Attachment of Geomembrane to Penetrations or Structures.
s. ASTM D6693 - Standard Test Method for Determining Tensile Properties of Nonreinforced Polyethylene and Nonreinforced Flexible Polypropylene Geomembranes.
t. ASTM D7238 - Standard Test Method for Effect of Exposure of Unreinforced Polyolefin Geomembrane Using Fluorescent UV Condensation Apparatus.
u. ASTM D8117 - Standard Test Method for Oxidative Induction Time of Polyolefin Geosynthetics by Differential Scanning Calorimetry.

3. Geosynthetic Research Institute:
   a. GRI GM6 - Practice for Pressurized Air Channel Test for Dual Seamed Geomembranes.
   b. GRI GM9 - Practice for Cold Weather Seaming of Geomembranes.
   c. GRI GM17 - Test Properties, Testing Frequency and Recommended Warranty for Linear-Low Density Polyethylene (LLDPE) Smooth and Textured Geomembranes.
   d. GRI GM19a - Specification for Seam Strength and Related Properties of Thermally Bonded Homogeneous Polyolefin Geomembranes/Barriers.

1.3 PRE-INSTALLATION MEETINGS

A. Section 01 30 00 - Administrative Requirements: Pre-installation meeting.

B. Convene a minimum 1 week prior to commencing installation of geomembranes.

C. Purpose of Meeting:
   1. Define responsibilities of each party.
   2. Establish lines of authority and lines of communication.
   3. Establish Work Site-specific quality assurance/quality control and monitoring procedures.
   4. Define installation procedures.
   5. Define method of acceptance of completed geomembrane.
   6. Define installation schedule.
   7. Discuss submittals.
   8. Review personal protective equipment and applicable regulations.
   9. Review safety plan and procedures.
   10. Review panel layout and numbering system for panels, seams, and test samples.
   11. Review methods for protecting installed work.
   12. Visit the Work Site for review of surface preparation, physical location of the Work Site, and access to the Work Site.
   13. Review critical design details.

1.4 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Shop Drawings: Indicate installation layout, dimensions, and details including field seams and protrusion details.

C. Product Data: Submit no later than 14 days prior to ordering.

D. Samples: Submit minimum 2 m length of standard width membrane no later than 14 days prior to ordering.

E. Manufacturers' Instructions: Submit at least 14 days prior to installation. Include written installation, handling, storage, and repair instructions.

F. Manufacturer's Certificate: At least 14 days prior to delivery to the Work Site, certify that products meet or exceed specified requirements. Include test results.

G. Manufacturer's Quality Assurance Plan or Manual: Submit no later than 14 days prior to ordering.

H. Installer's Quality Assurance Plan or Manual: Submit no later than 14 days prior to ordering.

I. Source Quality Control Submittals: Indicate results of testing no later than 14 days prior to ordering.

J. Daily Field Installation Report: submit no later than 1 day following date covered by report. Include:
   1. Subgrade surface acceptance form signed by manufacturer's representative and ENGINEER.
   2. Total quantity, type, and location of geomembrane placed.
   3. Identifiers of rolls with manufacturer's number.
   4. Quality control tests of materials used during the day.
   5. Total quantity and location of seams completed, identification of seamer, and welding equipment used.
   6. Observations of test seams, including seaming unit number and identification of names of seamers, weather conditions, speed, temperature setting, and results.
   7. Location and results of non-destructive testing.
   8. Location and results of destructive testing.
   9. Reasons for and observations of repairs and retesting, including locations, type of repair, name of repairer, and seaming equipment or product used.
   10. Observations of field seaming operations, including weather conditions, cleaning, overlaps, rate of seaming, names of seamers, and units used.
   11. Observations of placement and seams around appurtenances, and connection to appurtenances.

K. Manufacturer Qualifications Statements:
   1. Submit qualifications for manufacturer, no later than 30 days prior to ordering list of previous projects totaling 3 million sq ft of installation, and five projects including name of project, description of project, area, client's name and address, contacts, and telephone numbers; engineer's name, address, contact, and telephone number.
   2. Submit installer's name, address, contact, and telephone number; and date installed.
   3. Manufacturer shall be ISO 9001 certified.

L. Installer Qualification Statements:
   1. Submit manufacturer's approval of installer no later than 14 days prior to installation.
   2. Submit IAGI Certified Contractor Status.
   3. Submit IAGI Certificates and Certified Welding Technician Certificates for each seamer.

1.5 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for closeout submittals.

B. Project Record Documents: Indicate panel layout, including panel identifiers, date placed, installer's name, location of seams, and location and details of repair.

C. Warranties: Completed original warranty forms filled out in OWNER's name and registered with manufacturer.

1.6 QUALITY ASSURANCE

A. Provide manufacturer's quality assurance plan or manual to ensure that geomembrane is manufactured in accordance with and will meet the requirements of this Section.

B. Provide installer's quality assurance plan or manual to ensure that geomembrane will be installed in accordance with this Section and the noted references.

C. Certifications: Submit certificates based on GRI-required properties and testing frequencies.

D. Certificates pertaining to rolls or panels of geomembrane delivered to the Work Site shall accompany rolls or panels. Each roll or panel shall be identified by a unique manufacturing number. Quality control certificates shall be signed by a responsible party employed by manufacturer.

E. Certificates pertaining to raw materials and manufactured rolls or panels shall be provided by geomembrane manufacturer. ENGINEER will review test results for completeness and for compliance with minimum properties specified for both raw materials and manufactured rolls or panels. Materials and rolls or panels which are in non-compliance with minimum properties specified will be rejected.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum 20 projects, 25 million sq ft, and 5 years of documented experience.

B. Installer: Company specializing in installing products specified in this Section with minimum five projects, 10 million sq ft, 3 years of documented experience, certified/licensed by manufacturer, and a holder of IAGI Certified Contractor Status.

C. Seamers: Certification by IAGI and certification as a Certified Welding Technician is required for all personnel performing seaming operations.

D. Master Seamer: Same certification requirements as seamer, with at least 10 million sq ft of geomembrane of the same generic type as geomembrane used for the Project using the same type of seaming method. The master seamer will provide direct supervision over all seamers and will be present during all seaming operations.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Package and label rolls or panels prior to shipment to the Work Site. Label shall indicate manufacturer, type of geomembrane, thickness, lot number, roll number, and roll dimensions. Manufacturer is responsible for initial loading and shipping of geomembrane. Methods of unloading geomembrane shall be approved by manufacturer prior to shipment.

C. When transported to the Work Site, handle geomembrane rolls or panels by appropriate means so that no damage is caused, as recommended by geomembrane manufacturer.

D. During delivery and storage, protect geomembrane from direct sunlight, ultraviolet rays, excessive heat, mud, dirt, dust, debris, and rodents.

E. Take adequate measures to keep geomembrane away from possible deteriorating sources (e.g., vandalism, theft).

F. Use handling equipment approved by manufacturer when moving geomembrane from one place to another. Lift rolls by inserting bar, sized to limit deflection detrimental to geomembrane, through roll core. Attach slings or lifting chains at both ends of bar. Use a spreader bar to support and spread slings. Bar and support pipe shall be long enough to prevent damage to edges of geomembrane during hoisting.

G. Notify ENGINEER 3 days in advance of geomembrane delivery to the Work Site. Perform joint inspection with ENGINEER upon delivery. Defects or damage from shipping and handling will be grounds for rejection of a portion of geomembrane or of entire geomembrane roll or panel at ENGINEER's discretion. Remove rejected materials from the Work Site and replace with new materials.

1.9 AMBIENT CONDITIONS

A. Suspend installation operations whenever climatic conditions, as determined by ENGINEER or manufacturer's representative, are unsatisfactory for placing geomembrane to requirements of this Section.

B. Weather Conditions for Geomembrane Placement:
   1. Comply with manufacturer's recommendation.
   2. Do not unroll, unfold, or place geomembrane at an ambient temperature below 32 degrees F or above 104 degrees F, unless CONTRACTOR obtains written acceptance from geomembrane manufacturer and ENGINEER.
   3. Install on dry ground.
   4. Geomembrane placement shall take into account the Work Site’s drainage, wind direction, construction, access to the Work Site and production schedule of the Works.

5. Geomembrane placement shall not proceed if subgrade conditions have deteriorated due to moisture, or in the presence of high winds, as determined by ENGINEER, which might damage geomembrane.
6. Adequately ballast deployed geomembrane at all times to limit risk of wind damage.

C. Weather Conditions for Geomembrane Seaming:
1. Comply with manufacturer's recommendations.
2. Make no weld below 34 degrees F unless:
   a. CONTRACTOR strictly follows guidelines for field seaming of geomembrane in cold weather, as identified in GRI GM9.
   b. CONTRACTOR obtains written approval from geomembrane manufacturer to weld at temperature below 32 degrees F according to GRI GM9.
   c. Between 34 and 50 degrees F, seaming is possible if geomembrane is preheated by either sun or hot air device, and if there is not excessive cooling resulting from wind.
   d. Make no weld below minus 5 degrees F.
   e. In all cases, geomembrane must be dry while being welded.

1.10 WARRANTY

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for warranties.

B. Furnish 20-year manufacturer's warranty against manufacturing defects.

C. Warranty: Include coverage for:
1. Defective product found to be not in compliance with the requirements of this Section.
2. Replacement of geomembrane with new material, including costs associated with geomembrane installation.

PART 2 PRODUCTS

2.1 LLDPE GEOMEMBRANE

A. Manufactured from virgin resin with no more than 10 percent rework. Rework shall be of same formulation as the parent material. No post-consumer resin permitted.

B. Free of holes, blisters, undispersed raw materials, and any sign of contamination by foreign matter.

C. Melt index value less than 1.0 g/10 minutes in accordance with ASTM D1238.

D. Conforming to the following specifications:

LLDPE Geomembrane – Smooth – 40 mils			
Properties	**Test Method**	**Test Value**	**Testing Frequency (Minimum)**
Thickness (min. ave.) – mils • lowest individual of 10 values	ASTM D5199	nom. (40) -10% (36)	per roll
Formulated Density (max) - g/cc	ASTM D1505/D792	0.939	200,000 lb
Tensile Properties(1) (min. ave.) • break strength – lb/in. • break elongation - percent	ASTM D6693 Type IV	 152 800	20,000 lb
2% Modulus (max.) - lb/in.	ASTM D5323	2400	per formulation
Tear Resistance (min. ave.) – lb	ASTM D1004	22	45,000 lb
Puncture Resistance (min. ave.) – lb	ASTM D4833/D4833M	56	45,000 lb
Axi-Symmetric Break Resistance Strain (min.) - percent	ASTM D5617	30	per formulation
Carbon Black Content (range) - percent	ASTM D4218(2)	2.0 - 3.0	45,000 lb
Carbon Black Dispersion	ASTM D5596	note (3)	45,000 lb
Oxidative Induction Time (OIT) (min. ave.)(4) a) Standard OIT – min. -or- b) High Pressure OIT – min.	 ASTM D8117 ASTM D5885/D5885M	 100 400	200,000 lb
Oven Aging at 85°C(5) a) Standard OIT (min. ave.) – percent retained after 90 days -or- b) High Pressure OIT (min. ave.) – percent retained after 90 days	ASTM D5721 ASTM D8117 ASTM D5885/D5885M	 35 60	per formulation
UV Resistance(6) a) High Pressure OIT (min. ave.) – percent retained after 1600 hrs(7)	ASTM D7238 ASTM D5885/D5885M	 35	per each formulation

Notes:
min. ave. – minimum average
nom. – nominal
(1) Machine direction (MD) and cross machine direction (XMD) average values should be on the basis of 5 test specimens each direction.
- Break elongation is calculated using a gage length of 2.0 in. at 2.0 in./min.
(2) Other methods such as D1603 (tube furnace) or D6370 (TGA) are acceptable if an appropriate correlation to D4218 (muffle furnace) can be established.
(3) Carbon black dispersion (only near spherical agglomerates) for 10 different views:
- 9 in Categories 1 or 2 and 1 in Category 3
(4) The manufacturer has the option to select either one of the OIT methods listed to evaluate the antioxidant content in the geomembrane.
(5) Also evaluate samples at 30 and 60 days to compare with the 90-day response.
(6) The condition of the test should be 20 hr. UV cycle at 75°C followed by 4 hr. condensation at 60°C.
(7) UV resistance is based on percent retained value regardless of the original HP-OIT value.

2.2 SOURCE QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Testing, inspection, and analysis requirements.

B. Manufacturer shall perform test for parameters specified in PART 2, at a minimum frequency specified in GRI GM17.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 70 00 - Execution and Closeout Requirements: Verification of existing conditions before starting work.

B. Obtain ENGINEER's acceptance in writing prior to installing geomembrane and prior to placing subsequent materials on geomembrane.

C. Coordinate activities so that ENGINEER can observe testing. ENGINEER will observe all testing and collect samples for destructive testing.

3.2 PREPARATION

A. Do not begin installation of geomembrane until subgrade surface has been accepted by ENGINEER.

3.3 INSTALLATION

A. Maintain area of installation free of water.

B. Do not proceed with panel placement and seaming during precipitation, in presence of excessive moisture (e.g., fog, dew), nor in presence of high winds.

C. Place geomembrane in accordance with manufacturer's instructions. Minimize wrinkles, avoid scratches and crimps to geomembranes, and avoid damage to supporting material.

D. Designate each roll or blanket with an individual panel number and correlate with manufacturer's identification number. Mark each designation in each roll as it is deployed.

E. Protect installed geomembrane from displacement, damage or deterioration before, during and after placement of material layers.

F. Require workers to wear shoes which will not damage geomembrane.

G. Minimize pulling of geomembrane panels to reduce permanent tension.

H. Take the following precautions to minimize the risk of damage by wind during panel placement:

1. Orientate work according to the direction of prevailing winds if possible, unless otherwise specified.
2. Adequately secure the geomembrane panels to prevent uplift by wind, by any means necessary that will not damage geomembrane. Along the edges, ensure loading is continuous, to avoid possible windflow under the panels.

I. Replace damaged, torn or permanently twisted panels until accepted by ENGINEER. Remove rejected damaged panels from the Work Site.

J. Keep field seaming to minimum. Locate field seams up and down slopes, with no horizontal field seam less than 5 feet beyond toe or crest of slope.

K. Keep seam area clean and free of moisture, dust, dirt, debris and foreign material.

L. Make field seam samples in accordance with requirements specified in PART 3, FIELD QUALITY CONTROL on fragment pieces of geomembrane and test to verify that seaming conditions are adequate.

M. Test field seams as seaming work progresses by non-destructive methods over their full length, in accordance with ASTM D4437/D4437M. Repair seams which do not pass non-destructive test. Reconstruct seam between failed location and any passed test location, until non-destructive testing is successful.

N. Repair minor tears and pinholes by patching until non-destructive testing is successful. Patches to be round or oval in shape, made of same geomembrane material, and extend minimum of 3 inches beyond edge of defect.

3.4 INSTALLATION AROUND APPURTENANCES

A. Install geomembrane around appurtenances protruding through geomembrane.

B. Obtain ENGINEER's written acceptance for materials to be used to seal gaps between the geomembrane skirt and appurtenances.

C. Perform installation on rough surfaces carefully to minimize geomembrane damage. Additional loosely placed geomembrane sections may be used by geomembrane installer as protection for geomembrane, if accepted by ENGINEER.

D. Ensure clamps, clips, bolts, nuts, or other fasteners used to secure geomembrane around each appurtenance have a lifespan equal to or exceeding geomembrane.

E. Geomembrane penetration shall be in accordance with ASTM D6497 or as recommended by geomembrane manufacturer.

3.5 FIELD SEAMING

A. Overlap the panels a minimum of 4 inches for extrusion welds and a minimum of 4 inches for hot wedge welds.

B. Panel Preparation: Prior to seaming, clean the seam area and ensure it is free of moisture, dust, dirt, debris of any kind, and foreign material.

C. Seaming Equipment and Products: Seam geomembrane using extrusion or hot wedge welding equipment and installation methods recommended by manufacturer. For extrusion welding, use an extrudate composition identical to that of the geomembrane material, or weld all panels together using the hot wedge welding system. Include thermometers on the extrusion welding equipment to measure the temperature of the extrudate in the machine extruder and at the nozzle. Use wedge welding equipment capable of continuously monitoring and controlling the wedge temperature.

D. Orient seams downslope so that direction of seaming will not hinder flow of water over top of geomembrane. Specifically for hot wedge weld seams, overlap geomembrane on downslope side of seam.

E. If the supporting soil is yielding, provide a firm substrate by using a homogeneous board, a conveyor belt, or similar hard surface directly under seam overlap to effect proper rolling pressure.

F. Seaming Wrinkles: Cut fishmouths and corrugations so as to effect a flat overlap. Seam the cut fishmouths or wrinkles as well as possible, then install patch of the same generic geomembrane extending a minimum of 6 inches beyond the cut in all directions.

G. Do not cross slope seam less than 5 feet from the toe of slope unless slope is less than 10 percent. Cross slope seams may be utilized if cut at an angle of approximately 45 degrees.

H. Label each seam with date, seamer, equipment seaming temperature and speed, and time seam started and completed.

I. Seaming Tie ins: Only proceed with seaming of geomembrane tie ins once all panels to be seamed are at a uniform temperature (i.e., early in the morning or late in the day) to avoid excessive distortion in the geomembrane due to geomembrane contraction and expansion.

3.6 REPAIR PROCEDURES

A. Clean and dry surfaces at the time of repair.

B. Repair pinholes by applying a patch. Repair defective seams by re-seaming, flap welding, or applying a patch, as accepted by ENGINEER.

C. Repair tears, blisters, larger holes, undispersed raw materials, and contamination by foreign matter, or corrugations determined by ENGINEER to be excessive, by patches.

D. Patches:
1. Abrade surfaces as appropriate.
2. Label each patch with date, number, seamer, and equipment.
3. Ensure patches are round or oval in shape.
4. Make of same generic geomembrane.
5. Extend patch a minimum of 4 inches beyond edge of defects.

3.7 FIELD QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Field inspecting and testing.

B. Test quality of resin and geomembrane to ensure consistency of raw material and geomembrane quality in accordance with manufacturer's recommendations.

C. Inspect each panel for damage after placement and prior to seaming. Mark damaged panels or portions of damaged panels which have been rejected, as judged by ENGINEER, and record their removal.

D. Verify that weather conditions (appropriate air temperature, non-excessive wind, and lack of precipitation) are acceptable for panel placement.

E. Field Seaming Operations: Verify as follows:
   1. Seaming personnel have the specified qualifications.
   2. Overlaps meet specified requirements.
   3. Seaming area is clean and dry, as specified.
   4. A hard substrate such as a board or a piece of conveyor belt is used if the supporting soil is soft or uneven.
   5. Seaming equipment is available and meets specified requirements.
   6. Weather conditions for seaming are acceptable, as specified.
   7. Seaming procedures as specified are followed.
   8. Panels are properly positioned to prevent wrinkling.
   9. Equipment for testing seams is available on-site and operational.
   10. Field tensiometer has been correctly calibrated.

F. Provide test results to ENGINEER at the end of each shift for each shift's production, including documentation of non-destructive testing and repairs.

G. Test Seams:
   1. Perform test seams in shear and peel in accordance with ASTM D4437/D4437M to verify that seaming conditions are adequate. Conduct test seams at discretion of ENGINEER and at least two times each day (at the beginning of each seaming period, at least once every 4 hours thereafter, and at least once every 4 hours thereafter if welding operations are interrupted) for each seaming apparatus and each seamer used that day. Perform test seaming under the same conditions as production seaming. Provide 4-foot test seams for extrusion welds and 10-foot test seams for hot wedge welds. Perform test seams on scrap geomembrane not to be incorporated into the Works.
   2. Cut 1-inch-wide coupons from the test seam and assign to peel or shear test alternatively as they are cut across panel. Test coupons in shear and peel using a calibrated field tensiometer. Required minimum strength of geomembrane test seams are:
      a. Shear Test: 60 lb/in for both hot wedge and extrusion welded seams.
      b. Peel Test: 50 lb/in for hot wedge welded seams and 44 lb/in for extrusion welded seams.
   3. In addition, test coupons must not delaminate. Passing test results must be obtained from four of five coupons when tested in shear, and four of five coupons when tested in peel. For geomembrane test seams performed using a hot wedge welder, perform peel tests on both inside and outside welds; both welds must pass peel test. If a test seam fails, reject seaming equipment for field seaming until deficiencies are corrected and a successful test seam is produced.
   4. A passing test seam will be an indicator of seaming unit adequacy and seamer working under prevailing conditions at the Work Site, but not necessarily an indicator of field seam adequacy.
   5. Coordinate completion of test seams such that ENGINEER can observe such seams. ENGINEER will observe all test seams. Retain a sample from each test and label with

date, ambient temperature, serial number of seaming units, seamer, and pass or fail description. One half of sample will be retained by ENGINEER.

H. Non-destructive Seam Testing:
   1. Non-destructively test field seams over their full length by pressure testing according to GRI GM6 and ASTM D4437/D4437M. Pressure test results will be written on geomembrane near seam. Number or otherwise designate each seam. Record location, date, test unit, name of tester, and outcome of all non-destructive testing.
   2. Passing non-destructive test of field seams, meeting or exceeding requirements according to GRI GM6, indicates the adequacy of field seams, subject to results of destructive seam testing, as specified in PART 3, FIELD QUALITY CONTROL.
   3. Coordinate activities such that ENGINEER can observe all testing. ENGINEER will observe all testing. Non-destructive testing performed in absence of ENGINEER will be repeated. Conduct testing as seaming work progresses. Number and mark all defects found during testing immediately after detection. Repair, re-test, and re-mark all defects found to indicate completion of repair and acceptability. If pressure testing is performed, repair hole resulting from pressure needle following testing.

I. Destructive Seam Testing: Collect 2-foot long field seam samples at a frequency of approximately one sample per 1,000 linear feet of field seam at locations directed by ENGINEER, or more frequently if requested. Field test five coupons in peel and five coupons in shear according to GRI GM19a and ASTM D6392, using a calibrated field tensiometer. Perform peel tests on the inside and outside weld. At least four of each of the five coupons must not delaminate and must pass tensile strength requirements, based on field testing. Required minimum strength of geomembrane field seams for field tests:
   a. Shear Test: 60 lb/in for both hot wedge and extrusion welded seams.
   b. Peel Test: 50 lb/in for hot wedge welded seams and 44 lb/in for extrusion welded seams.

J. If either field tests fail, isolate defective seam and re-test as follows:
   1. Collect additional 2-foot long samples from field seam for testing using a field tensiometer, within 10 feet of each side of the failing sample as determined by ENGINEER, until passing test locations are identified.
   2. Repair field seam between passing test locations (based on field tensiometer results) by extrusion welding or patching.
   3. Non-destructively test patch or extrusion weld and repair, as required, until non-destructive test standards are achieved.
   4. Repeat above noted procedure until passing field test results are achieved, thereby delineating extent of defective seam.

K. Verification of Seams in Special Locations:
   1. Non-destructively test seams in special locations (i.e., appurtenances) if seam is accessible to testing equipment. ENGINEER will observe all seam testing operations. If seam cannot be tested in place, it will be observed by ENGINEER and CONTRACTOR for uniformity and completeness.
   2. In the case of visual inspections, record the seam number, date of inspection, name of tester, and outcome of inspection.
   3. Promptly repair, re-test, and re-mark defective seams to indicate completion of repair.

L. Defects and Repairs:
   1. Identification: inspect seams and non-seam areas of geomembrane for identification of defects, holes, blisters, undispersed raw materials, and any sign of contamination by foreign matter.

2. Evaluation: non-destructively test each suspect location, both in seam and non-seam, using methods specified in PART 3, FIELD QUALITY CONTROL. Mark and repair each location which fails non-destructive testing.
3. Verification of Repairs: Non-destructively test each repair using the method specified in PART 3, FIELD QUALITY CONTROL. Tests which pass non-destructive test standards will serve as an indication of an adequate repair. Re-repair and test failed test locations until a passing test results. Record the number of each repair, date, location, repair personnel initials, and test outcome. ENGINEER will observe non-destructive testing of repairs.

M. Geomembrane Acceptance:
1. Geomembrane will be accepted by ENGINEER when:
   a. Installation is finished.
   b. Documentation of installation is completed and submitted to ENGINEER.
   c. Verification of the adequacy of field seams and repairs, and associated testing, is complete.

3.8 MANUFACTURER'S FIELD SERVICES

A. Section 01 40 00 - Quality Requirements: Requirements for manufacturer's field services.

B. Furnish services of a qualified manufacturer's representative to observe placement of geomembrane, subgrade preparation, geomembrane installation, and backfilling operations. Manufacturer's representative will provide guidance to installer on proper installation techniques, but will not assume liability or responsibility in overall installation.

3.9 CLEANING

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for cleaning.

B. Remove construction debris from the Work Site and dispose in an environmentally responsible and legal manner.

3.10 PROTECTION

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for protection of installed work.

B. Do not permit vehicular traffic directly on geomembrane.

C. Place soil cover layer from lower elevations to higher elevations. Push soil cover layer by traveling only on previously placed material, never directly on geomembrane, and by avoiding sudden turns or accelerations.

END OF SECTION

SECTION 31 37 00

RIPRAP

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Riprap for river discharge and raised bench.

1.2 REFERENCES

A. Reference Standards:
   1. Section 01 00 00 - General Requirements: Requirements for references.
   2. ASTM International:
      a. ASTM C88 – Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate.
      b. ASTM C127 – Standard Test Method for Specific Gravity and Absorption of Coarse
      c. ASTM C666 – Standard Test Method for Resistance of Concrete to Rapid Freezing and Thawing.

1.3 SUBMITTALS

A. Section 01 00 00 - General Requirements: Requirements for submittals.

B. Material Source: Submit to ENGINEER the proposed source of riprap at least 14 days prior to commencing production, including any change in material source during performance of the Works.

C. Quality Control Plan:
   1. Submit at least 2 weeks prior to commencement of riprap production.
   2. Submit gradation test results, stone quality tabulations, or other data required for the Quality Control Plan as directed by ENGINEER.
   3. Make stone source inspector and loading facility inspector logs available at any time during the project for review by ENGINEER.
   4. At project closeout furnish copies of the complete Quality Control Plan records to ENGINEER.

D. Source Quality Control: Provide results of gradation testing prior to loading riprap for transport to the Work Site.

1.4 QUALITY ASSURANCE

A. Perform work of this Section in accordance with State of Texas Standards.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Section 01 00 00 - General Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Deliver, handle, and transport riprap at all times in a manner and with equipment that will prevent intermixing of riprap types, segregation, or contamination.

C. Stockpile riprap on the Work Site in locations approved by ENGINEER.

D. Minimize stockpiling requirements. Transport riprap from source directly to final position where possible.

E. Exercise care in loading, hauling, and unloading riprap and stone to prevent crushing and splitting that would lead to rejection.

1.6 AMBIENT CONDITIONS

A. Suspend operations whenever climatic conditions, as determined by ENGINEER, are unsatisfactory for placing riprap to the requirements of this Section.

PART 2 PRODUCTS

2.1 RIPRAP

A. Unweathered, durable crushed or blasted igneous, metamorphic, or sedimentary rock.

B. Free from organic material, mica, shale, or other unsuitable material.

C. Individual Rock Fragments: Hard, dense, sound, and resistant to abrasion and free of cracks, seams, and other structural defects that would tend to increase unduly their destruction by water and frost action and handling.

D. Do not use rock exhibiting marked deterioration by water or weather.

E. Bulk Specific Gravity of Rock Fragments: ASTM C127, minimum 2.6.

F. Maximum aspect ratio (greatest to least dimension) of any piece of riprap shall not be greater than 2.5 when measured on mutually perpendicular axes.

G. Gradation limits for riprap are in-place requirements. Make adjustment in production, transportation, and placement as necessary to ensure that placed materials are within specified range.

H. Rock Size:

D_{15} (in): Min 3.7, Max 5.2
D_{50} (in): Min 5.7, Max 6.9
D_{85} (in): Min 7.8, Max 9.2
D_{100} (in): Max 12.0

I. Well graded and not exhibiting gap grading or scalping from individual size ranges.

J. Rock Quality:
   1. Absorption: ASTM C127, 2 percent maximum water absorption.
   2. Soundness: ASTM C88, 15 percent maximum loss at 5 cycles.
   3. Freeze-Thaw: ASTM C666, 12 percent maximum loss at 35 cycles.

2.2 SOURCE QUALITY CONTROL

A. Section 01 00 00 - General Requirements: Testing, inspection, and analysis requirements.

B. Gradation Testing: Perform quality assurance gradations at riprap source as follows:
   1. Select a random sample of stone equal to a least 50 times the median stone weight in each classification.
   2. Measure each individual piece in the sample along 3 mutually perpendicular axes.
   3. Compute weights from measurements and record in table format using smallest axes size.
   4. Using this recorded information, assemble a gradation curve.
   5. Conduct 3 gradations for each stone type, unless gradation test results or observations of stone materials indicate additional gradations are required.

C. Bulk Specific Gravity: Perform bulk specific gravity in accordance with ASTM C127 on a representative sample of each gradation test sample.

D. If tests indicate materials do not meet specified requirements, change material or material source and retest.

E. Provide materials from the same source throughout the Works.

F. In the event of change to approved source of materials during performance of the Works, immediately advise ENGINEER of revised location, provide ENGINEER with the source testing results for the change, estimated quantity of material to be imported, and obtain approval of such locations and materials prior to use in the Works.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 00 00 - General Requirements: Verification of existing conditions before starting work.

B. Do not place riprap or stone over spongy subgrade surfaces.

3.2 PLACEMENT OF RIPRAP

A. Place riprap by suitable methods to ensure minimum breakage of individual pieces during placing.

B. Ensure riprap does not mix with or damage foundation material.

C. Place riprap to layer thickness and details shown on the Drawings.

D. Place riprap in an approved manner to secure the surface and to provide a stable mass.

E. Uniformly distribute larger rock over the entire area and distribute the remainder uniformly with smaller pieces filling voids between larger pieces.

F. Finish surfaces in such a manner so as to ensure they are stable, reasonably uniform, free from bumps or depressions, with no excessively large cavities below or individual rock pieces projecting above the general surface.

G. Place riprap as follows:
   1. Use larger pieces in lower course and as headers for subsequent courses.
   2. Stagger vertical joints and fill voids with rock spalls or cobbles.
   3. Finish surface even, free of large openings, and neat in appearance.

H. Riprap may be placed in location by equipment; however, take care in placing to obtain a good gradation of materials so that the riprap will be firm and solid. Level surfaces to the required alignment and slopes by hand placing the stone so as to fill large voids and to make the surface even.

3.3 FIELD QUALITY CONTROL

A. Section 01 00 00 - General Requirements: Field inspecting and testing.

B. ENGINEER shall have free access to CONTRACTOR's plant and equipment used for mixing and placing grout. Provide proper facilities for ENGINEER to sample material and view processes implemented in the mixing and placing of grout and for collecting grout test samples.

END OF SECTION

SECTION 31 41 16

SHEET PILES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Steel sheet piling to create a retaining and/or flood-protection wall.

1.2 REFERENCES

A. Section 01 40 00 - Quality Requirements: Requirements for references.

B. ASTM International:
1. ASTM A6/A6M - Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling.
2. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.
3. ASTM A108 – Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished
4. ASTM A325 – Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
5. ASTM A563 / A563M – Standard Specification for Carbon and Alloy Steel Nuts
6. ASTM A572/A572M - Standard Specification for High Strength Low Alloy Columbium Vanadium Structural Steel.
7. ASTM A576 – Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality
8. ASTM A588/A588M – Standard Specification for High-Strength Low-Alloy Structural Steel, up to 50 ksi (345 MPa) Minimum Yield Point, with Atmospheric Corrosion Resistance
9. ASTM A690/A690M – Standard Specification for High-Strength Low-Alloy Nickel, Copper, Phosphorus Steel H-Piles and Sheet Piling with Atmospheric Corrosion Resistance for Use in Marine Environments.
10. ASTM A722/A722M – Standard Specification for High-Strength Steel Bars for Prestressed Concrete
11. ASTM F436 – Standard Specification for Hardened Steel Washers
12. ASTM F3125/F3125M – Standard Specification for High Strength Structural Bolts and Assemblies

C. American Welding Society:
1. AWS D1.1/D1.1M - Structural Welding Code - Steel.

1.3 DEFINITIONS

A. Sheet Pile: Pile that is specially shaped to generally interlock with adjacent piles to form a reasonably tight wall with principal purpose of resisting lateral pressures, usually from soil or water with minimal water leakage.

1.4 SCHEDULING

A. Section 01 30 00 - Administrative Requirements: Requirements for scheduling.

B. Schedule sheet piling submittals sufficiently in advance of pre-installation meeting to ensure ENGINEER's review is complete.

1.5 PROGRESS SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Product Data:
1. Submit details of sheet piling.
2. Storage and handling procedures.
3. Interlock sealing material data and application procedures.
4. Details of templates or other temporary guide structures.
5. Datasheet for Pile Driving Equipment, including various attachments and installation capacity.

C. Shop Drawings:
1. Indicate location and extent of sheet piling, details of top protection, tip reinforcement, tip protection, splices, fabricated additions to plain piles, cut off method, interlock sealing.
2. Include complete dimensions and details of sheet piling sections and connectors.
3. Include sequence of driving, placement of fill material, and detailed drawings of templates or other temporary guide structures.

D. Test Reports:
1. Submit certified materials tests reports showing that sheet piling, and appurtenant metal materials meet the specified requirements, for each shipment and identified with specific lots. Include in the identification data piling type, dimensions, chemical composition, mechanical properties, section properties, heat number, and mill identification mark.
2. Submit Welding Procedure Specification (WPS) and Procedure Qualification Record for all welds as required by AWS D1.1/D1.1M.
3. Submit Inspection and Test Reports for review and approval by the ENGINEER prior to Closeout.
4. Test reports shall meet ASTM A6/A6M requirements.

E. Wall Installation:
1. Prior to commencement of pile driving, submit descriptions of pile driving equipment, including manufacturer's name, model numbers, capacity, rated energy, rated reaction, hammer or hydraulic equipment details, cushion material, helmet, templates, augering, and jetting equipment.
2. Submit qualifications of the sheet pile installer. Include in the qualifications, evidence of at least three (3) successfully completed steel sheet pile driving projects in last five (5) years, one (1) of which must have been completed by the press-in method. The steel sheet pile driving portion of the submitted projects must account for a minimum of five thousand (5,000) linear feet of successful installations.

1.6 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for closeout submittals.

B. Record Documents:
   1. Record actual locations of sheet piling and top and bottom elevations.
   2. Submit driving records with hammer blows for final 12 inches of driving.
   3. Submit a complete and accurate record of each sheet pile within one day of completion of pile driving operation. The record shall indicate the pile location (as driven or installed), date driven, size, driven length, embedded length, final elevations of tip and top, pile weight, and the total driving time. The record shall also include the type and size of the hammer or hydraulic equipment used and the rate of operation.
   4. Any unusual conditions encountered during pile installation such as delays during driving, damage to pile resulting from driving, or heave in adjacent piles shall be recorded and immediately reported to ENGINEER.
   5. Submit records indicating piles pulled.

1.7 REGULATORY REQUIREMENTS

A. Conform to the Project regulatory permits and approvals.

1.8 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum 5 years documented experience.

B. Installer: Company specializing in performing the work of this Section with minimum 15 years documented experience.

C. Design and select sheet pile components under direct supervision of professional structural Engineer experienced in design of this work and licensed in State of Texas.

D. Welders and Welding Procedures: AWS D1.1 qualified within previous 12 months.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Deliver sheet piling with manufacturer's logo and mill identification mark on each sheet piling.

C. Store and handle sheet piling in the manner recommended by the manufacturer to prevent permanent deflection, distortion or damage to the interlocks or the interlock sealants.

D. Handle using handling holes or lifting devices.

E. Support on level blocks or racks spaced not more than 10 feet apart nor more than 2 feet from the ends. Arrange supports for multiple lifts aligned vertically.

F. Protect sheet piling with factory-installed joint sealant.

G. Storage of sheet piling should facilitate required inspection activities and prevent corrosion prior to installation.

1.10 PRE-INSTALLATION MEETING

A. Convene prior to commencing work of this Section.

PART 2 PRODUCTS

2.1 STEEL SHEET PILING

A. Sheet Piling: ASTM A572 Grade 60.

B. Interlock Swing Allowable: 5 degrees or maximum allowed by Sheet Pile manufacturer.

C. Connectors: A572 Grade 60, or equivalent compatible with Sheet Piling.

D. Single manufacturer or provide certification for interlock compatibility.

2.2 COMPONENTS

A. Walers
   1. Structural Steel Bars, C, MC, and L Shapes: ASTM A36, Galvanized.
   2. Splice Connection: Galvanized, ASTM A325 Bolts with A563 Nuts and Hardened Washer

B. Tie-Rod & Connections:
   1. Full Threaded Bars, Grade 150 ksi, meeting requirements of ASTM A722, encapsulated in grease or appropriate single corrosion protection (SCP) and protective smooth-walled PVC tube.
   2. Hex Nut with Jam Nut for Tie-Rod connections: ASTM A108 / A576, Galvanized.
   3. Hardened Washer for Tie-Rod Connections: ASTM F436, Galvanized.
   4. Bearing Plate: ASTM A572 / A588 Grade 50, Galvanized.

C. Welding Materials: AWS D1.1; type required for materials being welded.

2.3 INTERLOCK SEALANTS

A. WADIT as manufactured PilePro Group, or an approved equivalent.

2.4 SHOP FABRICATION

A. Fabricate sheet piling and special fabricated sections to full length.

B. Fabricate tees, wyes, corners, and cross pieces to match sheet piling sections, with 1/2-inch minimum web thickness.

C. Perform welding according to AWS D1.1.

D. Fabricate sheet piling with standard pulling holes.

2.5 SOURCE QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Testing, inspection, and analysis requirements.

B. Allow witnessing of factory inspections and test at manufacturer's test facility. Notify OWNER before inspections and tests are scheduled.

C. Materials Tests:
1. Sheet piling and appurtenant materials shall be tested and certified by the manufacturer to meet the specified chemical, mechanical and section property requirements prior to delivery to the Work Site.
2. Testing of sheet piling for mechanical properties shall be performed after the completion of all rolling and forming operations.
3. Testing of sheet piling shall meet ASTM A6/A6M requirements.

D. Make completed sheet piling available for inspection at manufacturer's factory prior to packaging for shipment. Notify OWNER before inspection is allowed.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 70 00 - Execution and Closeout Requirements: Verification of existing conditions before starting work.

B. Examine the Work Site, subsurface conditions, and become familiar with conditions that may affect work of this Section.

C. In the presence of ENGINEER, conduct a condition survey of existing services, structures, and survey benchmarks and monuments, which may be affected by the Works. Document condition of adjacent structures prior to commencing the Works.

D. Check and locate buried utilities, including piping in the work area. Record location and depth of all utilities and surface features encountered.

E. Protect buried utilities from damage during construction operations. Notify ENGINEER of conflicts with underground utilities before proceeding with the Works. Damage to utilities due to work of this Section shall be repaired at CONTRACTOR's expense and at no additional cost to OWNER.

F. Select methods of construction suitable for actual conditions encountered in the Works. CONTRACTOR is solely responsible for the safety and adequacy of the method employed.

G. Once the work has begun, interpret each of the previous piles for data to be employed on subsequent piles.

H. Should an obstruction be encountered during driving of sheet piles that prevents placing of the sheet pile within the specified tolerances to the required depths, as herein specified, clear the obstruction, if possible. If it is not possible to clear the obstruction, relocate the pile to a new position, under direction of ENGINEER.

3.2 TEMPLATES

A. Prior to driving, provide template or driving frame suitable for aligning, supporting, and maintaining sheet piling in correct position during setting and driving:
   1. Structural frame sufficiently rigid to resist lateral driving forces.
   2. Provide at least two levels of support at 1/3 points or not less than 20 feet apart.
   3. Provide wood blocking to bear against webs of alternate sheet piling.
   4. Provide outer restraints to prevent sheets from warping or wandering.
   5. Provide visible markings on templates to verify correct sheet piling location and direction.

3.3 PREPARATION

A. Retain a registered land surveyor to locate the position of each pile prior to construction, and to determine the top elevation of each pile after construction. Submit written, signed reports for each pile as an attachment to the daily record.

B. Use equipment accepted by ENGINEER.

C. All pile driving equipment shall be free from defect and subject to ENGINEER’s review and acceptance prior to and during the placement of the piles.

D. If a piece of pile driving equipment becomes damaged or in need of repair which, in the opinion of ENGINEER may cause damage to the piles or incorrect placement of the piles, the CONTRACTOR shall not use that piece of equipment. The equipment must be replaced or repaired prior to subsequent use.

E. Use driving method that will not cause damage to nearby structures.

F. Protect structures including overhead and buried utilities near the Works, from damage.

3.4 SHEET PILING INSTALLATION EQUIPMENT

A. HYDRAULIC PRESS-IN EQUIPMENT
   1. Where approved and permitted by ENGINEER, pile driving may be accomplished by using the hydraulic press-in method.

2. Steel sheet piling shall be hydraulically pressed in using the following approved equipment, or an approved equal utilizing a non-percussive hydraulic press-in method:

   Silent Piler / Giken Reaction Base System (GRBS)
   Manufactured/distributed by:
   Giken America Corporation
   5802 Hoffner Ave. #707
   Orlando, Florida, 32822
   Phone # (407) 380-3232

3. The hydraulic press-in equipment shall not produce more than 84 dB of noise, at a distance of twenty-five (25) feet from the equipment, while in operation.
4. It shall not produce any strongly perceptible vibration at the ground surface, at a distance of fifteen (15) feet from the equipment, while in operation.

B. PILING HAMMER

1. Where approved and permitted by the ENGINEER, pile driving may be accomplished by using a piling hammer.
2. Keep hammer in good mechanical condition.
3. Operate hammer at speed and pressure recommended by manufacturer.
4. During piling driving operations, ENGINEER may make occasional measurements of velocity of hammer ram.
5. When energy per blow is less than 80 percent of rated energy per blow as specified by manufacturer of piling hammer, make necessary repairs to improve energy output to value of at least 80 percent of rated energy per blow, or replace piling hammer.
6. Use protective cap during driving to prevent damage to top of sheet piling.

3.5 EARTHWORK

A. Pre-excavation will not be permitted.

3.6 INSTALLATION

A. When driving is interrupted before refusal, drive additional 12 inches before resuming recording of performance data.

B. Placing: Pilings properly placed and driven shall be interlocked throughout their length with adjacent pilings to form a continuous diaphragm throughout the length or run of piling wall.
   1. Pilings shall be placed plumb with out of plumbness not exceeding deviations listed in PART 3, TOLERANCES and true to line. Manipulation of piles to force them into position will not be permitted without review and approval by the ENGINEER. Check all piles for heave. Re-drive all heaved piles to the required tip elevation.
   2. Provide temporary walers, templates, or guide structures to ensure that the pilings are placed and driven to the correct alignment.

C. Driving:
   1. Drive pilings with the approved equipment and by approved methods so as not to subject the pilings to damage and to ensure proper interlocking throughout their lengths.

2. Maintain installation equipment in proper alignment during driving operations by use of leads or guides attached to the equipment. Caution shall be taken in the sustained use of vibratory hammers when a hard driving condition is encountered to avoid interlock melt or damages. Discontinue the use of vibratory hammers and impact hammers employed when the penetration rate due to vibratory loading is one foot or less per minute.
3. Employ a protecting cap in driving when using impact hammers to prevent damage to the tops of pilings. Use cast steel shoe to prevent damage to the tip of the sheet piling. Remove and replace pilings damaged during driving or driven out of interlock at no additional cost to OWNER.
4. Drive pilings without the aid of a water jet unless otherwise authorized.
5. Take adequate precautions to ensure that pilings are driven plumb. Where possible, drive Z pile with the ball end leading. If an open socket is leading, a bolt or similar object placed in the bottom of the interlock will minimize packing material into it and ease driving for the next sheet. If at any time the forward or leading edge of the piling wall is found to be out of plumb in the plane of the wall the piling being driven shall be driven to the required depth and tapered pilings shall be provided and driven to interlock with the out of plumb leading edge or other approved corrective measures shall be taken to ensure the plumbness of succeeding pilings. The maximum permissible taper for any tapered piling shall be 1/8 inch per foot of length.
6. When using Pile hammer, sheet pilings in each run or continuous length of piling wall shall be driven alternately in increments of depth to the required depth or elevation. No piling shall be driven to a lower elevation than those behind it in the same run except when the pilings behind it cannot be driven deeper. Incrementally sequence driving of individual piles such that the tip of any sheet pile shall not be more than 4 feet below that of any adjacent sheet pile. When the penetration resistance exceeds five blows per inch, the tip of any sheet pile shall not be more than 2 feet below any adjacent sheet pile. If the piling next to the one being driven tends to follow below final elevation it may be pinned to the next adjacent piling.
7. If obstructions restrict driving a piling to the specified penetration, the obstructions shall be removed or penetrated with a chisel beam. If CONTRACTOR demonstrates that removal or penetration is impractical, make changes in the design alignment of the piling structure as directed by ENGINEER to ensure the adequacy and stability of the structure. Pilings shall be driven to depths shown and shall extend up to the elevation indicated for the top of pilings.
8. Pre-augering, jetting or spudding of piles will not be permitted.

D. Cutting Off and Splicing: Pilings shall be driven to refusal or to the point of termination. Piles extending above the required top elevation in excess of the specified tolerance shall be cut off to the required elevation. Pilings driven below the required top elevation and pilings damaged by driving and cut off to permit further driving shall be extended as required to reach the top elevation by splicing when directed by ENGINEER at no additional cost to OWNER. If directed by ENGINEER, pilings shall be spliced as required to drive them to depths greater than shown and extend them up to the required top elevation.
   1. Pilings adjoining spliced pilings shall be full length unless otherwise approved. Where spliced pilings adjoin, the welded joints shall be staggered to ENGINEER's approval. Ends of pilings to be spliced shall be squared before splicing to eliminate dips or camber. Pilings shall be spliced together with concentric alignment of the interlocks so that there are no discontinuities, dips or camber at the abutting interlocks. Spliced pilings shall be free sliding and able to obtain the maximum swing with contiguous pilings. The tops of pilings excessively battered during driving shall be trimmed when directed by ENGINEER, at no additional cost to OWNER. Piling cut offs shall become the property of CONTRACTOR and shall be removed from the Work Site.

E. Acceptance Criteria for Pile Refusal: It shall be considered Pile Refusal when penetration of the sheet pile is slowed or stopped in such a way that further pressing or hammering may cause damage to the pile.

A 1/2 pair pile section installed up to 5 feet above the design tip elevation (short pile) will only be accepted if it conforms to the criteria provided in the table below and at least 3 consecutive strokes (extraction and press-in) yield less than 2 inches of 1/2 pair pile section advancement using the lesser of 150% of the normal press-in force of the machine or the force that could potentially cause damage to the sheet pile.

1/2 pair pile section installed within 5 feet of design tip elevation	All piles within 5 pile pairs on both sides of the short pile shall be installed to within 1.5 feet of design tip elevation.
1/2 pair pile section installed within 3 feet of design tip elevation	All piles within 5 pile pairs on both sides of the short pile shall be installed to within 1.5 feet of design tip elevation.
1/2 pair pile section installed within 1.5 feet of design tip elevation	No spacing requirement provided the force/advancement criteria outlined above is met.

F. Inspection During Sheet Pile Installation: Perform continuous inspection during pile driving. Inspect all piles for compliance with tolerance requirements. Bring any unusual problems which may occur to the attention of ENGINEER. Inspect the interlocked joints of driven pilings extending above ground. Pilings found to be out of interlock shall be removed and replaced at no additional cost to OWNER.

3.7 INSTALLATION RECORDS

A. Maintain a pile driving record for each sheet pile driven.

3.8 WELDING AND SPLICING

A. Perform welding according to AWS D1.1 for shielded metal arc welding.

B. Splice sheet piling sections with one of the following:
   1. AWS D1.1 Prequalified CJP Groove Welded Joints.
   2. Splicer sleeve with flanges welded with full penetration groove welds.

C. Use jig or alignment device during welding to maintain required shape and alignment.

D. Use only butt weld splices within 20 feet from sheet piling cut off elevation or design grade, whichever is lower.

E. Inspect 10% of all complete penetration butt welds for each splice. Where inspected welds do not meet the acceptance criteria of AWS D1.1, repair welds and inspect 100% of welds of the repaired splice.

F. Comply with the following for number, type, and location of splices:
   1. No more than three splices for sheet piling over 100 feet long.
   2. No more than two splices for sheet piling up to 100 feet long.
   3. No splice closer than 25 feet from tip.
   4. Stagger splices in consecutive pairs of sheet piles by minimum 5 feet.

3.9 INTERLOCK SEALING

A. Clean off rust and debris from interlock section of piles and prepare interlocks in accordance with manufacturer's instructions.

B. Apply sealer to pile interlocks in horizontal configuration and tape ends in accordance with manufacturer's instructions.

C. Protect from moisture until ready to install piles.

D. After installation of piles, repair seal with cartridge application of sealer in accordance with manufacturer's instructions as required to provide fully sealed sheet pile wall.

3.10 TOLERANCES

A. Section 01 40 00 - Quality Requirements: Requirements for tolerances.

Deviation normal to the wall line at the top of the pile	2 inches ±
Finished level deviation from nominal level of top of pile	¼ inches ±
Finished level deviation from nominal level of toe of pile	+ 4 / - 0 inches
Vertical deviation normal to line of piles as percent of driving depth	0.5% ±
Vertical deviation along line of piles as percent of driving depth	0.5% ±

3.11 FIELD QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Field inspecting and testing.

B. Inspect for imperfections in joint interlock capable of impeding installation.

C. Reject damaged sheet piling sections or repair as required prior to installing.

D. Unacceptable Piles: Piles that are placed out of position, are below cutoff elevations, not plumb, or are damaged.

E. Replace piles to conform to specified requirements.

F. Repair interlock sealants damaged during installation.

G. Monitor deflections at top of piles during installation, fill placement, installation of tie-rods and take remedial action to maintain alignment within allowable tolerances.

END OF SECTION

SECTION 32 31 13

CHAIN LINK FENCES AND GATES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Removal and Replacement of existing fence fabric and slide gates.
2. Removal of fence posts by cutting off at ground surface (with remainder of post being disposed of with excavated soils)
3. Excavation for new post bases.
4. Fence framework, fabric, and accessories, where existing materials are not reusable.

1.2 REFERENCES

A. Reference Standards:
1. Section 01 40 00 - Quality Requirements: Requirements for references.
2. ASTM International:
a. ASTM A121 - Standard Specification for Zinc-Coated (Galvanized) Steel Barbed Wire.
b. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
c. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
d. ASTM A392 - Standard Specification for Zinc-Coated Steel Chain-Link Fence Fabric.
e. ASTM A780/A780M - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
f. A1011/A1011M Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.
g. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete.
h. ASTM F567 - Standard Practice for Installation of Chain-Link Fence.
i. ASTM F900 - Standard Specification for Industrial and Commercial Swing Gates.
j. ASTM F1083 - Standard Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures.
3. Chain Link Fence Manufacturers Institute:
a. CLFMI Product Manual.

1.3 SYSTEM DESCRIPTION

A. Fence Height: 6 feet nominal, with 12 inches barbed wire on top.

B. Line Post Spacing: At intervals not exceeding 10 feet.

C. Fence Post and Rail Strength: Conform to ASTM F1083, Light Industrial Fence quality.

1.4 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit data on fabric, posts, accessories, fittings, and hardware.

C. Shop Drawings: Indicate plan layout, spacing of components, post foundation dimensions, hardware anchorage, gates, and schedule of components.

D. Manufacturer's Instructions: Submit installation requirements.

1.5 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for closeout submittals.

B. Project Record Documents: Accurately record actual locations of property perimeter posts relative to property lines.

1.6 QUALITY ASSURANCE

A. Supply material in accordance with CLFMI Product Manual.

B. Perform installation in accordance with ASTM F567.

C. Certifications: Provide certificate of compliance from authority having jurisdiction.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum 3 years of experience.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Deliver fence fabric and accessories in packed cartons or firmly tied rolls.

C. Identify each package with manufacturer's name.

D. Store fence fabric and accessories in secure and dry place.

PART 2 PRODUCTS

2.1 MATERIALS

A. Framing (Steel): ASTM F1083, Schedule 40; galvanized steel pipe, welded construction, minimum yield strength of 25 ksi; coating conforming to ASTM F1043, Type A on pipe exterior and interior.

B. Fabric Wire (Steel): ASTM A392, Class 1; zinc-coated steel wire.

C. Concrete: Normal Portland Cement, 3,000 psi strength at 28 days.

2.2 COMPONENTS

A. Line Posts: 2.38-inch diameter.

B. Corner and Terminal Posts: 2.88-inch diameter.

C. Gate Posts: 4-inch diameter.

D. Top and Brace Rail: 1.66-inch diameter, plain end, sleeve coupled.

E. Gate Frame: 2-inch diameter for welded fabrication.

F. Fabric: 2-inch diamond mesh interwoven wire, 9 gage, top selvage knuckle end closed, twisted tight, bottom selvage twisted tight, knuckle end closed.

G. Tension Wire: 7 gage steel, single strand.

H. Tension Band: 0.188-inch steel.

I. Tension Strap: 0.188-inch steel.

J. Tie Wire: Aluminum alloy steel wire.

2.3 ACCESSORIES

A. Caps: Cast steel galvanized; sized to post diameter, set screw retainer.

B. Fittings: Sleeves, bands, clips, rail ends, tension bars, fasteners and fittings; galvanized steel.

2.4 FINISHES

A. Components and Fabric: Galvanized to ASTM A123/A123M for components; ASTM A153/A153M for hardware; ASTM A392 for fabric; 1.8 ounces per sq ft coating.

B. Hardware: Galvanized to ASTM A153/A153M, 1.8 ounces per sq ft coating.

C. Accessories: Same finish as fabric.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install framework, fabric, and accessories in accordance with ASTM F567.

B. Set posts plumb, in concrete footings with top of footing 2 inches above finish grade. Slope top of concrete for water runoff.

C. Line Post Footing Depth Below Finish Grade: 3 feet.

D. Corner, Gate and Terminal Post Footing Depth Below Finish Grade: 3 feet.

E. Brace each gate and corner post to adjacent line post with horizontal center brace rail and diagonal truss rods. Install brace rail one bay from end and gate posts.

F. Install top rail through line post tops and splice with 6-inch-long rail sleeves.

G. Install center and bottom brace rail on corner gate leaves.

H. Place fabric on outside of posts and rails.

I. Do not stretch fabric until concrete foundation has cured 7 days.

J. Stretch fabric between terminal posts or at intervals of 100 feet maximum, whichever is less.

K. Position bottom of fabric 2 inches above finished grade.

L. Fasten fabric to top rail, line posts, braces, and bottom tension wire with tie wire at maximum 15 inches on center.

M. Attach fabric to end, corner, and gate posts with tension bars and tension bar clips.

N. Install bottom tension wire stretched taut between terminal posts.

O. Connect to existing fence at existing terminal post or existing line post converted to terminal post by installation of brace rails and brace rods.

P. Install posts with 6 inches maximum clear opening from end posts to fences and other structures.

Q. Excavate holes for posts to diameter and spacing shown on the Drawings without disturbing underlying materials.

R. Center and align posts. Place concrete around posts and vibrate or tamp for consolidation. Verify vertical and top alignment of posts and make necessary corrections.

S. Allow footings to cure minimum 7 days before installing fabric and other materials attached to posts.

3.2 TOLERANCES

A. Section 01 40 00 - Quality Requirements: Tolerances.

B. Maximum Variation From Plumb: 1/4 inch.

C. Maximum Offset From Indicated Position: 1 inch.

D. Minimum Distance From Property Line: 6 inches.

3.3 FIELD QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Field inspection and testing.

B. Repair damaged galvanized surfaces in accordance with ASTM A780/A780M.

C. Apply field repair coating to damaged galvanized surfaces at dry film thickness at least equal to specified galvanized coating thicknesses.

END OF SECTION

SECTION 35 49 25

TURBIDITY CURTAIN

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Turbidity curtain to be installed in the river during installation and removal of sheet piling around the Northern Impoundment.

B. Related Requirements:
   1. Section 01 57 19 - Temporary Environmental Controls.

1.2 REFERENCES

A. Reference Standards:
   1. Section 01 40 00 - Quality Requirements: Requirements for references.
   2. ASTM International:
      a. ASTM D4355 - Standard Test Method for Deterioration of Geotextiles from Exposure to Light, Moisture and Heat in a Xenon Arc-Type Apparatus.
      b. ASTM D4491 - Standard Test Methods for Water Permeability of Geotextiles by Permittivity.
      c. ASTM D4533 - Standard Test Method for Trapezoid Tearing Strength of Geotextiles.
      d. ASTM D4632/D4632M- Standard Test Method for Grab Breaking Load and Elongation of Geotextiles.
      e. ASTM D4751 - Standard Test Methods for Determining Apparent Opening Size of a Geotextile.
      f. ASTM D6241 - Standard Test Method for Static Puncture Strength of Geotextiles and Geotextile-Related Products Using a 50-mm Probe.
      g. ASTM D4595 - Standard Test Method for Tensile Properties of Geotextiles by the Wide-width Strip Method.
      h. COE-02215 – US Army Corps of Engineers Test Method for Percent Open Area.

1.3 PRE-INSTALLATION AND PRE-REMOVAL MEETINGS

A. Section 01 30 00 - Administrative Requirements: Pre-installation and pre-removal meetings.

B. Convene 1 week prior to commencing installation of turbidity curtain and installation of sheet pile for each segment of sheet pile.

C. Convene 1 week prior to commencing installation of turbidity curtain and removal of sheet pile for each segment of sheet pile.

D. Mandatory attendance includes ENGINEER, CONTRACTOR and Subcontractor.

E. Purpose of Meeting:
   1. Review the Work Site-specific quality assurance/quality control and monitoring procedures.
   2. Review time schedules.
   3. Review applicable personal protective equipment and regulations.
   4. Review safety plan and procedures.

1.4 SEQUENCING

A. Sheet piles will be installed and removed in increments. At each increment (area of work) where the direction of water flow is away from the impoundment, the area will be enclosed by turbidity curtains.

B. Turbidity curtains will be deployed prior to the start of sheet pile installation or removal.

C. Prior approval of the ENGINEER is required before work proceeds in an area where turbidity curtains are deemed unnecessary.

1.5 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Samples: If requested by ENGINEER, submit a sample of the curtain material prior to its incorporation into the work.

C. Test Reports: Include material properties sheets and manufacturer’s certified report of test.

D. Manufacturer’s Certificates: Certify that curtain meets or exceeds specified requirements prior to installation.

E. Deployment Plan: Include placement of curtain and location of anchoring system.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Package and label curtain bearing manufacturer's markings to clearly identify it with applicable test report submitted to ENGINEER.

C. When transported to the Work Site, handle curtain by appropriate means as recommended by manufacturer so that no damage is caused.

D. When not immediately incorporated into the Works, store curtain as recommended by manufacturer to prevent damage, degradation, and theft or vandalism.

E. Use appropriate handling equipment when moving curtain from one place to another.

F. Notify ENGINEER in advance of curtain delivery to the Work Site. Perform joint inspection with ENGINEER upon delivery. Defects or damage arising from shipping and handling will be grounds for rejection of a portion of, or the entire curtain at the discretion of ENGINEER. Remove damaged curtain from the Work Site and replace with new material at no additional cost to OWNER.

1.7 AMBIENT CONDITIONS

A. Suspend installation operations whenever climatic or water conditions, or equipment proposed for placing the curtain, as determined by ENGINEER, are unsatisfactory for placing the curtain in accordance with the requirements of this Section.

B. Curtain placement shall account for wave, wind, and other related factors on the River at the proposed time of placement.

C. Deployed curtain shall be adequately ballasted at all times to limit the risk of wind damage and/or displacement from curtain placed alignment due to wave action and/or water velocities at the Work Site.

1.8 WARRANTY

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for warranties.

B. Provide 2 years manufacturer's warranty. Warranty shall not be pro-rated in a manner that would diminish coverage with increasing time from installation.

C. Warranty: Include coverage for:
   1. Full refund or replacement.
   2. Labor and equipment to repair or replace the curtain and consequential and incidental damage that occurs as a result of failure of the curtain.

D. Warranty coverage starts from the date of placement of the curtain in the water.

PART 2 PRODUCTS

2.1 PERMEABLE TURBIDITY CURTAIN (TURBIDITY BARRIER)

A. ABASCO Type 3 Heavy Duty Turbidity Curtain (TC-3-HD) with sufficient ABASCO Anchor package(s) to secure the curtain in place or an approved equal.
   1. Any substitution shall be made in accordance with Section 01 60 00 - Product Requirements.
   2. Proposed substitution shall meet or exceed the followings:
      a. Dual 5/16" galvanized steel Top Tension cables contained in polyethylene tubes, one above and one below the float
      b. 10" expanding polystyrene EPS Flotation enclosed in individually sealed upper pockets
      c. 22 oz/yd2 Coated PVC Fabric with 40-oz PVC fabric to reinforce all corners
      d. 3/8" galvanized steel ballast chain

e. Aluminum universal slide connectors with anchor points and toggle pins
f. Lighted buoys
g. Variable length permeable skirt (WINFAB 2199 or equivalent) with the technical properties provided. Values are Minimum Average Roll Value.

PROPERTY	TEST METHOD	UNIT	VALUE
Tensile Strength (grab)	ASTM D-4632	lbs	370 X 250
Elongation	ASTM D-4632	%	15 X 15
CBR Puncture	ASTM D-6241	lbs	950
Trapezoidal Tear	ASTM D-4533	lbs	100 X 60
Wide Width Tensile (Ultimate)	ASTM D-4595	lbs/ft	2700 X 1740
Ultraviolet Resistance	ASTM D-4355	%	90
Apparent Opening Size (AOS)	ASTM D-44751	US Std Sieve	70
Percent Open Area (POA)	COE-02215	%	4
Permittivity	ASTM D-4491	sec^{-1}	0.28
Permeability	ASTM D-4491	cm/sec	0.01
Water Flow Rate	ASTM D-4491	gpm/ft^2	18

B. ABASCO AS-40 Boom/Barrier Anchor Package or Equivalent
1. Any substitution shall be made in accordance with Section 01 60 00 - Product Requirements.
2. Proposed substitution shall meet or exceed the followings:
h. Galvanized steel Danforth type anchor, min 40 lbs
i. 3/8” chain leader 8 ft long with 3/8” shackles
j. 3/4” polypropylene rope (yellow) with thimble eyes and 1/2” shackle
k. Anchor buoy Polyform A-2 (Orange) with ½” shackle
l. 3/4” polypropylene rope (yellow) painter line with thimble eyes and 1/2” shackle
m. Fabricated with a PVC coated nylon upper and lower pockets to receive ballast and flotation billets. Double over and stitch ends for reinforcement with the addition of grommets for connecting additional sections of curtain.

2.2 SOURCE QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Testing, inspection, and analysis requirements.

B. Manufacturer Quality Control:
1. Sample and test permeable skirt material at a minimum once every 100,000 sq ft for tests specified for each respective product in PART 2, PERMEABLE TURBIDITY CURTAIN (TURBIDITY BARRIER), to demonstrate that the material conforms to requirements as specified. Test for UV stability and apparent opening size at a minimum once every month.
2. Perform samples on sacrificial portions of material so that repair of material is not required.
3. If permeable skirt sample fails to meet the quality control requirements of this Section, sample and test each roll manufactured in the same lot, or at the same time, as the failing roll. Continue sampling and testing of rolls until a pattern of acceptable test results is established.
4. At permeable skirt manufacturer's discretion and expense, additional testing of material may be performed to more closely identify the non-complying material and/or to qualify individual rolls of material.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 70 00 - Execution Requirements: Verification of existing conditions before starting work.

B. Verify depth of the water body along specified alignment prior to ordering.

3.2 PREPARATION

A. Placement shall not proceed until CONTRACTOR's Work Site-Specific Health and Safety Plan has been approved by ENGINEER.

B. Prepare and submit drawings identifying anchor locations.

C. Obtain required permits for placement of curtain.

D. Take appropriate health and safety precautions when working on the river.

3.3 PLACEMENT

A. Place the curtain in accordance with manufacturer's instructions.

B. The top of the curtain shall be installed a minimum of 12 inches above the water surface elevation.

C. Install curtain and secure it prior to commencing any work activity related to sheet pile installation and removal that could generate silt or sediment in the River.

D. Replace any portion of the curtain that is damaged during its installation or during any work activity related to sheet pile installation and removal at no additional cost to OWNER.

E. Attach adjacent sections of curtain by the use of grommet clips, lacing with rope through the end grommets, or as directed by ENGINEER.

F. Provide grommets in end sections at spacing recommended by the manufacturer, vertically at both ends of each unit.

G. Install a reinforcement belt of polyester webbing at the top of the curtain to provide additional tensile reinforcement and dimensional stability, as required.

H. Use anchoring devices as required by River bottom conditions.

I. Mark curtain location with flags, buoys, or other devices as required by applicable regulations, permits and the U.S. Coast Guard.

3.4 FIELD QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Field inspections and testing.

B. ENGINEER will inspect curtain for proper placement and maintenance and confirmation it is being maintained in good working order. If any maintenance or repairs are to be made to any part of the curtain, the work shall be initiated immediately after CONTRACTOR is informed of deficiency.

C. Inspect installed curtain for tears and gaps. Confirm top edge of curtain is above the water surface and bottom edge is free of sediment.

3.5 REMOVAL

A. Remove curtain on completion of sheet pile installation or removal and when approved by ENGINEER.

3.6 PROTECTION

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for protection of installed work.

B. Protect curtain from damage. Utilize marking/warning devices required by permits and local regulations.

C. Check curtain for damage daily. Repair any damage and restore the curtain functionality to the satisfaction of ENGINEER.

END OF SECTION

SECTION 40 05 13

COMMON WORK RESULTS FOR PROCESS PIPING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. General engineering requirements.
2. General product requirements.
3. General fabrication and testing requirements.
4. General installation and commissioning requirements.

B. Related Requirements:
1. Section 40 05 31.13 - Polyvinyl Chloride Process Pipe.
2. Section 22 05 03 - Pipe Data Sheet- PVDF Tubing and Carrier Piping
3. Section 40 05 33 - High-Density Polyethylene Process Pipe

1.2 REFERENCES

A. Definitions:
1. The following are industry abbreviations for plastic materials:
a. ABS: Acrylonitrile-butadiene-styrene plastic.
b. CPVC: Chlorinated polyvinyl chloride plastic.
c. HDPE: High-density polyethylene plastic.
d. PE: Polyethylene plastic.
e. PVC: Polyvinyl chloride plastic.
2. The following are industry abbreviations for metal materials:
a. CLDI: Cement-lined ductile iron.
b. CS: Carbon steel.
3. The following are industry abbreviations for rubber materials:
a. EPDM: Ethylene-propylene-dieneterpolymer rubber.
b. NBR: Acrylonitrile-butadiene rubber.
4. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
5. Exposed Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
6. Exposed Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
7. Concealed Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.
8. Concealed Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

B. Reference Standards:
1. Section 01 40 00 - Quality Requirements: Requirements for references.

2. American Society of Mechanical Engineers:
   a. ASME B1.20.1 - Pipe Threads, General Purpose (Inch).
   b. ASME B18.2.1 - Square and Hex Bolts and Screws - Inch Series.
3. ASTM International:
   a. ASTM D1785 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
   b. ASTM D2564 - Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems.
   c. ASTM D2657 - Standard Practice for Heat Fusion Joining of Polyolefin Pipe and Fittings.
   d. ASTM D2672 - Standard Specification for Joints for IPS PVC Pipe Using Solvent Cement.
   e. ASTM D2855 - Standard Practice for Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings.
   f. ASTM D3138 - Standard Specification for Solvent Cements for Transition Joints Between Acrylonitrile-Butadiene-Styrene (ABS) and Poly (Vinyl Chloride) (PVC) Non-Pressure Piping Components.
   g. ASTM D3139 - Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.
   h. ASTM D3212 - Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.
   i. ASTM F402 - Standard Practice for Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermoplastic Pipe and Fittings.
   j. ASTM F656 - Standard Specification for Primers for Use in Solvent Cement Joints of Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings.
4. American Water Works Association: AWWA C110 - Standard for Ductile-Iron and Gray Iron Fittings 76 mm Through 1219 mm.
5. Underwriters Laboratories (UL).

1.3 SCHEDULING

A. Coordinate with work of other trades for piping fabrication, supporting, installation, insulation, connection to equipment and packages, and testing.

B. Coordinate installation of required in-line instrumentation and control valves.

C. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for mechanical installations.

D. Coordinate installation of required supporting devices and other structural components as they are constructed.

1.4 SUBMITTALS

A. Product Data: Submit detailed catalog information on selection, identification, shop and/or Work Site fabrication procedure, installation, and adjusting, for the following products, including components:
   1. Pipes.
   2. Flanges.
   3. Fittings.
   4. Expansion joints, flexible hoses, and hose adapters.

5. Mechanical sleeve seals.
6. Supports, hangers, guides, and anchors.

B. Shop Drawings:
1. Include descriptive information as required to fully describe the materials and procedures to be used in fabrication of the piping system. Submit all data as specified below. Partial submittals / submittals without all information as listed below in a single submittal will not be accepted by ENGINEER and will be returned Revise and Resubmit.
2. Clearly specify pipe material and joint type selected for each pipeline, where alternatives are specified.
3. Include Shop Drawings for fabricated components of pipe, fittings, anchors, and guides.
4. Include a complete laying plan and section, detailing dimensions, location of each pipe section and each special length, special fittings, bends, coatings, and other pertinent information.
5. Include double-lined to-scale drawings of each pipe support system to the scale shown on the Drawings.
6. Locate each support and hanger, identify with type of catalog number or Shop Drawing detail number. Show anchor locations and identify them by Shop Drawing detail number.
7. Include detailed installation drawings, catalog information, and complete component selection list for tie rods and thrust restraints systems.
8. No change in material or joint selection will be permitted after submittal of Shop Drawings and their final review by ENGINEER.

C. Certificates and Reports:
1. Certify that products meet or exceed specified requirements.
2. Indicate results of field hydrostatic testing.

1.5 CLOSEOUT SUBMITTALS

A. Record Documents: Indicate location, size, and service of piping systems.

B. Warranties: Completed original warranty forms filled out in OWNER's name and registered with manufacturer.

1.6 QUALITY ASSURANCE

A. Fabrication of flanged, threaded, and grooved piping shall be in accordance with ASME and AWWA standards.

1.7 QUALIFICATIONS

A. Fabricator: Company specializing in the works of this Section, and supplementary individual piping specification Sections, with minimum 3 years documented experience.

B. Installer: Company specializing in performing the work of this Section, and supplementary individual piping Sections, with minimum 3 years documented experience.

C. Independent Testing Firm: Company specializing in inspection of AWWA piping material, fabrication final pressure testing, with minimum 5 years documented experience.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Handle piping items strictly in accordance with manufacturer instructions, during all stages of delivery and storage.

C. Ensure no damage is done to exterior, interior, shape of pipe during activities prior to fabrication and installation.

D. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

E. Protect the products from dirt, damage, deformation, non-compatible materials, heat, cold, sunlight exposure, rain, and moisture.

F. Receive the products in factory finish condition. Inspect for damage or deterioration of product quality. Replace damaged or deteriorated quality product as required and directed by ENGINEER.

1.9 WARRANTY

A. Provide 3-year manufacturer's warranty for products covered in this Section.

PART 2 PRODUCTS

2.1 DESIGN REQUIREMENTS

A. Design the system to ASME and AWWA standards.

B. Piping Sizes and Materials: TBD by CONTRACTOR.

2.2 JOINING MATERIALS

A. Refer to Section 40 05 33 for specific details on individual system joining methods and materials.

B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents:
   1. ASME B16.21, nonmetallic, flat, asbestos-free, 3.2 mm maximum thickness unless thickness or specific material is indicated in piping data sheet.
   2. Full-face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
   3. Narrow-face Type: For raised-face, Class 250, cast-iron and steel flanges.
   4. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and

full-face or ring type, unless otherwise indicated.

C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

E. Solvent Cements for Joining Plastic Piping:
1. PVC Piping: ASTM D2564. Include primer according to ASTM F656.

F. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 PIPE, FITTINGS, JOINTS, AND EXPANSION PROVISIONS FOR EXPOSED PIPING

A. Refer to the Drawings for location and overall arrangement of piping systems.

B. CONTRACTOR is required to install pipe anchors and flexible couplings to facilitate piping installation, provided that completed details describing location, pipe supports, and hydraulic thrust protection are submitted to ENGINEER for review.

C. Provide thrust ties for flexible couplings, transition couplings, and flanged coupling adapters on pressure piping as specified, including those shown on the Drawings. Thrust protection shall be adequate to sustain the force developed by 1 1/2 times the operating pressures and the test pressure specified.

D. Pipe or tube connections of dissimilar metals / materials shall be made as shown on Drawings. CONTRACTOR may use the following methods for joining pipes of different materials unless specifically stated on the Drawings. All pipe connections shall be rated to 150 psi at 120 degrees F:
1. Stainless steel compression fittings for joining stainless steel pipe to HDPE pipe or tube. Compression fittings shall be axially restrained.
2. Stainless steel threaded transition adapter nipple fitting with O-ring seals for joining HDPE pipe to stainless steel pipe by ISCO pipe or equal.
3. Stainless steel reinforced PVC threaded adapter fittings for joining PVC to metal pipe by Spears or equal.

E. Quick disconnect fittings shall be stainless steel camlock couplers with rated pressure of 250 psi:
1. Female coupler with hose shank shall be used with movable pipes.
2. Male coupler shall be used on fixed pipes.
3. Quick disconnect fittings shall be Dixon "Andrews" couplers or equal.
4. Provide caps and plugs for all quick disconnect fittings.

2.4 PIPING SUPPORT AND RESTRAINING SYSTEMS

A. Support piping, in general, as described hereinafter and as shown on the Drawings.

B. Manufacturer's catalog figure numbers are typical of the types and quality of standard pipe supports and hangers to be employed. Special support and hanger details are shown to cover typical locations where standard catalogue supports are inapplicable.

C. Pipe supports shown on the Drawings are intended to present the general arrangement of

pipe supports in the area, represented as typical of similar arrangements to be used. No attempt has been made to show all required pipe supports and restraints in all locations, either on the Drawings or in the details, standard or custom made. CONTRACTOR shall be responsible for providing adequate number, size, and type of piping supports required.

D. Pipe support and restraining system components shall withstand the dead loads imposed by the weight of the pipes filled with water and shall have a minimum safety factor of 5, and live loads created by pumped fluid thrust and shall be adequately anchored to resist such forces without undue shock, vibration, or damage to the piping system or related equipment.

E. Support horizontal piping with adjustable swivel-ring, split-ring, or clevis type hangers as shown, Grinnel Figure 104 or 260, galvanized; or welded steel wall bracket, Grinnel Figure 199, galvanized, or approved equal; or approved alternative.

F. Support stacked horizontal runs of piping along walls by a metal framing system attached to concrete insert channels; Unistrut, or approved alternative. No pipe shall be supported from the pipe above or below itself.

G. Horizontal piping hanger support rods shall attach to steel beams with I-clamps, to concrete with inserts or flanges fastened with flush shells, to wood not less than 2-5/8 inch thick with lag screws and angle clips.

H. Vertical piping hangers and supports shall be Unistrut channel and pipe clamps, or approved alternative.

I. All hangers, rods, clamps, protective shields, metal framing support components, and hanger accessories shall be galvanized unless otherwise specified. Expansion anchors shall be Type 316 stainless steel. Submerged supports shall be Type 316 stainless steel and shall be electrically isolated from metal piping with a 1/4-inch by 3-inch neoprene rubber wrap.

J. Support Spacing: Maximum distance between pipe supports as set out below unless otherwise indicated on the Drawings:

	Maximum Distance Between Support Points		
Pipe Size	*CS*	*DIP, SST, STL*	*PVC*
Up to 3/4 inch diameter	3' 3"	3' 3"	2' 0"
1 inch to 1 1/2 inch	6' 0"	6' 0"	3' 3"
2 inch to 3 inch	6' 0"	6' 0"	3' 3"
3 inch to 4 inch	6' 0"	8' 3"	3' 3"
5 inch to 8 inch	6' 0"	8' 3"	3' 3"
8 inch and over	6' 0"	8' 3"	3' 3"

* Spacing above are for specific gravity of 1.0, reduce spacings for greater specific gravities. Reduce spacings to 50 percent of above where valves occur in lines. Actual spacing will depend on pipe size and special loading conditions.

K. Hanger rod sizing for plastic pipe shall be the same as for steel pipe. Spacing of hangers shall be as recommended by the manufacturer for the flow temperature in the pipe.

L. Support piping in a manner that will prevent undue strain on any valve, fitting, or piece of equipment. In addition, provide pipe supports at changes in direction or elevation, adjacent to flexible couplings, and where otherwise shown. Do not install pipe supports and hangers

in equipment access areas.

2.5 PIPING FABRICATION AND ERECTION

A. Join pipe and fittings according to the following requirements.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before fabrication and assembly.

D. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
   1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
   2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

E. Do not use pipe sections that have cracked or open welds.

F. Piping fabrication, inspection and testing shall be in accordance with this specification, ASME and AWWA standards.

G. Erect piping with flanged and threaded connections as applicable in accordance with good engineering practice suitable for hydrocarbon processing industry. Use suitable lubricants on bolt threads.

H. The overall fabrication, supporting, and erection of piping shall be done in such a way as to impose minimum possible loading on connected equipment and valves. Wherever required, verify the alignment of the equipment and drive motor in pipe-connected and disconnected state, to verify that piping is not imposing undue load on the equipment.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that surfaces and the Work Site conditions are ready to receive work.

3.2 INSTALLATION OF PIPING SYSTEMS - GENERAL REQUIREMENTS

A. Install piping as shown on the Drawings unless deviations to layout are approved by ENGINEER.

B. Mark each pipe and fitting on the outside to indicate the class of pipe and location number of the laying plan. Furnish and install piping in accordance with the reviewed Shop Drawings. All marking shall be coded to the Shop Drawings.

C. Provide allowance for piping to be modified around CONTRACTOR supplied equipment. Piping and piping systems may be modified up to 5 ft in any direction after receipt of equipment Shop Drawings to suit provided equipment. All Piping shown on drawings shall be confirmed in field prior to installation.

D. Specific flange joint requirements are shown on the Drawings. Provide other break flanges / unions in accordance with general industrial practice.

E. Install piping to maximum possible extent at right angles, and club together to manage in designated piping-ways. Diagonal runs are prohibited unless specifically indicated otherwise.

F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

G. Install piping to permit valve servicing.

H. Install piping at indicated slopes.

I. Install piping free of sags and bends.

J. Install manufactured fittings for changes in direction and branch connections. Fabricated fittings shall not be accepted where standard manufactured fittings are available.

K. Install piping to allow application of insulation where indicated.

L. Select system components with pressure rating equal to or greater than system operating pressure.

M. Valves shall be accessible from relevant level flooring, and shall be installed in accordance with manufacturers instructions.

N. Support all piping connections to dynamic equipment suitably to prevent overstressing of equipment casing beyond limits specified by the equipment manufacturers. Provide spring supports wherever necessitated due to variable loads.

O. Hard-pipe and route overflow and drain lines to appropriate drain collection points.

P. Verify final equipment locations for roughing-in.

Q. Refer to equipment specifications in other Sections of these specifications for roughing-in requirements.

R. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Coordinate sleeve sizes with the seal manufacturer for required annular space.
   1. Install steel pipe for sleeves smaller than 150 mm in diameter.
   2. Install cast-iron wall pipes for sleeves 150 mm and larger in diameter.
   3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

S. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required

for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.3 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and individual Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
   1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
   2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

E. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

F. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
   1. Comply with ASTM F402 for safe-handling practice of cleaners, primers, and solvent cements.
   2. ABS Piping: Join according to ASTM D2235 and ASTM D2661 Appendices.
   3. CPVC Piping: Join according to ASTM D2846/D2846M Appendix.
   4. PVC Pressure Piping: Join schedule number ASTM D1785 PVC pipe and PVC socket fittings according to ASTM D2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D2855.
   5. PVC Non-pressure Piping: Join according to ASTM D2855.
   6. PVC to ABS Non-pressure Transition Fittings: Join according to ASTM D3138 Appendix.

G. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D3139.

H. Plastic Non-pressure Piping Gasketed Joints: Join according to ASTM D3212.

3.4 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment as shown on the Drawings.

3.5 GROUTING

A. Mix and install grout for piping base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide smooth bearing surface for pipe supports.

G. Place grout around anchors.

H. Cure placed grout.

3.6 FIELD QUALITY CONTROL

A. Clean piping systems by flushing with water or blowing with air with valves wide open prior to testing and before installing any primary element instrumentation on the piping systems.

B. Provide temporary restraints or isolate expansion joints which cannot sustain the reactions due to test pressure.

C. Isolate from the piping, equipment that is not to be subjected to the test pressure.

D. Piping must pass field tests.

E. No leakage will be allowed.

F. Hydrostatically test piping using clean water at ambient temperature except where there is risk of damage due to freezing. Another fluid may be used if it is safe for workmen and compatible with the piping.

G. Apply the hydrostatic test pressure (1.5 times design pressure) for 4 hours.

H. If leaks are found, repair and retest until no leakage units found.

I. Drain piping and blow dry following successful completion of testing.

J. Prepare a report for each test. Include in the report the following:
   1. Location or section of piping.
   2. Time and duration of test.
   3. Test pressure at start and completion.
   4. Ambient and water temperatures.

3.7 CLEANING

A. Following assembly and testing, prior to disinfection of potable water lines, and following final acceptance, flush pipelines, except as stated below, with water at 160 gpm minimum flushing velocity until foreign matter is removed.

B. Remove accumulated debris through drains 2 inches and larger or by removing spools and valves from piping.

END OF SECTION

SECTION 40 05 33

HIGH DENSITY POLYETHYLENE PROCESS PIPE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. This Section defines the minimum requirements for supply and installation of High-Density Polyethylene (HDPE) pressure piping and associated appurtenances.
   1. All jointing and gasketing materials, harnessing, and other miscellaneous appurtenances and accessories shall be provided.

1.2 RELATED SECTIONS

A. Section 40 05 13 – Common Work Results for Process Piping

1.3 QUALITY ASSURANCE

A. Manufacturers Qualifications: Piping for each service or system specified herein shall be provided by a manufacturer who has thoroughly familiarized himself with the design intent of the system and will provide piping suitable for the service intended.

B. Source Quality Control: All pipe shall be marked with a class designation thereon. The name or trademark of the manufacturer shall also be marked on the pipe.

C. Each type of pipe shall be obtained from no more than one manufacturer.

D. Reference Standards: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.
   1. ASTM D 2657, Standard Practice for Heat Joining Polyethylene Pipe and fittings.
   2. ASTM D 2683, Standard Specifications for socket type Polyethylene fittings for outside diameter controlled Polyethylene Pipe and Tubing.
   3. ASTM D 2837, Standard Testing Methods for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials.
   4. ASTM D 3261, Specifications for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Plastic Pipe and Tubing.
   5. ASTM D 3350, Standard Specifications for Polyethylene Plastic Pipe and Fitting Materials.
   6. PPI TR- 3, Policies and Procedures for Developing Recommended Hydrostatic Design Stress for Thermoplastic Pipe Materials.
   7. PPI TR-4, Recommended Hydrostatic Strengths and Design Stresses for Thermoplastic Pipe and Fitting Compounds.
   8. ANSI/NSF, Standard No. 61 for Drinking Water Systems Components- Health Effects.
   9. AWWA C901, Standards for Polyethylene (PE) Pressure Pipe and Tubing 1/2 inches through 3 inches for Water Service.
   10. AWWA C906, Standards for Polyethylene (PE) Pressure Pipe and Tubing 4 inches through 63 inches for Water Service.

E. Shop Tests:
   1. Piping manufacturer shall maintain a continuous quality control program. All Polyethylene molding materials used to manufacture pipe and fittings under this Section shall be tested for conformance to the requirements of AWWA C901 or AWWA C906.

1.4 SUBMITTALS

A. Shop Drawings: CONTRACTOR shall submit for approval Shop Drawings showing the following:
   1. Detailed procedures to be used in jointing and installing piping system including manufacturer's recommendations.
   2. Interfacing of piping system to equipment, appurtenances, and other types of pipe.
   3. Detail requirements for burial, supports, anchors, guides, expansion joints, and all accessories required for a satisfactory piping system.
   4. Affidavit of Compliance in accordance with AWWA C901 or AWWA C906.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 – Product Requirements: Requirements for transporting, handling, storing, and protecting products.
B. Inspect for damage.

1.6 WARRANTY

A. Provide 3-year manufacturer's warranty for products covered in this Section.

PART 2 PRODUCTS

2.1 MATERIALS

A. General

B. Polyethylene (HDPE) Pipe
   1. Materials used in the manufacture of the polyethylene pipe shall be PE 4710, high density polyethylene meeting the requirements of ASTM D 3350, cell classification of 445474C.
   2. The material shall have a minimum hydrostatic design basis of 320 psi at 73 degrees Fahrenheit when tested in accordance with PPI TR-3 and shall be listed in the name of the pipe manufacturer in PPI TR-4.
   3. Polyethylene pipe shall be manufactured in accordance with AWWA C901 for sizes 1/2 inches through 3 inches and in accordance with AWWA C906 for sizes 4 inches through 63 inches.
   4. The pipe and fittings shall contain no recycled compounds except that generated in the manufacturer's own plant from resin of the same specification from the same raw material.
   5. All piping and tubing furnished for use on this project shall meet the following

requirements, unless indicated otherwise on the Contract Drawings:
   a. Iron Pipe Size (IPS) PE4710
   b. Nominal 10-Inch HDPE (excluding creek crossing HDD installations): DR 21
   c. Nominal 10-Inch HDPE for creek crossing HDD installations: DR 11
   d. Nominal 8-Inch HDPE: DR 11
   e. Nominal 3-Inch HDPE: DR 11
   f. Nominal 2-Inch HDPE: DR 11
6. Restrained joints for polyethylene piping shall be accomplished by completion of butt fusion joints.
7. Restrained polyethylene pipe connections to stainless steel or carbon steel mechanical joint fittings shall be accomplished by use of a HDPE adapter piece which must be butt fused to the plain end of the HDPE piping. The adapter piece shall be PE 4710, with the same DR rating as the HDPE piping which it will be fused to.
8. When transitioning from one pipe material to HDPE pipe flex-restraints are required, and an electrofusion flex restraint by Central Plastics shall be used with a concrete collar to prevent pull outs from expansion of HDPE pipe or approved equal.
9. Product and manufacturer: HDPE piping shall be manufactured by:
   a. Plexco
   b. ISCO Industries
   c. Or equal

C. Butt Fusion Fittings:
1. Fittings shall be made of HDPE material with a minimum material designation of PE 4710 and with a minimum Cell Classification as noted in B.1. Fittings shall have a minimum pressure rating equal to or greater than the pipe to which they are joined unless otherwise specified on the plans or accepted by OWNER/ENGINEER. All fittings shall meet the requirements of AWWA C901 or AWWA C906.
   a. Molded fittings shall comply with the requirements of ASTM D 32610
   b. All fabricated elbows, tees, reducing tees, and end caps shall be produced and meet the requirements of ASTM F 2206, holding an ISO 9001 quality system certificate. Each fitting will be marked per ASTM F 2206 Section 10 including nominal size and fitting EDR, which will meet or exceed the pipe DR identification for the project. Fabricated fittings shall be manufactured using a McElroy DataLogger to record fusion pressure and temperature and shall be stamped with unique joint number that corresponds to the joint report. A graphic representation of the temperature and pressure data for all fusion joints made producing fittings shall be maintained for a minimum of 5 years as part of the quality control and will be available upon request of OWNER/ENGINEER. Test results validate ASTM section 7.3 and 9 shall be provided to OWNER/ENGINEER upon request.
   c. Socket fittings shall meet ASTM D 2683.

D. Magnetic Tape Marker for Underground Pipe:
1. All below ground Polyethylene (HDPE) pipe shall have a magnetic tape marker laid directly above the pipe for the full length of the pipe and approximately 18 inches below ground surface. At each concrete structure, cleanout, and/or valve box, the CONTRACTOR shall install the tape in such a manner where the tape runs up the exterior wall of the structure and is affixed at the top. The tape shall be affixed in such a fashion where OWNER can attach his detection device to the tape to produce a stronger signal for pipeline detection.
2. Tape shall be 3 inches wide consisting of two (2) exterior plies of polyethylene with an aluminum alloy foil core.

3. Tape shall be manufactured by Paul Potter Warning Tape, Alarm Tape, or approved equal.
4. Tape shall be green color and shall be labeled "Sewer" in black letters.
5. Splices, where needed, shall be made in accordance with manufacturer's recommendations.
6. At completion of the project, before final payment, the CONTRACTOR shall test the entire length of the pipe using pipe location equipment. Tests shall be made only in the presence of OWNER and ENGINEER. Any section of tape not continuous or that is undetectable shall be removed and relayed.

PART 3 EXECUTION

3.1 EXAMINATION

A. CONTRACTOR shall inspect all piping prior to installation to assure that pipe is free from defects in material and workmanship. The compatibility of all pipe and fittings shall be verified. Pipe fittings and accessories that are cracked, damaged, not identified, or in poor condition shall be rejected. Any pipe section or fitting containing significant scratches, dents, or marks shall be deemed unusable and rejected, or the suspect section removed from service. Any fitting or pipe section containing scratches, dents, or marks exceeding ten percent of the calculated wall thickness shall be rejected. Any substantial scratch in the opinion of ENGINEER may be cause for rejection. Rejection will be at the sole discretion of ENGINEER.

B. The Inspector shall have free access to all joints and test joints for determining the suitability of the joining procedure. Where construction restrictions limit inspection of joints, ENGINEER may have the person joining the pipe and/or fittings perform a test joint in the presence of ENGINEER or have the joint in question tested. ENGINEER shall determine the method of testing: either visual inspection, bent strap testing, or ultrasonic testing, per DOT CFR 49, Part 192.286 (b)(ii) or (b)(iii).

C. During construction, the first fusion of the day shall be a trial fusion which shall be allowed to cool completely and destructively tested as directed by ENGINEER. If the trial fusion fails, additional trial fusions shall be made and tested until successful fusions are completed. The procedure used to join the successful trial fusion shall be used for the balance of the day’s work, provided the procedure is within the limitations recommended by the manufacturer. ENGINEER shall have the authority to disallow any installer from completing heat fusion of HDPE pipe if that installer has consecutively failed trial joints. Any person deemed unqualified by ENGINEER will require training as specified in 1403.0102 before being permitted to heat fuse HDPE pipe.

D. During construction, CONTRACTOR shall report any occurrence of potential soil contamination in the vicinity of the pipe trench to ENGINEER immediately. Work shall be stopped until the contamination is remedied.

3.2 FIELD QUALITY CONTROL

A. Placing and Laying. All HDPE pipe shall be installed to minimize shear and tensile stresses. The minimum radius of field bends shall be ten pipe diameters for pipe twenty-four inches and larger.

B. Field Testing. CONTRACTOR shall perform hydrostatic leakage tests on all HDPE pipe in accordance with the non-monitored makeup water test.

3.3 MONITORED MAKE-UP WATER TEST

A. The test procedure consists of initial expansion, and test phases. During the initial expansion phase, the test section is pressurized to the test pressure, and enough make-up liquid is added each hour for three (3) hours to return to test pressure.

B. The test phase follows immediately, and may be one (1), two (2), or three (3) hours. At the end of the test time, the test section is returned to test pressure by adding a measured amount of liquid. If the amount of make-up liquid added does not exceed Table 1 values presented in PART 3, TEST PHASE MAKE-UP AMOUNT, leakage is not indicated.

C. For any test pressure from 1 to 1-1/2 times the system operating design pressure, the total test time including initial pressurization, initial expansion, and time at test pressure, must not exceed eight (8) hours. If the test is not completed due to leakage, equipment failure, etc., depressurize the test section, then allow it to “relax” for at least eight (8) hours before bringing the test section up to test pressure again.

3.4 TEST PHASE MAKE-UP AMOUNT

TABLE 1

Nominal Pipe Size (in.)	Gallons/100 ft. of Pipe		
	1 Hour Test	2 Hour Test	3 Hour Test
3	0.10	0.15	0.25
4	0.13	0.25	0.40
6	0.30	0.60	0.90
8	0.50	1.0	1.5
10	0.75	1.3	2.1
12	1.1	2.3	3.4
14	1.4	2.8	4.2
16	1.7	3.3	5.0
18	2.2	4.3	6.5
20	2.8	5.5	8.0
22	3.5	7.0	10.5
24	4.5	8.9	13.5
26	5.0	10.0	15.0
28	5.5	11.1	16.8
30	6.3	12.7	19.2
32	7.0	14.3	21.5
34	7.0	16.2	24.3
36	9.0	18.0	27.0

END OF SECTION

SECTION 40 05 51

COMMON REQUIREMENTS FOR PROCESS VALVES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Ball valves.
   2. Butterfly valves.
   3. Check valves.

1.2 REFERENCES

A. Reference Standards:
   1. Section 01 40 00 - Quality Requirements: Requirements for references.
   2. American National Standards Institute: ANSI B16.1 - Cast Iron Pipe Flanges and Flange Fittings Classes 25, 125, and 250.
   3. American Petroleum Institute (API).
   4. ASTM International:
      a. ASTM A126 – Standard Specification for Gray Iron Casings for Valves, Flanges and Pipe Fittings.
   5. American Water Works Association:
      a. AWWA C509 - Standard for Resilient Seated Gate Valves for Water Supply Service.
      b. AWWA C550 – Protective Epoxy Interior Coatings for Valves and Hydrants.
   6. Manufacturers Standardization Society: MSS SP-110 – Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.
   7. Underwriters Laboratories Inc. (UL).

1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Shop Drawings: Indicate dimensions, inlet and outlet size connections and connection ratings, materials of construction, CV/pressure loss curve, trim finish, coatings, mounting requirements and valve operators.

C. Product Data: Include vendor information.

D. Design Data: Indicate operating pressure data.

E. Manufacturer's Instructions: Indicate installation instructions.

F. Power and control wiring diagrams, including terminals and numbers.

G. Complete motor nameplate data.

H. Sizing calculations for open close/throttle and modulating.

1.4 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for closeout submittals.

B. Record Documents: Indicate location of valves and valve number, tests and inspection data.

C. Manufacturer's Certificate of Proper Installation.

D. Certificate of Compliance for:
1. API ANSI Classes 150 valves; full compliance with API standards.

E. Operation and Maintenance Data: Indicate instructions for operation, maintenance, and cleaning.

F. Warranties: Completed original warranty forms filled out in OWNER's name and registered with manufacturer.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Blank off ends of valves with plywood or install plugs in valves for shipment to protect valve internals from debris during handling. Leave valves blanked off until installation.

C. Accept valves on the Work Site in original packaging. Inspect for damage.

D. Protect valves from damage.

1.6 WARRANTY

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for warranties.

B. Provide one-year manufacturer's warranty for valves.

C. Warranty: Include coverage for defects in material and workmanship.

PART 2 PRODUCTS

2.1 GENERAL

A. All valves shall include operator, actuator (as indicated on the Drawings) handwheel, extension stem, operating nut and accessories for a complete operation.

B. Valve shall be suitable for intended service. Renewable parts shall not be of a lower quality than specified.

C. Valve shall be same size as adjoining pipe.

D. Valve ends to suit adjacent piping.

E. Size operator to operate valve for the full range of pressures and velocities.

F. Valve shall open by turning counterclockwise.

G. Factory-mount operator, actuator, and accessories.

2.2 FACTORY FINISHING

A. Epoxy Lining and Coating:
   1. Use where specified for individual valves described herein.
   2. In accordance with AWWA C550 unless otherwise specified.
   3. Either two-part liquid material or heat activated (fusion) material except only heat activated material if specified as "fusion" or "fusion bonded" epoxy.
   4. Minimum 1.5 mm dry film thickness except where limited by valve operating tolerances.

B. Exposed Valves: Safety isolation valves and lockout valves with handles, handwheels, or chain wheels "safety yellow".

2.3 BUTTERFLY VALVES

A. Butterfly valves shall be used for pipeline greater than 2.0 inches unless otherwise specified.

B. Pressure ratings, 200 psi cold working pressure.

C. Operators: Provide valves six inches and less with handwheel operators. Provide valves over 6 inches with gear box and wheel operator unless otherwise specified.

D. Accessories: Provide chain wheel operator for valves mounted over six feet above floor level.

2.4 BALL VALVES

A. Ball Valve (2.0 inches and smaller):
   1. Ball valve shall be designed for two-way blocking capability. Valve shall provide bubble-tight shut-off.
   2. Ball valve shall be constructed of PVC Type 1, Grade 1. All elastomeric parts shall be made of Viton.
   3. Ball valve shall be of a True Union design with socket end connectors and be rated at 150 psi at 120 degrees F.
   4. As manufactured by Chemline, Type 21, Hayward Gordon or approved equal.

2.5 CHECK VALVES

A. PVC Check Valve (1.5 inches and smaller):
   1. PVC check valves shall be used for chemical service (includes methanol, ferric chloride, and phosphoric acid).
   2. Check valve shall be designed to be non-clog, fully automatic with internal ball as the only moving part. Valve shall provide a tight shut-off under pressure.
   3. Check valve body shall be constructed of PVC Type 1, Grade 1. Valve seat and O-rings shall be Viton.
   4. Check valve shall be of a True Union design with socket end connectors and be rated at 150 psi at 120 degrees F.
   5. As manufactured by Chemline, Hayward Gordon or approved equal.

B. Swing Check Valve (2.0 inches and larger):
   1. Swing check valve, cast iron body to ASTM A126 Class B, bolted bonnet, bronze disc under 6 inches, cast iron disc above 8 inches, bronze trim, stainless steel hinge pin, flanged ends to ANSI B16.1 Class 125, rated 150 psi, as manufactured by Crane, or approved equal.

2.6 VALVE OPERATORS

A. General: All valves shall be equipped with operators. The valve operator types, as specified herein, describe only the general characteristics of the operator. The operator shall be compatible with the valve with which it will be used and shall be of the same manufacturer, or a product that is recommended by the valve manufacturer. The operator shall be sized to operate the valve for the full range of pressures and velocities imposed by the service. All valve operators shall open by turning counterclockwise.

B. Manual Operators:
   1. General:
      a. Manual handwheel operators shall be provided unless otherwise shown or specified. Ferrous handwheels shall be galvanized and painted the same color as the valve and associated pipeline. Lever operators may be supplied on quarter-turn type valves 6 inches and smaller, if recommended by the manufacturer; however, operator force shall not exceed initial breakaway.
      b. When the maximum force required to operate a valve under full operating head exceeds 40 pounds, gear reduction operations shall be provided. Gear operators shall be totally enclosed and lubricated.
      c. On quarter-turn valves, the valve operators shall be of the self-locking type to prevent the disc or plug from creeping and shall be provided with position indicators to show the position of the valve disc or plug. Operators of the worm and gear type shall have self-locking worm gears, one-piece design, of bronze material, and accurately machine cut. The worm shall be hardened alloy steel, with thread ground and polished. Operators of the geared travelling nut type shall have threaded steel reach rods with an internally threaded bronze or ductile iron nut.
   2. Exposed Operators:
      a. Valves with operating nuts located more than 6 feet above finish floor elevation shall be fitted with chain wheels and guides, as manufactured by DeZurik Corporation, Series W or LWG, or equal. Chain wheels and guides shall be galvanized or cadmium plated. Chains shall be of the size recommended by the valve manufacturer and shall extend to within 4 feet of the operating floor. Where

chains hang in normally travelled areas, appropriate "L" type tie-back anchors shall be provided and located as approved by ENGINEER.

b. Level type operators shall have some means of being fixed in any given position to prevent accidental movement; shall be of rugged, noncorrosive construction; and shall be fully compatible with the valve.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that installations of previous trades are complete and ready to receive work.

3.2 HANDLING OF VALVES

A. Chains, cables and ropes must not be placed through valve ports or attached to operating cylinders or handwheels. Slings must be used either around the valve body or with bolts or rods through the flange bolt holes.

3.3 STORAGE OF VALVES

A. Store valves in a cool location clear of moving vehicles or other objects. Prevent dirt and debris from entering the valve internals. On no account shall the valve seats on butterfly valves be painted. Valves must not be rested on handwheels or operating shafts.

B. Store butterfly valves with valves slightly off the closed position.

C. Cover the valves to shield them from dirt and to avoid exposing the seats to sunlight or mercury arc light.

3.4 INSTALLATION OF ACTUATORS

A. Install actuators where shown as per manufacturer's recommendations. Secure the base of actuator in place. Field support from building steel or concrete block structure, if valve body does not properly support actuator body. Do not install actuators in such a position that makes them inaccessible or with hard maintenance access. Maintain spacing and access. Position indicators shall be visible and legible from the floor level.

B. Supply testing equipment and manufacturer technical representatives at the Work Site to verify actuator installation, adjustment of travel limits based on valve operation, torque and speed settings, and valve operational tests prior to the control system commissioning. Provide written report confirming proper installation.

C. Supply touch-up paint and touch up all exterior finish damage when installation is complete. Hand the remainder of touch-up paint in an identified container(s) to OWNER.

3.5 INSTALLATION OF VALVES

A. Install valves in accordance with manufacturer's instructions. Before installing valves, inspect the pipeline to ensure that no foreign debris or objects may work loose and prevent the valve from closing.

B. Provide non-conducting dielectric connections wherever jointing dissimilar metals.

C. Provide clearance for installation of insulation and access to valves and fittings.

D. Provide access where valves and fittings are not exposed.

E. Provide support for valves where required for proper support and operation.

F. Install operator in position for convenient operation. Ensure space is available for operation of separators.

G. Install valves with stems upright or horizontal, not inverted. Ensure that each valve operates freely after installation into pipe.

H. Install unions downstream of valves.

3.6 FIELD QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Field inspecting and testing.

B. Perform hydrostatic test with piping.

3.7 CLEANING

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for cleaning.

B. Clean valves prior to painting.

3.8 PROTECTION OF FINISHED WORK

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for protection of installed work.

B. Keep valves in closed position following installation.

3.9 VALVE SCHEDULE

Service	**Valve Type**
Process Piping (Influent/Effluent)	Swing Check Valve (PVC)
	Ball Valve (PVC)
	Butterfly Valve (PVC)
Solids Handling (Sludge)	Ball Valve (PVC)
	Swing Check Valve
Chemical Piping	PVDF Ball Valve

END OF SECTION

SECTION 40 70 00

INSTRUMENTATION FOR PROCESS SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Instrumentation for flow, turbidity, pH, and level measurement.

1.2 REFERENCES

A. Reference Standards:
   1. Section 01 40 00 - Quality Requirements: Requirements for references.
   2. National Fire Protection Association, Inc.:
      a. NFPA 70 - National Electrical Code.
   3. Underwriters Laboratories Inc. (UL).

1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Reference Data:
   1. Include process measurement device type, process tag, name, manufacturer's name, list of supplied items with complete model numbers and process measurement device calibrated range.
   2. Provide Supplier/distributor contact and location of manufacturer's closest service location.

C. Description and Engineering Data: Indicate minimum/maximum range, operating, and performance data, application conditions and limitations of use, layout drawings with overall dimensions, clearance requirements, size and location of connections, wiring diagrams, materials, process connection, mounting details, control schematics with signals identified, wiring connection details, and other technical specifications required to describe product.
   1. Provide detailed description of operation, when applicable.
   2. Provide detailed product data and operating manuals, sheets or manuals for review when required to evaluate submittal, or as requested by ENGINEER.

D. Test Reports: Process measurement device calibration certificates including process measurement device reference data; identify testing/calibration equipment, date of original calibration, subsequent calibrations, calibration method, and test laboratory/location.

E. Manufacturer's Instructions: Provide installation details, manufacturer's instructions, and instructions for storage, handling, protection, examination, preparation, setup, and installation of product.

F. Manufacturer's Field Reports: Commissioning report on field tests, including all test forms and confirming proper installation prior to introduction to process media and energization.

1.4 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for closeout submittals.

B. Record Documents:
   1. Indicate actual locations of instrumentation.
   2. Include actual setpoints and analog signal spans including any field modifications.

C. Operation and Maintenance Data: Indicate and submit maintenance data for incorporation into Operations and Maintenance Manuals.
   1. Process measurement device reference data, and description and engineering data. As-built product data including any field modifications.
   2. Copies of factory test/manufacturer's calibration report, field report, and process measurement device setup/parameter configuration (including passwords) datasheets for each process measurement device. Include data communication registers layout.
   3. Provide detail installation drawings.
   4. Certificates or letters stating each piece of equipment has been installed to the satisfaction of the factory technical representative.
   5. Include operating manuals, manufacturer's setup, calibration instructions and control descriptions. Recommended renewal parts list and service/calibration schedules.
   6. Submit operation and maintenance data in printed and electronic Adobe Acrobat PDF format on electronic media. Upon approval, large manuals may be provided only in PDF format.
   7. Furnish special inspection certificates, when applicable.

1.5 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Conform to NFPA 70.
   2. Electrical components must comply with requirements of current edition of applicable electrical safety regulations.
   3. Process measurement devices with electrical components to be UL certified. Manufacturers and approval marks must be accessible and legible after equipment is installed.
   4. Mechanical components must comply with of current edition of applicable standards and safety regulations.

1.6 QUALIFICATIONS

A. Installer: Company specializing in performing work of this Section with minimum 5 years of experience.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Ship process measurement devices to the Work Site in factory containers. Store equipment on Work Site in clean, dry, temporary storage containers for security purposes. Indicate any specific requirements for storage of process measurement devices during proposal stage.

C. Do not purchase sensors, probes, reagents, etc. or install sensors which have short storage/life time until they are ready to be put into continuous operation.

1.8 WARRANTY

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for warranties.

B. Provide one-year manufacturer's warranty for instruments.

C. Warranty: Include coverage for defects in material and workmanship.

PART 2 PRODUCTS

2.1 INSTRUMENT LIST

A. Appended to this Section is Attachment 1, Instrument List, which tabulates the instruments that form part of the Works. Use this list in conjunction with Drawings.

2.2 ANALYTICAL INSTRUMENTATION-pH/ORP ANALYZER

A. Manufacturer List:
1. Emerson Rosemount
2. Endress + Hauser
3. Or Approved Equal

B. Differential electrode measurement pH/ORP analyzer with built in temperature compensation.

C. Output: 4-20 mA output signal proportional to range.

D. Operating Temperature Range: Minus 5 degrees C to 70 degrees C.

E. Materials: Wetted parts to be PEEK material or approved equal.

F. Mounting Assembly: Immersion in process tanks or in process piping. See P-02 drawing.

G. Sensor Cable: Integral, as long as required.

H. Controller:
1. The controller shall be suitable to accept multiple different sensors and have a quick connect capability. Sensors to be connected via a termination box.
2. Controller to provide 2 independent 4-20 mA outputs.
3. Manufacturer: Hach SC-200 or approved equal.

4. Enclosure: Type 4.
5. Electrical Requirements: 120V single phase 60 Hz.

I. Accessories: Sensor mounting hardware as required, junction box and 4-conductor extension cables with one shield and jacket. All in-line instrumentation shall be "hot tap" assemblies allowing instrumentation to be removed from piping while piping remains in service.

J. Ranges: Refer to table below.

Tag No.	Operating Range	Process Fluid	Location	Classification
AIT-2100	1 to 14 pH Sensitivity of 0.01	Impacted water	Rapid Mix Tank	Unclassified
AIT-2803	1 to 14 pH Sensitivity of 0.01	Final treated effluent	Final discharge pipe	Unclassified

2.3 FLOW INSTRUMENTATION– MAGNETIC FLOW METERS

A. Manufacturer List:
1. Emerson Rosemount.
2. Endress + Hauser.
3. Or Approved equal.

B. Description:
1. Four-wire, microprocessor-based dc magnetic flowmeter transmitter with integral display of measured flow and flow totalizer values in engineering units (m^3/h, L/s, m^3), HART protocol, sensor/electronics failure mode and annunciation, field programmable, menu driven limit and control settings (units, range, zero and span adjustment), non-volatile memory, local or remote mounted as indicated above.
2. Flow Tube:
   a. Flanged style capable of monitoring liquids with conductivity greater than 5 µS/cm in vertical or horizontal position; with full tube.
   b. Housing: Steel.
   c. Metering Tube: Lined, Type 304 stainless steel.
   d. Electrodes: Hard rubber liner, Hastelloy C, rated and certified for use in potable water installation.
      1) Accuracy: Plus or minus 0.5 percent of calibrated span.
      2) Stability: Plus or minus 0.2 percent of calibrated span for 12 months.
3. Power Supply: 120 VAC plus or minus 10 percent power, internal fusing.
4. Outputs:
   a. 4-20 mA linear, analog current signal with superimposed digital HART protocol into load between 0 and 500 Ω minimum.
   b. Pulse, digital; totalizer signal for flow totalizing.
5. Diameters: As required for design process flow.
6. Enclosure:
   a. Transmitter: NEMA 4X.
   b. Flow Tube: Rated IP 68, suitable for occasional submergence.
   c. Permanently attached engraved tags associating each tube and flowmeter.
7. Application: Unclassified area.
8. Connections: Flanged to ASME B16.5 Class 150.

9. Accessories:
   a. Type 316 stainless-steel ground ring.
   b. Stainless-steel protective inlet ring.
   c. Calibration certificate from factory.
   d. Tube to transmitter cable.
   e. Mounting Hardware: Where applicable for remote-mounted transmitter, provide mounting bracket as required to mount to pipe or wall.
10. Schedule: Refer to table below.

Tag No.	Flowrate	Pipe Size	Process Fluid	Service/Notes
FE-2002	0-1,000 gpm	TBD by CONTRACTOR	Impacted water	Installed on influent to Rapid Mix Tank
FIT-2804	0-500 gpm	TBD by CONTRACTOR	Final treated effluent	Installed on discharge of the water treatment system

2.4 PRESSURE INSTRUMENTATION – GAGES

A. Manufacturer List:
   1. Ashcroft.
   2. Dwyer.
   3. Endress + Hauser.
   4. Winters.
   5. Or approved equal.

B. Description:
   1. Pressure gages and accessories conforming to ANSI/ASME B40.1 and CRN approved.
      a. Accuracy: Plus or minus 0.5 percent of scale range, Grade 2A.
   2. Pressure Gages: Steel case (black epoxy painted), 113 mm dial size, threaded ring, solid front with blow-out back, molded acrylic window, white painted aluminum face with dual black reading dials (PSIG and kPa), micrometer adjustable type black pointer. Stainless-steel rotary type movement with stainless-steel bushings, Type 316 stainless-steel Bourdon tube and socket suitable for potable water service, throttling device (screw, pressure snubber), standard 13 mm NPT bottom process connection. Liquid-fill capability.
   3. Range and scale sized according to process conditions.
      a. Accuracy: Plus or minus 2.5 percent of full scale.
   4. Gages shall be calibrated. Submit a three-point factory calibration certificate for each gage or perform a three-point field calibration and submit results to ENGINEER. Gages not having an accuracy of 5 percent within 30 to 100 percent span shall be replaced.
   5. Accessories:
      a. As required, such as isolation ball valves, nipples, reducers to match seal and process connection, mounting hardware.
      b. Identification tagging/engraving as indicated below.
   6. Provide pressure gauges (0-100 psig) at the discharge of all water treatment system pumps. Provide pressure gauges upstream and downstream of each of the multimedia filters, bag/cartridge filters, as well as upstream/downstream of each of the GAC vessels.

2.5 LEVEL INSTRUMENTATION – ULTRASONIC

A. Manufacturer List:
   1. Emerson Rosemount.
   2. Endress + Hauser.
   3. Or approved equal.

B. Description:
   1. Microprocessor based non-contact ultrasonic level transmitter.
   2. Four-wire electronic level transmitter with LCD display of measured level in engineering units, sensor/electronic failure mode and annunciation, fully field programmable (limit and control setting, range, zero and span adjustment), non-volatile memory, self-calibration, remote mounted.
   3. Ultrasonic sensor with built-in temperature compensation, rated NEMA 4X, corrosion resistant to listed media, and rated for location when listed. The sensor will withstand accidental submersion and be mounted as approved by ENGINEER.
      a. Beam Angle: Maximum 8 degrees.
      b. Accuracy: Plus or minus 0.5 percent of calibrated span.
      c. Stability: Plus or minus 0.5 percent of calibrated span for 12 months.
   4. Power Supply: 120 VAC.
   5. Output: 4-20 mA analog, linear isolated signal into load between 0 and 500 Ω
   6. minimum.
   7. Enclosure: NEMA 4X.
   8. Mountings: Stainless-steel sensor flange mounting hardware for connection to tank nozzles or open-top tanks.
   9. Application: Unclassified areas; indoor applications.
   10. Accessories: Sensor to transmitter cable, mounting brackets/hardware for sensor and, where remote transmitter is required, separate hardware for transmitter as indicated. Identification tagging/engraving as indicated in table below.

Tag No.	**Range**	**Location**	**Process Fluid**	**Notes**
LIT-2000 LIT-2001	0 to 10 m	Influent Tanks (2)	Impacted water	Outdoor Installation - Remote mount transmitter/readout with minimum 20 m cable length and hardware as required to mounting location.
LIT-2400	0 to 10 m	Filter feed tank	Clarifier effluent	Outdoor Installation - Remote mount transmitter/readout with minimum 20 m cable length and hardware as required to mounting location.
LI-3500 LI-3300 LI-3100 LI-3200 LI-3210 LI-3400	0-5 m	Chemical storage tanks (totes)	Coagulant, flocculation polymer, organosulfide acid, caustic, thickener polymer	TBD by CONTRACTOR.

2.6 TURBIDITY INSTRUMENTATION– TURBIDIMETER

A. Manufacturer List:
1. Emerson Rosemount.
2. Endress + Hauser.
3. Hach.
4. Or Approved equal.

B. Description:
1. Four-wire, microprocessor-based dc turbidity transmitter with integral display of measured turbidity value in NTU, HART protocol, sensor/electronics failure mode and annunciation, field programmable, menu driven limit and control settings (units, range, zero and span adjustment), non-volatile memory, local or remote mounted as indicated above.
2. Power Supply: 120 VAC plus or minus 10 percent power, internal fusing.
3. Outputs:
   a. 4-20 mA linear, analog current signal with superimposed digital HART protocol into load between 0 and 500 Ω minimum.
4. Enclosure: NEMA 4X
5. Application: Unclassified area.
6. Schedule: Refer to table below.

Tag No.	Range	Pipe Size	Process Fluid	Service/Notes
AIT-2302	0-XXX NTU	TBD by CONTRACTOR	Clarifier effluent	Installed after clarifier to show any failure in clarification process.
AIT-2803	0-XXX NTU	TBD by CONTRACTOR	Final treated effluent	Installed on the final discharge line of the treatment system.

2.7 DESIGN REQUIREMENTS

A. Furnish products listed and classified as suitable for purpose specified and indicated. Supplied process measurement devices must conform to the details specified. Except as specified elsewhere, equipment to be provided by acceptable manufacturers for each process measurement device or element as specified in equipment Sections.

B. Provide new devices unless otherwise specified. Provide process measurement devices of minimum specified design and quality, conforming to published ratings and for which replacement parts are readily available. Use products of one manufacturer for equipment or material of same type or classification unless otherwise specified. Refurbished devices are not considered new.

C. Devices that are removed but not re-used are the property of OWNER and are to be disposed of or stored as directed by ENGINEER. Items to be re-used, when listed to be checked, recalibrated and cleaned, then shown to ENGINEER, before being re-installed. Do not use materials and equipment removed from existing premises, except as specifically permitted by the Contract Documents.

D. Process measurement devices and components to be approved for the area classification and location in which it is being installed. Wetted parts of primary elements to be suited for process medium. External trim materials to be corrosion resistant. Internal parts to be assembled in watertight, shockproof, vibration-proof, assembly.

E. Process measurement devices ranges indicated are for general guidance only and do not limit the device. Coordinate requirements based on actually installed equipment.

2.8 ACCESSORIES

A. Include mounting hardware, sampling lines, fittings, tubing, check valves, vacuum, and pressure relief valves, pressure and flow reducing control valves, selection and isolation valves, and other appurtenances necessary for process measurement devices operation.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 70 00 - Execution and Closeout Requirements: Verification of existing conditions before starting work.

B. Review, verify, and confirm compatibility and performance of the proposed instrument for treatment process and conditions.

C. Field verify process conditions and locations.

3.2 INSTALLATION

A. Install and assemble according to manufacturer's instructions. Exactly follow manufacturer's instructions and installation procedures for sensors directly interfacing process medium.

B. Install components of process measurement devices located as indicated. ENGINEER may change location of any process measurement device within process stream. Provide changes without extra cost if requested before installation.

C. Do not install process measurement devices at locations where other equipment is to be installed, obstruct walkway, or makes inaccessible or hard maintenance access. Maintain spacing and access.

D. Support process measurement devices, process connection lines, and sensors on pipe stands, plates, or channel brackets. Install and securely mount all devices in accessible locations with all gauges, dials, displays, or indicators visible and legible from floor level.

E. Provide electrical and control signals connections to all process measurement devices with manufacturer's instructions.
   1. Bond devices.
   2. Provide electrical identification.
   3. Wire process measurement device through junction box with terminal blocks if more than two wires have to be connected to a single terminal block inside process

measurement device, or process measurement device terminal blocks require wire size reduction. Wire size reduction by cutting the strings is not acceptable.

F. Configure, calibrate, and test all process measurement devices.

G. Provide digital network communication devices (HART handheld terminal, modem with PC software), obtain instrument current electronic data/configuration files, and configure digital communication, and device variables (registers).

H. Touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint. Clean and prime exposed non-galvanized hangers, racks, and fastenings to prevent rusting.

3.3 INTERFACE WITH OTHER PRODUCTS

A. Sequence, schedule, and coordinate work with other trades involved with process measurement device installation. Make arrangements for process measurement device process connection required to install electrical components.

B. Coordinate testing with SCADA integrator and verify data network communication.

3.4 MANUFACTURER'S FIELD SERVICES

A. Where specified, provide manufacturer's representative to inspect after installation and submit report prior to startup, verifying installation and operation of process measurement devices is according to specifications and manufacturer's instructions.

3.5 SYSTEM STARTUP

A. Provide startup and commissioning support for all process measurement device testing and calibration.

B. Energize all process measurement devices and introduce to the process medium. Alternative procedures may be implemented for process measurement devices, which cannot be safely tested and energized.

C. Provide assistance during start up and rectify deficiencies, conduct troubleshooting and otherwise take corrective action of installed systems.

D. Perform operational tests using process media. Include operation of all process measurement devices by actuation of their controlling variable and monitoring of received signals. If the process media are not physically available or not available at required level (e.g., high pressure or temperature), provide testing means and media to simulate process conditions. Remove and reinstall sensors when required for testing.
   1. Provide digital meter, 4-20 mA signal readers and 24 VDC portable power supply for loop powered devices including accessories (alligator clips, metering leads, temporary wiring, etc.).
   2. Provide temporary tubing, fittings, and pressure regulators for testing.
   3. Provide testing solutions to verify operation of analytical process measurement devices.
   4. Provide movable targets to verify operation of level process measurement devices.

5. Provide vacuum/pressure calibration pump complete with reference gauges to verify operation of pressure process measurement devices.
6. Provide ice and hot water in suitable containers complete with reference thermometers to verify operation of temperature process measurement devices.

E. Keep copy of manufacturer's instructions on Work Site, available for review during startup.

3.6 ADJUSTING

A. Calibration of analysis process measurement devices, sensors, gauges, and meters must proceed on a system by system basis. No equipment or system performance acceptance tests to be performed until process measurement devices, gauges, and meters to be installed in that particular system have been calibrated, the calibration work has been witnessed by ENGINEER and reports have been submitted to ENGINEER.

B. Analytical process measurement devices and sensors used for performance testing to be subject to recalibration, if necessary, to confirm accuracy after completion, but prior to acceptance of each performance test. Recalibrate process measurement devices not meeting specifications or process conditions. Field change of process measurement device signal range, units, display configuration, etc. to suit process is considered a part of calibration work and it will not be considered as an extra to the Contract.

C. Provide calibration tags complete with technician name and date of calibration performed, next date of calibration to be performed and range.

D. Adjust process measurement device set points as listed on process measurement device list and as directed by ENGINEER.

E. Provide assistance during start up to rectify deficiencies, conduct troubleshooting, and otherwise take corrective action of installed systems.

3.7 CLEANING

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for cleaning.

B. Prior to energization of process measurement devices, clean inside of all enclosures such that it is free of any dust and debris, cause corrosion, or arc (wire strings).

C. Clean process lines prior to process measurement device installation. Clean process measurement devices process connection components, manifolds, fittings, etc. from construction debris and chemicals to avoid sensor damage or contamination.

3.8 DEMONSTRATION AND TRAINING

A. Section 01 80 00 - Facility Operation: Requirements for demonstration and training.

B. Demonstrate process measurement devices operation.

C. Provide training services for operator training on proper operating and maintenance procedures after satisfactory startup and commissioning.

D. Provide two non-consecutive 8-hour days of training, spread over 3 weeks.

E. Operation and Maintenance Training:
   1. Class training with overview of process measurement devices, technology, and principles. Provide study and training materials and manuals.
   2. Field hands-on training. Provide presentation by instructor with plant operators. Include:
      a. Instrument overview.
      b. Sensor process connection.
      c. Operator interface.
      d. How to setup and configure process measurement device.
      e. How to calibrate instrument. Provide hands-on presentation by instructor with plant operators following and physically calibrating instrument mandatory for all analytical process measurement devices.
      f. Maintenance and basic checks.
      g. Troubleshooting; simulate alarms and explain causes and procedures.

F. Provide simulators for practice purposes.

3.9 PROTECTION

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for protection of installed work.

B. Protect all process measurement devices from moisture, dust, debris, and environmental, mechanical or electrical damage during construction. Allow for mechanical protection, removals and reinstallation where required for construction activities.

END OF SECTION

SECTION 46 07 01

WATER TREATMENT SYSTEM (WTS)

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Design, construction, operation, and maintenance of contact water treatment system capable of treating contact water generated during performance of Work. Sources are:
a. Mounded Water: drains into excavation from surrounding soils.
b. Persistent Infiltration: water that infiltrates through the soil from the river.
c. Stormwater: accumulates in the excavation and containment area during a rain event.
d. Equipment Decontamination Water: generated by the washing/rinsing of equipment (e.g., Truck Wash)
e. Miscellaneous Contact Water: other water that comes into contact with waste material not associated with water types listed above.
2. Treated water discharge criteria are presented in Table 3.

B. Related Requirements:
1. Section 01 91 00 - Water Treatment Consumables
2. Section 22 05 53 - Pipe Data Sheet – PVDF Tubing and Carrier Piping
3. Section 23 05 53 - Identification for Piping and Equipment
4. Section 40 05 13 - Common Work Results for Process Piping
5. Section 40 70 00 - Instrumentation for Process Systems
6. Section 40 05 51 - Common Requirements for Process Valves

1.2 REFERENCES

A. Acronyms:
1. ARARs: Applicable or Relevant and Appropriate Requirements
2. FRP: Fiberglass Reinforced Plastic
3. GAC: Granular Activated Carbon
4. GPM: Gallons Per Minute
5. HMI: Human-machine Interface
6. HRT: Hydraulic Retention Time
7. ISO: International Organization for Standardization
8. PLC: Process Logic Controller
9. PID: Process and Instrumentation Diagram
10. PFD: Process Flow Diagram
11. SSPC: Steel Structures Painting Council
12. TSS: Total Suspended Solids.
13. TBD: To be Determined

14. WTS: Water Treatment System

B. Definitions:
   1. Contact Water defined as:
      a. Stormwater: accumulates in the excavation and containment areas (e.g., WTS, excavated materials storage, dewatering) during a rain event.
      b. Persistent Infiltration: water that infiltrates through the soil from the river when the base of the excavation is below the average mean sea level (AMSL) of the river (i.e., 1.5 ft-AMSL)
      c. Mounded Water : Drains into excavation from surrounding soils when the bottom of the exaction is lower than the groundwater level.
      d. Equipment Decontamination Water: generated by the washing/rinsing of equipment (e.g., Truck Wash)
      e. Miscellaneous Contact Water: other water that comes into contact with waste material not associated with water types listed above.
   2. Hazardous Material: Solid or liquid materials regulated by federal or state regulations as hazardous materials.
   3. Hazardous Waste: Listed in applicable regulations as a hazardous waste or exhibiting the characteristics of hazardous substances including properties such as ignitability, corrosiveness, toxicity or reactivity.
   4. Non-hazardous Waste: Waste that in not classified as a Hazardous Waste.
   5. Commissioning or Commission: the overall process of starting, testing, adjusting, and balancing the various components, equipment, and subsystems of a system or facility to place the system or facility into a fully operational condition.
   6. Work: All activities related to excavation, material transportation, contact water collection and treatment which is include but not limited to mobilization, start up and commissioning, operation, decommissioning and demobilization.
   7. WTS Effluent: all treated water discharged to the river .

C. Reference Standards:
   1. Section 01 40 00 - Quality Requirements: Requirements for references.
   2. American National Standards Institute (ANSI).
   3. Institute of Electrical and Electronics Engineers (IEEE).
   4. National Electrical Manufacturer's Association (NEMA).

1.3 SYSTEM DESCRIPTION

A. WTS will be required to manage contact water for the Northern Impoundment RA. Design, obtain ENGINEER's approval, and implement water management program compatible with construction schedule and methodologies selected to perform the Works.

B. WTS must be placed in a secondary containment area with available volume (i.e., area not occupied by other tanks) equal to or greater than the volume of the largest tank plus precipitation captured within the containment area.

C. Contact water shall be directed from the excavation and all containment areas to the Influent Tanks using transfer pump(s) at a rate to be determined by CONTRACTOR to prevent delay of work.

D. Provide sufficient storage capacity for contact water (including storm water falling into excavations and BMP area) collected within the work area to prevent delay of Works.
   1. Equalization storage capacity shall be provided upstream of the WTS. This capacity is currently estimated at 1.8 million gallons
   2. Stormwater
      a. Rainfall will comprise a majority of the contact water generated at the Work Site
      b. The storage and treatment capacities included herein shall be designed to account for a worst-case assumption that all stormwater that falls within the BMP area and the WTS containment area is contact water. The area inside the BMP is ~730,000 ft^2. The area inside the WTS is ~60,000 ft^2.
      c. Largest, historic 24-hour storm event during the construction period of November 1st to April 30th is 6.2 inches/day
      d. The maximum expected 24-hr contact water generation during the remediation period from the BMP area is ~415,000 ft^3 or ~2.8 million gallons
      e. The maximum expected 24-hr contact water generation during the remediation period from the WTS containment area is ~31,000 ft^3 or ~232,000 gallons
   3. Mounded Water
      a. Contact water generated from mounded water will primarily be generated at the start of the season as the mounded drains into the excavation
      b. The highest predicted daily flowrate of mounded water into the excavation is ~90,000 GPD
   4. Additional water that may be generated from sources like truck washing, excavated materials storage, dewatering areas are included in the stormwater volumes above.

E. The WTS shall be fed contact water by treatment feed pump which shall be connected to Influent Tanks. The design flow rate from the Influent Tanks to the WTS shall be at least 300 GPM.

F. Summary of estimated contact water sources is provided in Table 1.

Table 1: Summary of Contact Water Influent Sources

Influent Sources	Maximum 24-Hour Contact Water Generation	Notes
BMP Area	2.8 million GPD	Assumes all rain that falls within the BMP could be contact water. Area = 730,000 ft^2. Maximum 24-hour rain event (1930 to 2019) = 6.2 inches
Rain Collection - WTS Containment Area	232,000 GPD	24-hr rain event, 60,000 ft^2. Maximum 24-hour rain event (1930 to 2019) = 6.2 inches
Mounded Water (gpd)	90,000 GPD	See assumption above

Influent Sources	Maximum 24-Hour Contact Water Generation	Notes
Rain Collection in Dewatering Areas (gpd)		Assumed to be accounted for in the BMP Area contact water
Truck Wash		Assumed to be accounted for in the BMP Area contact water

G. Take all necessary steps to protect WTS equipment and conveyance equipment (e.g., pumps, pipes, hoses) from extreme weather condition, including, but not limited to, storms, sunlight, extreme temperature.

H. WTS shall be designed to treat contact water that will vary in quality/quantity. The overall treatment strategy shall conform to the details of this Section. Collected contact water is expected to contain elevated levels of suspended solids (sediment), dioxins and furans, and heavy metals, based on historical analytical data obtained during a recently executed treatability study. Applicable discharge criteria are provided in Table 3.
   1. WTS is not intended for management of domestic sanitary wastewater that will be generated on the Work Site. This liquid waste stream is to be managed by other means.

I. Should WTS process adjustment/optimization of the proposed treatment equipment fail to meet the discharge criteria listed in Table 1, make modifications to treatment systems as necessary based on actual conditions observed during execution of Works. Modifications may include, but not be limited to bulk solids removal equipment (i.e., clarifier) changing treatment chemicals, reducing flow rate, and/or installation of additional treatment equipment. Any modifications to the WTS equipment configuration will be reviewed/approved by OWNER/ENGINEER prior to implementation.

J. Sequence the Works, including temporary storage in active areas, to provide adequate water treatment to meet the project schedule.

1.4 SEQUENCING

A. CONTRACTOR shall be solely responsible for managing and coordinating related work that affects the quality and quantity of the contact water that is routed to the WTS for treatment and discharge.

B. Coordinate contact water treatment and discharge rates to maintain WTS capacity.

C. Minimize TSS transferred from the excavation to the WTS.

D. Sequence and coordinate work so that the WTS is operational prior to beginning operations that will generate contact water.

E. Continuously maintain the WTS and continue all contact water treatment efforts until all of the following conditions have been met:

1. All of the on-site operations that could potentially generate contact water have been completed.
2. All of the impacted materials have been transported off-site.

F. WTS shall be installed, tested, and inspected by ENGINEER prior to commencing work which may generate contact water.

G. Works included:
1. Supply of specified treatment system equipment to meet the specified system requirements.
2. Delivery of equipment to Work Site and field installation.
3. Provision/construction of necessary foundations for WTS equipment.
4. Calibration, certification, and commissioning of the supplied equipment.
5. Provision of complete O&M manual for ENGINEER and OWNER reference.
6. Perform pressure testing and provide pressure testing reports to ENGINEER.
7. Supply, testing, and calibration of all process instrumentation associated with treatment equipment within the WTS.
8. Provide load list and all electrical requirements for the treatment equipment.
9. Provide electrical panel and process logic controller (PLC) and human-machine interface (HMI) for automated operation of the WTS.
10. Provision of all required spare parts so as to minimize system downtime during maintenance.
11. Provide access hatches for system enclosures to allow for expendable media replacement and equipment clean-out/maintenance.
12. Provide treatment equipment enclosures shall include ventilation systems to prevent internal temperatures in excess of 40 deg. C. Provisions shall be made to maintain a minimum temperature within the containerized system of 10ºC or as specified by equipment manufacturer.

1.5 SUBMITTALS

A. Contact Water Treatment Plan: Submit a Contact Water Treatment Plan, including process and instrumentation diagrams (P&IDs), equipment selected (cutsheets), storage and pumping capacities, draft process control narrative, electrical load list and power distribution plan, effluent monitoring program, general arrangement of equipment within containers/enclosures and overall intended layout of containers and operating plan compatible with and demonstrating compliance with specified requirements. Design of WTS shall be approved by ENGINEER prior to construction. The WTS will include example operations log sheets identifying operational data that will be routinely collected by the WTS operators and/or WTS PLC.

B. Example operations data collection is provided in Table 2.

Table 2: Example of Operation Data Collection

Operating Parameter	Value
Minimum Daily Flow	

Maximum Daily Flow	
Average Daily Flow	
Total Daily Flow	
Rapid Mix Tank pH Set Point	
Daily Coagulant Consumption	
Coagulant Dose Set Point	
Daily Polymer Consumption	
Polymer Dose Set Point	
Filters/GAC Pressure	
Effluent pH	
Backwash Event (vessel, flow, duration)	

C. Residuals, Solids, and Sediment Waste Management Plan: As part of the Contact Water Treatment Plan, submit a Residuals, Solids, and Sediment Waste Management Plan, including details for management of solids, soils, and sludge resulting from treatment activities as well as the management of expendables such as multimedia filter, GAC media, tank liners, etc.. Such plans will detail testing of residuals to identify required disposal requirements per applicable local, state and federal laws and regulations.

D. Shop Drawings
   1. CONTRACTOR shall submit drawing, datasheets, and other information outlined below for the equipment selected for the WTS to OWNER/ENGINEER for review
   2. Equipment Data to include:
      a. Performance criteria, compliance with appropriate reference standard, characteristics, limitations, and trouble-shooting protocol.
      b. Product transportation, storage, handling, and installation requirements.
      c. Inlet pressure requirements, inlet/outlet diameters, included controls, included options, brochure cuts indicating dimensions and weights, surface loading rates, number of installations in North America, and location from where system services and technical support would be provided.
      d. A list of all supplied equipment including the length of supplied piping/hose as part of the hookup requirements.
      e. A system schematic and process control narrative.
      f. Overall dimensions of equipment.
   3. Drawings:
      a. Work Site plan including containment area.
      b. General arrangement and dimensions of accessories.

c. Process and Instrumentation Drawings (P&IDs).Process Control Narrative detailing the automatic water treatment operations associated with the WTS including proposed set points and alarms.
d. Work Site Acceptance Test (SAT) Plan: CONTRACTOR shall provide and implement a Work Site acceptance test to demonstrate satisfactory automatic operation of the WTS. SAT will be executed as part of overall commissioning of the WTS.
e. Provide required drawings and calculations sealed by a professional engineer licensed in state of Texas for non-standardized components.
f. Electrical load list and details of electrical distribution/control for powered equipment.
g. Design Data: Indicate tanks sizes, pump sizes, and treatment rates.

E. Test Reports/Commissioning Reports:
1. Provide records of commissioning performance and final set points, indicate on the reviewed shop drawings all adjustments made during commissioning.
2. Submit commissioning procedure to ENGINEER for review a minimum 4 weeks prior to WTS commissioning. Commissioning report documentation (e.g., checklists) shall be provided for review. If intended commissioning documentation is deemed unsatisfactory by ENGINEER, ENGINEER-provided commissioning documentation will be utilized by CONTRACTOR.
3. Final effluent testing will be completed by an independent laboratory chosen by the OWNER/ENGINEER. OWNER/ENGINEER shall carry all costs for contact water sampling and analysis.
4. The system is to be fully commissioned using clean water (supplied by CONTRACTOR).
5. Following clean water commissioning, CONTRACTOR shall store an initial volume of treated contact water until analytical results are received that document compliance with ARARs.

F. Operation, Maintenance and Equipment Data:
1. Operation and maintenance data: Indicate and submit maintenance data for incorporation into Operation and Maintenance Manuals.
2. Identification: Manufacturing name, type, year, serial number, number of units, capacity, and identification of related systems.
3. Data necessary for maintenance of equipment.
4. Manufacturer's recommended list of spare parts and associated costs.

1.6 CLOSEOUT SUBMITALS

A. Facility Operation Report: Include all operational data from each operating day including flow rates, volumes, test results and effect on process, actual quantities of chemicals added, process modifications, etc. See Table 2

1.7 QUALIFICATIONS

A. Design WTS under direct supervision of professional engineer experienced in design of work of this Section and licensed in the State of Texas.

B. Manufacturer/Supplier of WTS equipment: Company specializing in supply and operations of containerized/skid mounted contact water treatment equipment for substantially similar applications, with minimum 5 years documented product development, testing, and operations experience. Project references over the past five years shall be provided outlining application, treatment flow, and treatment technologies. Reference Project contact information may be required upon request of ENGINEER.

1.8 QUALITY ASSURANCE

A. Perform work of this Section in accordance with approved Contact Water Treatment Plan and ARARs.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Contactor shall store equipment, supplies and consumables (e.g., treatment chemicals, filtration media, GAC, etc.) under suitable covers or structures to protect from environment (e.g., heat, moisture, wind, etc.). in a manner consistent with manufacturer recommendations

B. Contactor shall maintain adequate supplies to maintain operations including all expendable materials and treatment chemicals. Store products in an appropriate manner with all health and safety/environmental requirements satisfied.

C. Contactor shall maintain and service equipment to ensure they are in working order.

PART 2 PRODUCTS

2.1 DESIGN CRITERIA

A. Design WTS to operate for the duration of the Works. The minimum design flow rate and the maximum allowed treated effluent discharge shall be within the limits of ARARs which are presented in Table 3.

B. The WTS shall be designed based on the influent parameters outlined in Table 3. Influent water quality is based pilot testing conducted during the Northern Impoundment RD. 20,000 gallons of representative contact water were generated from the Northern Impoundment. In order to produce this volume, waste material was excavated from a 20-ft by 20-ft by 10-ft cell. The excavated material was stored in roll-off containers. Approximately 20,000 gallons of potable water was then transferred into the excavation and mixed with the excavated material using an excavator bucket to generate a worst-case suspended solids mixture that may be encountered in stormwater during the Works. This simulated contact water was then pumped to two storage tanks and the contents of the two tanks were homogenized and subsequently sampled.

C. CONTRACTOR is fully responsible for the provision of temporary power to the WTS. CONTRACTOR shall obtain all necessary permits and coordinate with local utility/authorities as required. CONTRACTOR shall obtain all necessary permits associated with the provision of temporary power to the WTS.

D. CONTRACTOR is responsible to make any necessary modifications to the WTS due to changing influent concentrations to continually optimize treatment to achieve target criteria. Any required changes shall be made in a timely manner so as to not hinder Works. Changes to the WTS shall be reviewed and approved by the ENGINEER prior to implementation.

E. Table 3 provides expected concentration of constituents of concern and their estimated discharge. limits.

F. Water Treatment System shall include equalization, coagulation/flocculation, clarification, filtration, and GAC adsorption. Filtration step shall involve media filtration, 10-micron cartridge or bag filter. 1-micron cartridge or bag filter. Precipitation of metals may be added if needed. Design criteria for major equipment are summarized in Table 4 below.

Table 3: Concentrations of Constituents of Concern and Estimated Discharge Criteria

Component	Units	Discharge criteria[1,2]	North Impoundment Pilot Contact Water	
			Tank #1	Tank #2
Dioxins/Furans				
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	pg/L	100	590	370 J
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	pg/L	100	15000 J+	8800 J
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	pg/L	50	880 J-	600 J
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	pg/L	50	840	540 J
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	pg/L	50	320	240 J

Component	Units	Discharge criteria[1,2]	North Impoundment Pilot Contact Water	
			Tank #1	Tank #2
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	pg/L	50	3100	2500 J-
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/L	50	11 U	4.9 U
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/L	50	790	650 J-
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/L	50	30 J	20 J-
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	pg/L	50	53	40 J-
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/L	50	18 J-	8.5 J-
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	pg/L	50	2100	1900
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	pg/L	50	160	130
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/L	50	93	73 J-
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	pg/L	50	1200	1100
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	pg/L	10	50000	46000

Component	Units	Discharge criteria[1,2]	North Impoundment Pilot Contact Water	
			Tank #1	Tank #2
2,3,7,8-Tetrachlorodibenzo- p dioxin (TCDD)	pg/L	10	18000	15000
Total heptachlorodibenzofura (HpCDF)	pg/L	50	1600 J	1100 J
Total heptachlorodibenzo-p- dioxin (HpCDD)	pg/L	50	2000 J	1300 J
Total hexachlorodibenzofuran (HxCDF)	pg/L	50	4600 J	3800 J
Total hexachlorodibenzo-p- dioxin (HxCDD)	pg/L	50	260 J	180 J
Total pentachlorodibenzofura (PeCDF)	pg/L	50	5000 J	4600 J
Total pentachlorodibenzo-p- dioxin (PeCDD)	pg/L	50	190 J	160 J
Total tetrachlorodibenzofuran (TCDF)	pg/L	10	100000 J	100000 J
Total tetrachlorodibenzo-p- dioxin (TCDD)	pg/L	10	20000 J	16000 J
Dioxins/Furans (dissolved)				
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF) (dissolved)	pg/L	100	170	11 U
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD) (dissolved)	pg/L	100	5400 J+	280 J+

Component	Units	Discharge criteria[1,2]	North Impoundment Pilot Contact Water	
			Tank #1	Tank #2
1,2,3,4,6,7,8- Heptachlorodibenzofuran (HpCDF) (dissolved)	pg/L	50	240	12 J
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD) (dissolved)	pg/L	50	250	27 J
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF) (dissolved)	pg/L	50	88	4.9 U
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF) (dissolved)	pg/L	50	750	31 J
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD) (dissolved)	pg/L	50	4.6 U	3.1 U
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF) (dissolved)	pg/L	50	190	9.8 J
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD) (dissolved)	pg/L	50	6.7 J	2.1 J
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF) (dissolved)	pg/L	50	14 J	4.8 U
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD) (dissolved)	pg/L	50	5.7 J	1.7 U
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF) (dissolved)	pg/L	50	450	20 J
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD) (dissolved)	pg/L	50	40 J	3.0 J

Component	Units	Discharge criteria[1,2]	North Impoundment Pilot Contact Water	
			Tank #1	Tank #2
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF) (dissolved)	pg/L	50	23 J	2.8 U
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF) (dissolved)	pg/L	50	250	11 J
2,3,7,8-Tetrachlorodibenzofuran (TCDF) (dissolved)	pg/L	10	11000	540 J
2,3,7,8-Tetrachlorodibenzo- p dioxin (TCDD) (dissolved)	pg/L	10	3800	150 J
Total heptachlorodibenzofura (HpCDF) (dissolved)	pg/L	50	430 J	20 J
Total heptachlorodibenzo-p- dioxin (HpCDD) (dissolved)	pg/L	50	630 J	51 J
Total hexachlorodibenzofuran (HxCDF) (dissolved)	pg/L	50	1100 J	48 J
Total hexachlorodibenzo-p- dioxin (HxCDD) (dissolved)	pg/L	50	74 J	6.9 J
Total pentachlorodibenzofura (PeCDF) (dissolved)	pg/L	50	1100 J	44 J
Total pentachlorodibenzo-p- dioxin (PeCDD) (dissolved)	pg/L	50	51 J	3.0 J
Total tetrachlorodibenzofuran (TCDF) (dissolved)	pg/L	10	21000 J	920 J

Component	Units	Discharge criteria[1,2]	North Impoundment Pilot Contact Water	
			Tank #1	Tank #2
Total tetrachlorodibenzo-p- dioxin (TCDD) (dissolved)	pg/L	10	4000 J	170 J
Metals				
Antimony	mg/L	25.623	0.0039 U	0.0039 U
Arsenic	mg/L	0.164	0.026	0.023
Barium	mg/L	N/A	1.1	0.96
Cadmium	mg/L	0.0439	0.0028 J	0.0025 J
Chromium	mg/L	0.389	0.12	0.11
Copper	mg/L	0.0167	0.11	0.093
Lead	mg/L	0.107	0.12	0.098
Mercury	mg/L	0.000598	--	--
Mercury	ng/L	598	28 J	6.3 J
Mercury	ug/L		--	--
Nickel	mg/L	0.103	0.095	0.081
Selenium	mg/L	0.619	0.0029 U	0.0029 U
Silver	mg/L	0.00493	0.0013 U	0.0013 U
Thallium	mg/L	0.5	0.0042 U	0.0042 U
Zinc	mg/L	0.165	0.40	0.36
Metals (dissolved)				
Antimony (dissolved)	mg/L	25.623	0.0039 U	0.0039 U
Arsenic (dissolved)	mg/L	0.164	0.014	0.0041 J
Barium (dissolved)	mg/L	N/A	0.55	0.30

Component	Units	Discharge criteria[1,2]	North Impoundment Pilot Contact Water	
			Tank #1	Tank #2
Cadmium (dissolved)	mg/L	0.0439	0.0013 J	0.00040 J
Chromium (dissolved)	mg/L	0.389	0.048	0.0039 J
Copper (dissolved)	mg/L	0.0167	0.036	0.0081 U
Lead (dissolved)	mg/L	0.107	0.037	0.0022 U
Mercury (dissolved)	mg/L	0.000598	--	--
Mercury (dissolved)	ng/L	598	--	22 J
Mercury (dissolved)	ug/L	0.598	--	--
Nickel (dissolved)	mg/L	0.103	0.033	0.0030 J
Selenium (dissolved)	mg/L	0.619	0.0029 U	0.0029 U
Silver (dissolved)	mg/L	0.00493	0.0013 U	0.0013 U
Thallium (dissolved)	mg/L	0.5	0.0042 U	0.0042 U
Zinc (dissolved)	mg/L	0.165	0.15	0.026 J
pH	SU	6-9		
TSS	mg/L	30	3500	4600

Component	Units	Discharge criteria[1,2]	North Impoundment Pilot Contact Water	
			Tank #1	Tank #2

Notes:

-- Data not available

[1]Per an EPA email dated February 18, 2020, compliance with the Texas Surface Water Quality Standards will be determined using the minimum level of the EPA approved method (1613B), cited in 40 CFR Part 136, in sampling of dioxin concentrations for surface water discharges during the Remedial Action.

[2]Estimated discharge criteria were calculated for all parameters except dioxins and furans utilizing the TCEQ model, TEXTOX MENU # 5 for bays or wide tidal rivers.
pg/L - picograms per Liter
mg/L - milligrams per Liter
ug/L - micrograms per Liter
s.u. - standard unit
U - Not detected at the associated reporting limit.
J - Estimated concentration.
UJ - Not detected; associated reporting limit is estimated.

Table 4: Preliminary WTS Treatment Equipment List

Equipment/Process Description	Sizing/Selection Criteria Assumptions	Design Value	Notes
Remediation Cell Dewatering Pump	Dewater BMP area after largest expected rain event within 24 hours after rain event stops	Dewatering flowrate of up to 1000 GPM.	
Influent Tanks	Working volume to hold 3.4-inch, 24-hour rain event in BMP area, containment area, truck wash, excavated materials storage, and dewatering area	1.72 million-gallons (~860,000 gallons working volume/tank)	Lake Tank B-24 portable storage tank was used for design. Assumes 8 inches of freeboard and minimum water level of 24 inches to keep liner in place.
Containment Area Sump Pump(s)	CONTRACTOR shall select pump to dewater Containment Area after a rain event to allow work to resume. Preliminary flowrate provided on the Drawings.	TBD by CONTRACTOR. Preliminary flowrate provided on the Drawings.	Largest 24-hour rain event for the construction period (November to April) for the years 1930-2019 was ~6.2."
Sludge Dewater Sump	CONTRACTOR shall select pump to ensure the contact water draining from the Sludge Dewatering Boxes and any rain water is discharged to the Influent Tank with backing up in the sump. Preliminary flowrate provided on the Drawings.	TBD by CONTRACTOR. Preliminary flowrate provided on the Drawings.	
Treatment Feed Pump	300 GPM base treatment flow	300 GPM to accommodate return streams	Pump will operate on VFD to adjust treatment rate, as required. Pump will shutdown on high level in Inclined Plate Clarifier.
Rapid Mix Tank	Minimum retention time: 7 minutes	Minimum working volume of 2,100-gallon capacity	Provide mixing at high enough velocity to full mix coagulant, organon sulfides, acid and/or caustic, and polymer. Overflow of tank shall be set above the operating level of the Inclined Plate Clarifier to allow for gravity flow.
Flocculation Tank	Minimum retention time: 7 minutes	Minimum working volume of 2,100-gallon capacity	Tank will include baffles to prevent vortexing, if needed. Tank will be mixed by top entry mixer(s) with paddle-type blades to prevent shearing solids. Mixer shall be variable speed. Overflow of tank shall be set above the operating level of the Inclined Plate Clarifier to allow for gravity flow.
Inclined Plate Clarifier	Maximum Hydraulic Loading rate: 0.25 GPM/ft^2	3,200 ft^2 of inclined plate separation area	Clarifier shall include integral sludge hopper to allow for sludge withdrawal. Overflow shall be set above the operating level of the Filter Feed Tank to allow for gravity flow.
Filter Feed Tank	Nominal retention time: 20 minutes	Minimum working volume of 6,000-gallon capacity	Overflow of tank shall be set above the operating level of the Inclined Plate Clarifier.
Filter Feed Pump	300 GPM base treatment flow	Up to 400 GPM	Pump will operate on VFD and controlled by level in Filter Feed Tank.
Multimedia Filters	5-15 GPM/ft^2 Hydraulic Loading	Minimum of 60 ft^2 of active media filter area	Minimum of three vessels, forward-feed automated backwash.
10-um Bag Filtration System (2 in parallel)	10-micron bag or cartridge filters with minimum 95% removal efficiency	25 GPM/cartridge elements with total system capacity of 400 GPM	Rosedale Filter Cartridge Model PL-POMF-R1-10-P2 or equal
1-um Bag Filtration System (2 in parallel)	1-micron bag or cartridge filters with minimum 95% removal efficiency	25 GPM/cartridge elements with total system capacity of 400 GPM	Rosedale Filter Cartridge Model PL-POMF-R1-1-P2 or equal
Granular Activated Carbon	10-minute Empty Bed Contact Time (min) per stage 5 GPM/ft^2 Hydraulic Loading	400 ft^3 Bed Volume; 60 ft^2 of active bed area	GAC vessels will be configured in a lead-lag configuration providing a total contact time up to 20 minutes (total).
Sludge Wasting/Recycle Pump	75 GPM (~25% of Influent Feed Pump)	50 GPM to 150 GPM	Sludge Wasting/Recycle pump will be positive displacement pump (e.g, air diaphragm). Flowrate will depend on solids accumulation rate and will be adjusted during start-up and operations.

Equipment/Process Description	Sizing/Selection Criteria Assumptions	Design Value	Notes
Sludge Dewater Boxes	Allow for dewatering of sludge from Inclined Plate Clarifier. Filter fabric over a false bottom to trap solids and allow contact water to drain into sump.	25-CY filter box	25-CY Filter Boxes are available.
Coagulant Feed Pumps	Flow paced at dosage of 50 ppm coagulant solution - treatability study used 100 ppm	Up to 2 GPH	Chemical metering pumps. (e.g., diaphragm, peristaltic).
Organ sulfide Feed Pumps (if needed)	Flow paced at dose of 50 ppm organ sulfide solution	Up to 2 GPH	Chemical metering pumps. (e.g., diaphragm, peristaltic).
Acid/Caustic Feed Pumps (if needed)	Flow paced based on measured pH of contact water in Rapid Mixing Tank	Up to 2 GPH	Chemical metering pumps. (e.g., diaphragm, peristaltic).
Polymer Feed Pumps	Flow paced at dose of 25 ppm (neat polymer)	Up to 15 GPH (dilute polymer solution)	Chemical metering pumps. (e.g., diaphragm, peristaltic), polymer activation/aging equipment will be provided, as needed.

Notes:
The 90% process flow diagram (drawing P-01) and piping and instrumentation diagrams (drawings P-02 through P-05) illustrate the major water treatment system equipment and components.

GPM - Gallons per minute
VFD - Variable frequency drive
ft^2 - Square feet
CY – Cubic yard
ppm - Parts per million
GPH - Gallons per hour

2.1 STORAGE TANKS

A. Operating Conditions:
   1. Fluid: Impacted contact water (sediment dewatering effluent, impacted precipitation, etc.).
   2. Size: See attached equipment list and drawings. Final selection approved by ENGINEER.

B. Type and Materials:
   1. Model: Lake Tank B-24
   2. Volume: ~1.03 Million Gallons.
   3. Quantity: 2
   4. Dimensions: 125 ft (dia). X 12 ft (H)

C. Performance Requirements:
   1. Storage of contact water to minimize construction downtime due to contact water in the excavation area.

D. Fabrication:
   1. All materials shall be suitable for continuous contact with contact water.

E. Make and Model:
   1. Lake Tank B-24.

F. Other Requirements
   1. None

2.2 RAPID MIX TANK

A. Operating Conditions:
   1. Fluid: Chemical dosed impacted water (sediment dewatering effluent, impacted precipitation, etc.).
   2. Size: TBD by CONTRACTOR. It should be sized to adequately provide HRT and mixing regime for coagulation and floc formation.

B. Type and Materials:
   1. Frame: TBD by CONTRACTOR.
   2. Piping and Flanges: TBD by CONTRACTOR.
   3. Chemical Injectors: TBD by CONTRACTOR.

C. Performance Requirements:
   1. Flow Capacity: Design Flow.
   2. Mixing Requirement: The motor rpm and size of mixing paddles shall be sized/selected by equipment supplier to completely mix treatment chemicals with influent contact water utilizing static mixing elements. The speed of the slow mix tank shall be adjustable by mechanical (gear reducer) or electrical (variable frequency drive) means.

D. Fabrication:
   1. All materials shall be suitable for continuous contact with contact water.

E. Make and Model: TBD by supplier.

F. Other Requirement: The rapid mix tank shall be configured to allow for gravity flow into the flocculation tank and subsequently the clarifier.

2.3 FLOCCULATION TANK

A. Operating Conditions:
   1. Fluid: Rapid mixing tank (above) effluent.
   2. Size: TBD by CONTRACTOR. It should be sized to adequately provide HRT and mixing regime for coagulation and floc formation.

B. Type and Materials:
   1. Piping and Flanges: TBD by CONTRACTOR.

C. Performance Requirements:
   1. Flow Capacity: Design Flow.
   2. Mixing Requirement: The electromotor rpm and size of mixing paddles shall be sized/selected by equipment supplier to completely mix treatment chemicals and promote floc growth. The speed of the slow mix tank shall be adjustable by mechanical (gear reducer) or electrical (variable frequency drive) means.

D. Fabrication:
   1. All materials shall be suitable for continuous contact with contact water.

E. Make and Model:
   1. TBD by supplier.

2.4 INCLINED PLATE CLARIFIER

A. Operating Conditions:
   1. Fluid: Flocculation tank effluent

B. Unit Type: Inclined plate clarifier. The unit shall consist of the lamella tank with sludge hopper. Alternative bulk solids removal may be provided by CONTRACTOR with ENGINEER approval.

C. Performance Requirements:
   1. Hydraulic Capacity: Design flow (operation flow plus recirculation sludge flow as identified in PFD (P-01)).
   2. The clarifier shall allow for a hydraulic loading rate (surface overflow rate) of 0.25 -1.0 GPM/ft2 at the design flow. Settling plates shall be installed at a 45-60 deg. angle (above horizontal). Nominal plate spacing shall be 2 inches
   3. Additional Clarifier Specifications:
      a. The sludge hopper shall be outfitted with a minimum of 1 manual sludge blanket sample ports.
      b. Plates shall be a minimum of 2 mm thick.

c. The clarifier sludge hopper shall include an actuated sludge purge valve that will allow for manual or timer-based sludge wasting. Sludge will be discharged with the assistance of a sludge wasting pump provided by CONTRACTOR.
d. The clarifier shall be equipped with sludge recirculation/transfer pump.

4. The ability to access and clean the clarifier media must be available.

D. Fabrication:
1. All materials shall be suitable for continuous contact with contact water.

2.5 SLUDGE DEWATERING BOX

A. Operation condition:
1. Fluid: Clarifier underflow dosed with polymer (to accelerate flocculation).
2. Location: Outdoor.
3. Operational volume: See equipment list. Final selection approved by ENGINEER

B. Type and Materials:
1. Model: 25-yard Dewatering Box
2. Volume: 25 yd^3.
3. Quantity: 2
4. Dimensions: ~23 ft x ~8 ft x ~5 ft

C. Unit type
1. 25-yd^3 Filter Box

D. Performance Requirements:
1. Capable of dewatering clarifier solids by gravity to 6 to 8 percent solids.
2. Use of filter fabric to prevent significant amounts of solids from being discharged into the collection sump.

E. Fabrication:
1. All materials shall be suitable for continuous contact with contact water.

F. Make and Model:
1. Roll-off 25 Yard Filter Box

2.6 FILTER FEED TANK (OR CLARIFIER EFFLUENT STORAGE TANK)

A. Operating Conditions:
1. Fluid: Clarifier Effluent.
2. Location: Between clarifier and multimedia filter.
3. Collection of clarified contact water from clarifier and feed tank for pumps feeding the multimedia filters, bag filters, and GAC.
4. Operational volume: TBD by CONTRACTOR.

B. Performance and Connection Requirements:
1. Model: TBD by supplier.
2. Material: TBD by CONTRACTOR.
3. Nozzles: Flanged.

a. Outlet/drain: Flanged (bottom).
b. Inlet: Flanged (bottom).
c. Level Transmitter: Flanged (bottom).
d. Sample Port: Flanged (side).

C. Performance Requirements:
1. Hydraulic Capacity: Adequate capacity to regulate flow between clarifier and filtration units.
2. Minimum Capacity 6000 gallons
3. Minimum Residence Time: 20 minutes

D. Fabrication:
1. All materials shall be suitable for continuous contact with contact water.

2.7 MULTIMEDIA FILTERS

A. Operating Conditions:
1. Fluid: Clarifier Effluent.
2. Operational Flow: Design Flow.

B. Unit Type: Mixed media (sand) pressure filtration units.

C. Performance Requirements:
1. Hydraulic Capacity: Design flow.
2. Solid Separation: Nominal particulate removal range of 10 microns.
3. Quantity: TBD by CONTRACTOR.
4. The multimedia filters should be sized/selected to allow for a maximum filtration rate of 10 GPM/ft^2 with one vessel out of service.
5. Forward Feed Backwash

2.8 CARTRIDGE/BAG FILTERS (10 um)

A. Operation condition:
1. Fluid: Multimedia Filter Effluent.
2. Operational Flow: Design flow.

B. Unit type:
1. Manually operated duplex filter (n+1)
2. 10-micron bag or cartridge filters with minimum 95% removal efficiency (Rosedale Filter Cartridge Model PL-POMF-R1-10-P2 or equal)
3. 25 GPM/cartridge elements with total system capacity of 400 GPM

C. Performance requirement
1. Solid Separation: Particulate removal range of 10 micron and larger.
2. Quantity: TBD by CONTRACTOR.
3. Parallel filters shall be provided, to allow for replacement and maintenance without affecting the operation of the treatment system.

2.9 CARTRIDGE/BAG FILTERS (1 um)

A. Operation condition:
   1. Fluid: Multimedia filter effluent.
   2. Operational flow: Design flow.

B. Unit type:
   1. Manually operated duplex filter (n+1)
   2. 1-micron bag or cartridge filters with minimum 95% removal efficiency (Rosedale Filter Cartridge Model PL-POMF-R1-1-P2 or equal)
   3. 25 GPM/cartridge elements with total system capacity of 400 GPM

C. Performance requirements:
   1. Solid Separation: Particulate removal range of 1 micron and larger.
   2. Quantity: TBD by CONTRACTOR.
   3. Parallel filters shall be provided, to allow for replacement and maintenance without affecting the operation of the treatment system.

2.10 GAC VESSELS

A. Operating Conditions:
   1. Fluid: 1-micron filter effluent.
   2. Operational flow: Design flow.

B. Unit Type: Pressurized granular activated carbon contactor for additional removal of chemicals of concern.

C. Performance Requirements:
   1. Quantity: TBD by CONTRACTOR (Lead and lag configuration).
   2. The GAC contactors should be sized/selected to allow for a maximum hydraulic loading rate of 2- 5 GPM/FT2). Each granular activated carbon contactor should provide a minimum effective media contact time of 10 minutes.

2.11 DISCHARGE DIFFUSERS

A. Operating Conditions:
   1. Fluid: GAC Vessel Effluent.
   2. Operational Flow: Design Flow.

B. Unit Description:
   1. Diffuser to disperse treated effluent from the WTS into the river
   2. Perforated Pipe: Dual Wall HDPE Perforated Pipe
   3. Pipe Perforation Pattern: AASHTO Class II perforations with a minimum inlet area of 1.5 in^2/ft
   4. Geotextile: 3 oz. Light weight non-woven geotextile
   5. Pipe elevation to be minimum of 6” above average water surface elevation of river
   6. Assumed length of pipe leading to energy dissipator – 20 ft
   7. Final design approved by ENGINEER

C. Operating Conditions:
   1. Design flow – up to 400 GPM

2.12 CHEMICAL DOSING EQUIPMENT

A. Unit Description:
   1. Chemical metering pumps dose treatment chemicals from the chemical storage area to the WTS as it shown in drawing P-01 (PFD).
   2. The metering pumps are controlled by the plant PLC in auto mode or locally in manual mode. Metering pumps shall modulate dosing flow to an adjustable dose setpoints (flow- paced model). The list of chemical dosing pumps presented below.

Pump #	Capacity	Liquid pumped	Note
P-3006, P-3007	0.2 – 2.5 GPM	Polymer solution	0.5-1.0%(w/w)
P-3010, P-3011	0.02 – 2.5 GPM	Coagulant solution	
P-3008, P-3009	0.015 – 2.5 GPM	Acid/Caustic	
P-3004, P-3005	0.03 – 2.5 GPM	Organosulphide	
P-3014, P-3015	0.2 – 2.5 GPM	Polymer solution	0.5-1.0%(w/w)

B. Design Requirements:
   1. Type: Chemical metering pumps, sized by supplier, materials of construction to be suitable for fluid mentioned above. Metering pump/accessories for each chemical system to be mounted on independent chemical pump panel.
   2. Provide polymer mixing, activation/maturation tank, and dilution equipment as required. Polymer shall be received as liquid emulsion (or powder) to be activated and diluted as a solution of 0.5-1.0 weight percent or less.

C. Make and Model: TBD by supplier.

D. Performance Requirements:
   1. See design drawings
   2. See Table 4.

E. Other Requirements:
   1. Backpressure valve, internal pressure relief valve, isolation valves, calibration column, pulsation dampener, drain/flushing port to be included on pre-plumbed skid. Pump to come with all accessories mounted on a board with a single inlet/outlet connection.
   2. See Table 4

2.13 WTS PROCESS PUMPS

A. Operating Conditions:
   1. Fluid: Impacted contact water (see Article 1.3).

2. Size: See attached equipment list and drawings. Final selection approved by ENGINEER.

B. Type and Materials:
1. Model: various
2. Flowrate: 400 GPM
3. Quantity: See design drawings. Final selection approved by ENGINEER.
4. See Table 4
5. Material: Suitable for operating conditions

C. Performance Requirements:
1. See design drawings
2. See Table 4.

D. Fabrication:
1. All materials shall be suitable for continuous contact with contact water.

E. Make and Model:
1. TBD by CONTRACTOR and submitted for approval by ENGINEER.

F. Other Requirement:
1. The process pumps are controlled by the WTS PLC in auto mode or locally in manual mode.
2. Final pump sizing/selection is the responsibility of CONTRACTOR based on identified service flows below. Operating pressure for pumps will be confirmed by CONTRACTOR based on the physical configuration of the WTS.
3. All temporary discharge /piping from the WTS to discharge point is the responsibility of CONTRACTOR. This includes piping associated with the discharge of treated water.
4. Provide upstream/downstream isolation, discharge check valves, and pressure gauges for all process pumps.

2.14 TREATMENT EQUIPMENT ENCLOSURES

A. All proposed WTS equipment shall be installed in one or more containers or other approved weather enclosure with the exception of equipment suitable for operation outdoors. Larger exterior tanks may not fit within ISO containers and can be installed in other approved temporary enclosure or be protected from weather harsh conditions.

B. General arrangement of equipment within containers shall be provided by supplier as well as arrangement of shipping containers on Work Site plan.

C. The enclosures shall include at a minimum:
1. Plywood floor.
2. Barn style rear double doors.
3. Ventilation fan/heater(s) with thermostat and hood. Ventilation system shall be sized to prevent enclosure temperature from exceeding 40 degrees C. Heating systems shall be provided to ensure temperature within temporary enclosures does not fall below 10 degrees C or based on equipment manufacturer's requirements

4. Access hatches as required for removal of spent treatment media from the media filters, vessels, and GAC Contactors.
5. Structural review of modified ISO container shall be completed and sealed by a professional engineer licensed in the state of Texas.
6. CONTRACTOR shall provide appropriate foundations for treatment equipment enclosures to prevent shifting or settling.

2.15 CONTROL NARRATIVE

A. See Attachment A at the end of this Section

2.16 ELECTRICAL CONTROL PANEL AND PLC SYSTEM

A. Operating Conditions: Outdoor (NEMA 4)

B. Control Panel:
   1. Enclosure: A PLC (Programmable Logic Controller) Panel must be provided based on treatment equipment supplier PLC IO list, which calls out specific PLC hardware.
   2. The electrical instrument design, specification portion of this Project shall conform to the latest editions of the NEMA, ANSI, IEEE, UL, the National Electrical Code, the Occupational Safety and Health Act, and any regulations or codes of any governmental jurisdictions, that may be more exacting than these references and related codes and standards as designated herein.
   3. All specifications, standards, codes, etc. referenced are to be the latest edition, and together with all addenda, revisions, and supplements shall be considered part of this Project.
   4. Hardware:
      a. Other Requirements: All automatic equipment and process set points shall be controlled through an HMI touch screen. All alarms generated by the process shall activate a written description of the alarm on the HMI touch screen.

C. Programming: The software for the controls system shall be developed using the latest software development tools. The design of the automation system is based upon the criteria listed below:
   1. All systems are operated at all times to meet required quality metric, and process data storage requirements along with client requirements, standards and objectives.
   2. All systems are designed for automatic, unattended operation. The status of operating equipment is continuously monitored to detect operational excursions, equipment failures, and automatic shutdowns.
   3. Manual control is provided for maintenance, startup and emergency shutdown where appropriate.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install Water Treatment Facility in location approved by ENGINEER.

B. Installation: According to manufacturer's instructions and in accordance with state of Texas standards.

C. Maintain working area free of standing water.

D. Provide all necessary temporary piping/hose/etc. for interconnection of WTS tanks and treatment equipment.

3.2 FIELD QUALITY CONTROL

A. Functional Test: Prior to facility startup, all equipment shall be inspected and verified for installation of equipment by others is satisfactory.

B. Testing Equipment: Furnish all instruments and labor as required for this procedure.

C. Provide online monitoring of turbidity at the clarifier overflow, filter effluent, and service tank effluent.

D. Provide online monitoring of flow prior to rapid mix tank and after service water storage tank.

E. Provide online monitoring of pH in rapid mix tank and after service water storage tank.

F. Provide TSS analysis results per operation cycle or as requested by ENGINEER.

G. Monitor lead GAC column for dioxins to ensure compliance with ARARs at effluent.

3.3 COMMISSIONING AND PERFORMANCE VERIFICATION

A. Commissioning:
   1. Verify that equipment and systems are installed according to manufacturer's instructions, industry accepted minimum standards, and the Contract Documents.
   2. Verify that equipment and systems receive adequate operational checkout by CONTRACTOR.
   3. Verify and document proper performance of equipment and systems.
   4. Verify that complete operation and maintenance documentation is delivered to OWNER.
   5. Verify that operating personnel are adequately trained.
   6. Commissioning does not relieve CONTRACTOR of responsibility to provide a finished and fully functioning Project.
   7. Work Site Acceptance Testing:
      a. Supplier shall test the system as a whole to bring the system online to treat the influent to the required effluent criteria.
      b. Chemicals and consumables required for the start up and performance verification shall be provided by CONTRACTOR. CONTRACTOR shall provide additional consumables as needed throughout project duration.
      c. In general, equipment start up and performance verification shall include:
         i Bring temporary systems into operating condition.

ii Ensure operation of equipment, devices, instrumentation and alarms required for the proper operation of the temporary systems.
iii Operate WTS, perform multiple start and stop sequences and adjust settings as required. The number of operational treatment trains shall be dependent on the impacted water generation rates. During low flow periods, the WTS may need to operate in a batch mode.
iv Simulate failures for WTS and shut down sequence. Adjust as required.
v Operation of the associated equipment.

8. Performance Verification:
   a. Performance verification shall happen after all equipment has completed start up testing and has been signed off by equipment supplier.
   b. Operate the system as a whole, bringing each system online as required by plant operation to treat water.
   c. Fine tune dosing points of chemical coagulant and flocculent at clarifier to meet the performance requirements of the system. Record all adjustments made and record final set points.
   d. If a system must be removed from service in order to perform a cleaning cycle or other regular maintenance, the cleaning or maintenance activities shall be considered part of the WTS provided that the activities are not required to address failure of mechanical components or failure to meet operational standards.
   e. Malfunctions shall be defined as an event of 1) mechanical failure of a system or component, or 2) failure to meet the operational standards required for the system. In the event of a malfunction, the system shall be required to be re tested to ensure system performance is met.

3.4 DEMONSTRATION

A. Supplier shall supervise CONTRACTOR's operating personnel during the startup period. Startup operations shall be continuous until it is satisfactorily demonstrated that the equipment is suitable for continuous services.

3.5 OPERATION

A. Do not operate the WTS until ENGINEER has inspected facility and authorization for discharge has been received from ENGINEER.

B. Operate the WTS and do work necessary to treat collected contact water. Operation shall include treatment of feed tank contact water and discharge of treated water for duration of the Works.

C. Operate and maintain treatment units as required to meet ARARs. Provide for removal of solids as necessary.

D. Provide for removal and disposal of solids as approved by ENGINEER.

E. Provide for removal and disposal of media in approved CONTRACTOR-supplied containers to an approved off-site disposal facility.

F. Provide for removal and disposal of media in approved CONTRACTOR-supplied containers to an approved off-site disposal facility.

G. Provide daily flow rate and turbidity data to ENGINEER on a daily basis in a Log Sheet format acceptable to ENGINEER.

H. Operate treatment system in compliance with OWNER's permit.

I. Provide daily flow rate data to the OWNER on a daily basis in a Log Sheet format acceptable to the OWNER. Daily log sheets shall also detail volume/mass of consumables utilized as well as any major upkeep/maintenance activities (e.g., GAC media replacement).

J. Start up and Shutdown Procedures – WTS:
   1. The WTS may need to operate intermittently and in a batch fashion. CONTRACTOR shall provide one full time operator (minimum) to execute WTS operations. Before starting the WTS, the operators should prepare the chemical solutions. These solutions must be maintained over the course of the operating period.
   2. The operators should make sure all monitoring and instrumentation devices are online and operational per manufacturer recommendations. All instrumentation should be cleaned and calibrated per manufacturer recommendations.

K. System Monitoring and Automatic Shutdown for Equipment – WTS (Refer to design drawings for instrumentation location)
   1. Control of the WTS shall be achieved by a programmable logic controller (PLC) and operator intervention.
   2. The Transfer Pumps shall shutdown on high-level in Influent Tank Treatment Feed Pump flowrate shall be flow controlled using an operator adjusted setpoint and the flow meter located at the feed line of the WTS treatment trains
   3. Treatment Feed Pump shall shutdown if high-level is detected in Inclined Plate Clarifier or Filter Feed Tank
   4. Treatment Feed Pump shall shutdown if high turbidity (operator adjustable) is detected in effluent of Inclined Plate Clarifier
   5. Treatment Feed Pump shall shutdown if flowrate drops below operator setpoint TBD which indicates a potential break in the influent pipeline
   6. Chemical dosing systems shall be on a flow-paced mode to adjust the injection flow rate to achieve a desired dose
   7. If needed, pH adjustment chemicals shall be added based on the pH in Rapid Mix Tank
   8. Chemical dosing systems shall shutdown upon stopping of mixer in the Rapid Mix Tank or Flocculation Tank
   9. Chemical dosing systems shall shutdown if flowrate of the Influent Feed Pump drops below operator adjustable flowrate
   10. Filter Feed Pump shall shutdown on high turbidity as measured by filter effluent
   11. Filtration Feed Pump shall shutdown on high-level in Treated Effluent Holding Tank(s).
   12. Settled sludge collected from the underflow of the Clarifier unit shall be conveyed by a sludge pump to the Sludge Dewatering Boxes

13. Sludge shall be discharged from Clarifier based on adjustable timer controls (e.g., frequency and duration of sludge transfer events) or by the operator at their discretion when the height of sludge reaches a certain level in the clarifier.
14. Decanting Pump shall shutdown on high-level in Influent Tanks
15. The treated water shall be monitored for pH, turbidity, and flow before discharge to the outfall

3.6 MONITORING OF CONTACT WATER TREATMENT AND DISCHARGE

A. CONTRACTOR shall monitor contact water that is treated and discharged from the Water Treatment System. Monitoring shall include periodic field and laboratory testing of Water samples.

B. CONTRACTOR may conduct additional testing of the water in support of operational or discharge decisions.

C. CONTRACTOR shall conduct water testing in accordance with approved Contact Water Treatment Plan – to be submitted by CONTRACTOR.

3.7 DISCHARGE LIMITS

A. Comply with ARARs in Table 3.

3.8 FAILURE TO MEET CRITERIA

A. Should analyses indicate that effluent has not met treatment criteria as agreed upon in the Contact Water Treatment Plan, discharge shall cease immediately. Further action shall be performed in accordance with the Field Sampling Plan.

B. Provide sufficient water storage until treatment criteria can be met. Store contact water, carry out the treatment system checks, and repair the WTS.

3.9 DECOMMISSIONING

A. Decontamination of all WTS equipment shall be completed by CONTRACTOR prior to removal from the Work Site.

B. All impacted material such as exhausted activated carbon, media filters, bag filters, cartridge filters, tank liners, etc. need to be disposed of by CONTRACTOR.

C. At the completion of each season of the Works, CONTRACTOR shall be responsible for the removal all equipment and materials from Work Site unless otherwise directed by OWNER.

END OF SECTION

Attachment A
Process Control Narrative

1. P&ID P-02

1.1 Description

Several sources are pumped into the influent tanks TK-2000 and TK-2001 prior to subsequent treatment by the Water Treatment System (WTS):

1. Contact water from excavation activities
2. Contact water from excavation material stockpile area
3. Contact water from excavation dewatering areas
4. Contact water from equipment decontamination wash stations
5. Water collected in sumps from inside the water treatment system (WTS) containment area
6. Backwash from Multimedia Filters in the WTS
7. Contact water from dewatering of solids generated by the WTS

Sources will be pumped to one of the Influent Tanks based on the orientation of installed manual valves, ready to send to the WTS for treatment, after which point flow will be directly into the other Influent Tank. Contact water is pumped to the WTS by the Treatment Feed Pump P-2001, which is equipped with a Variable Frequency Drive (VFD).

1.2 Controls

TK-2000 has a continuous level transmitter LIT-2000 to provide feedback for level control. Level in TK-2000 is controlled as follows:

1. Low level turns OFF P-2001 at operator adjusted setpoint and per tank supplier specifications.
2. High-high level alarm informs the WTS Operator to stop discharges into TK-2000 and to start feeding flow into the WTS, if not already started.

TK-2001 has a continuous level transmitter LIT-2001 to provide feedback for level control. Level in TK-2001 is controlled as follows:

1. Low level turns OFF P-2001 at operator adjusted setpoint and per tank supplier specifications.
2. High-high level alarm informs the WTS Operator to stop discharges into TK-2001 and to start feeding flow into the WTS, if not already started.

1.3 Operations

P-2001 operates to maintain constant flow to WTS and to empty the operating Influent Tank (either of TK-2000 or TK-2001) as quickly as possible so that it is available to receive water sources for subsequent treatment by the WTS.

2. P&ID P-03

2.1 Description

Contact water from P-2001 is pumped into the Rapid Mix Tank TK-2100, which has a submersible mixer MX-2100 with VFD, operated at a high speed. Chemicals are fed into TK-2100 to facilitate chemical mixing:

1. Coagulant is fed by Coagulant Feed Pumps (1 duty/1 spare) P-3501 and P-3502.
2. Organosulfide (if needed) is fed by Organosulfide Feed Pumps (1 duty/1 spare) P-3101 and P-3102.
3. Acid (if needed) is fed by Acid Feed Pumps (1 duty/1 spare) P-3201 and P-3202.
4. Caustic (if needed) is fed by Caustic Feed Pumps (1 duty/1 spare) P-3211 and P-3212.

Contact water from TK-2100 flows by gravity to the Flocculation Tank TK-2200, which has a submersible mixer MX-2200 with a VFD. MX-2200 is operated a low speed to facilitate the formation of flocs. Polymer is added to TK-2100.

1. Polymer is fed by Polymer Feed Pumps (1 duty/1 spare) P-3301 and P-3302.

Contact water from TK-2200 flows by gravity to the Inclined Plate Clarifier (IPC) CLR-2300, where flocs settle to allow for liquid-solids separation. Solids from CLR-2300 are pumped via Sludge Transfer Pump P-2310 to be returned to TK-2100 or to Sludge Dewatering Boxes (TK-3600 and TK-3601) for dewatering, while clarified water flows by gravity to TK-2400 for further treatment by the WTS.

2.2 Controls

2.2.1 P-2001

P-2001 is controlled by on-off Flow Control Valve FCV-2002 and Flowmeter FE-2002. Flow from P-2001 is controlled as follows:

1. To send flow to the WTS, FCV-2002 to OPEN prior to turning ON P-2001. P-2001 VFD starts slowly and increases in speed until the flow measured by FE-2002 reaches an operator-adjustable setpoint (nominally 300 gpm).
2. To stop flow to the WTS, P-2001 VFD slowly decreases in speed until the flow measured by FE-2002 reaches 0 gpm and P-2001 turns OFF. FCV-2002 to CLOSE after turning OFF P-2001.
3. P-2001 VFD adjusts speed to maintain the operator-adjustable flow setpoint for the WTS.
4. P-2001 will shutdown is pump is running and 0 gpm is measured by FE-2002 for a period of time beyond WTS operator setpoint.

2.2.2 TK-2100

TK-2100 has a high-level switch LSH-2100 to provide feedback for level control. Level in TK-2100 is controlled as follows:

1. High level sends an alarm to WTS Operator
2. High level turns OFF P-2001.

TK-2100 has a pH probe and transmitter AIT-2100 to monitor and control pH inside the tank. If used, acid and/or caustic controls the pH in TK-2100 as follows:

1. pH below an operator-adjustable setpoint adds Caustic to TK-2100 via pumps P-3201 or P3202.
2. pH above an operator-adjustable setpoint adds Acid to TK-2100 via pumps P-3211 or P3212.

The other chemicals are fed (as needed) manually by the WTS Operator into TK-2100, by manually setting the pumping rates and turning ON pumps P-3401/3402, P-3301/3302, P-3501/3502, P-3101/3102, and/or P-3111/3112 based on jar testing.

2.2.3 CLR-2300 and TK-2400

The discharge chamber of CLR-2300 and the Filter Feed Tank (TK-2400) are hydraulically connected. CLR-2300 receives flocculated contact water from TK-2200. turbidity meter (AIT-2301) CLR-2300 has two high level switches. LSH-2300 in the main chamber of the CLR-2300, and LSH-2301 in the discharge chamber. LSH-2300 is a redundant high-level switch to LSH-2100. LSH-2301 serves as a high-level switch for TK-2400.

The discharge CLR-2300 also has a turbidity analyzer and transmitter (AIT-2301) that continuously measures turbidity in the clarified water from the IPC to check the efficiency of the clarifiers for removal of TSS. A high turbidity indicates that operational changes to the chemical dosage rates may need to be made.

1. The effluent of the CLR-2300 should have a TSS of less than 50 ppm to prevent excessive backwashing of the media filters.
2. During set-up, operator will calibrate the AIT-2301 to TSS.
3. High turbidity send alarm to operator indicating that chemical feed rates into TK-2100 and/or TK-2200, and/or P-2310 sludge flowrate (as measured by P-2310) need to be adjusted to improve clarified water quality.
4. High turbidity sends an alarm to WTS Operator based on operator-adjusted setpoint.

Level in CLR-2300 is controlled as follows:

1. High level as measured by LSH-2300 sends an alarm to WTS Operator
2. High level as measured by LSH-2300 turns OFF P-2001.

2.2.4 P-2301

P-2310 is operated manually by the WTS Operator based on the sludge blanket depth in CLR-2300. Flowmeter FIT-2314 continuously measures sludge flow from P-2310 to TK-2100 (for return) and FIT-2313 continuously measures flow of sludge to sludge dewatering boxes. Isolation valves are provided to the return and disposal sludge lines, and the WTS Operator opens the respective valve for return or disposal as required. Flow information from FIT-2313 and FIT-2314 is provided for WTS Operator information only, so that he can adjust P-2310 sludge flowrate as needed to adequately return/remove solids from CLR-2300 and measure volume of sludge recycled or discharged to sludge dewatering boxes.

2.3 Operations

P-2001 operates to maintain flow through the WTS at the operator-adjustable setpoint. LSH-2100, LSH-2300, and LSH-2301 prevent overflow of TK-2100, TK-2200, CLR-2300, and TK-2400 due to system malfunction such as pump failure, clogged pump, etc..

3. P&ID P-04

3.1 Description

Clarified water from CLR-2300 flows by gravity to the Filter Feed Tank TK-2400. Filtration Feed Pump P-2401, equipped with a VFD, sends water through the three (3) sets of filters, in order as follows:

Four (4) Multimedia Filters (n+1) FLT-2500A, 2500B, 2500C and 2500D,

Two (2) 10-micron Bag Filter Systems (1 duty/1 spare) FLT-2600A and 2600B,

Two (2) 1-micron Bag Filters Systems (1 duty/1 spare) FLT-2700A and 2700B, and

Two (2) Granular Activated Carbon (GAC) Adsorbers (lead/lag) GAC-2800 and 2800.

Flow from the GAC adsorbers is sent to Effluent Storage Tanks.

3.2 Controls

TK-2400 has a continuous level transmitter LIT-2400 to provide feedback for level control. TK-2400 has low--level switch LSL-2400 and high-level switch LSH-2301 to provide redundant control. Flow from P-2401 is controlled by level as follows:

1. LSL-2400 turns OFF P-2401
2. High-high level as measured by LIT-2400 or LSH-2301 sends alarm to WTS Operator and turns OFF P-2100 to reduce likelihood of overfilling TK-2400, and provides the following redundant control to LIT-2400
3. The VFD associated with P-2401 ramps up and down to maintain the operator adjustable setpoint for TK-2400 as measured by LIT-2400

P-2401 is controlled by on-off Flow Control Valve FCV-2401 and LIT-2400. LIT-2400 will have four (4) operating setpoints as described below

Low-Low Level Setpoint (L-01):

- Operator adjustable Level
- Pump stops and FCV-2401 will close
- Initially set at 1 ft of water about level at which LSL-01 activates

Low Level Setpoint (L-02):

- Operator adjustable level
- FCV-2401 will open and pump will start at minimum speed.
- Operator adjustable speed
- Assume 35 Hz at start-up
- Initially set at 2 ft of water

Operating Setpoint (L-03):

- Operator adjustable
- Pump speeds up and slows down to maintain constant level in sump
- Initially set at 4 ft of water
- When the when the contact water enter TK-2400 is less than the P-2401 discharge rate at the minimum speed, the water level in the sump will decrease until the level reach L-01 and the pump shuts off and FCV-2401 will close

High-Level Setpoint (L-04):

- Operator adjustable
- Initially set at 7 ft of water
- Pump speed up to 60 Hz
- Alarm sent to operator

4. To send flow to the filters, FCV-2401 to OPEN prior to turning ON P-2401. If contact water level in T-2400 is above.

Pressure indicators PI-2402, PI-2501, PI-2601, PI-2701 and PI-2802 monitor pressures upstream and downstream of FLT-2500A/B/C/D, FLT-2600A/B, FLT-2700A/B, and GAC-2800/2801.

1. PI-2402 and PI-2501 monitor the pressure across FLT-2500A/B/C/D. The WTS Operator visually monitors the differential pressure across the filters. Filter backwash will be automatic based on the differential pressure across each individual filter.
2. PI-2501 and PI-2601 monitor the pressure across FLT-2600A/B. The WTS Operator visually monitors the differential pressure across the operating filter. Once the differential pressure exceeds a prescribed setpoint, the Operator will manually send flow to the non-operating filter and isolate the previously operating filter for filter bag change-out.
3. PI-2601 and PI-2701 monitor the pressure across FLT-2700A/B. The WTS Operator visually monitors the differential pressure across the operating filter. Once the differential pressure exceeds a prescribed setpoint, the Operator will manually send flow to the non-operating filter and isolate the previously operating filter for filter change-out.
4. PI-2701 and PI-2802 monitor the pressure across GAC-2800/2801. The WTS Operator visually monitors the differential pressure across the GAC system.

The effluent line out of the FLT-2700A/B has a turbidity analyzer and transmitter AIT-2702 that continuously measures turbidity in the treated effluent from the 1-micron bag filters. High turbidity indicates a malfunction of the FLT-2700A/B (e.g., missing filter bag, ruptured filter bag).

1. High turbidity level sends an alarm to WTS Operator based on an operator-adjustable setpoint and turns OFF P-2401

The effluent line out of the GAC-2800/2801 has a turbidity analyzer and transmitter AIT-2803 that continuously measures turbidity in the treated effluent. High turbidity indicates a potential problem with the GAC or the upstream treatment system.

1. High turbidity level sends an alarm to WTS Operator based on an operator-adjustable setpoint and turns OFF P-2401

3.3 Operations

P-2401 VFD adjusts speed to maintain the water level in TK-2400 at an operator-adjusted setpoint. Flow from P-2401 will increase and decrease based on the flowrate of P-2001. Turbidity of discharges from FLT-2700A/B and GAC-2800/2801 are continuously. Turbidity above operator-adjustable setpoint indicates a malfunction in the system and will turn OFF P-2401 and send WTS operator an alarm.

4. P&ID P-005

4.1 Description

4.1.1 Chemical Feed and Sludge Dewatering

P-2301 pumps sludge from CLR-2300 to one of two Dewatering Boxes TK-3600 and TK-3601. Contact water that drains out of TK-3600 and TK-3601 is collected in a sump and pumped to TK-2000.

The chemical storage and feed systems are provided as part of the WTS:

- Coagulant sent to TK-2100 is stored in TK-3500 and pumped (1 duty/1 spare) via P-3501 or P-3502.
- Polymer sent to TK-2200 is made down and stored in TK-3300 equipped with mixer MX-3300 and pumped (1 duty/1 spare) via P-3301 or P-3302.
- Polymer sent to TK-3600/3601 is made down and stored in TK-3400 equipped with mixer MX-3400 and pumped (1 duty/1 spare) via P-3401 or P-3402.
- Organosulfide (if used) sent to TK-2100 is stored in TK-3100 and pumped (1 duty/1 spare) via P-3101 or P-3102.
- Acid (if used) sent to TK-2100 is stored in TK-3200 and pumped (1 duty/1 spare) via P-3201 or P-3202.
- Caustic (if used) sent to TK-2100 is stored in TK-3210 and pumped (1 duty/1 spare) via P-3211 or P-3212.

4.2 Controls

4.2.1 Chemical Feed and Sludge Dewatering

Polymer for dewatering is fed manually by the WTS Operator into the sludge line feeding TK-3600/3601, by manually setting the pumping rates and turning ON P-3401/3402 based on jar testing.

The WTS Operator selects and monitor which of TK-3600 or -3601 will receive and store sludge for dewatering. When visually inspected to be full, the WTS Operator will arrange for the full dewatering box to be trucked off for disposal and manually begin filling the other empty dewatering box.

Level indicators/transmitters are installed in each chemical storage LIT--3100, -3200, -3300, -3400, and -3500 for TK-3100, -3200, -3300, -3400, and -3500, respectively, so that the WTS Operator can keep track of the chemical volumes available for the system.

4.3 Operations

4.3.1 Sludge Dewatering

WTS Operator to dispose of full dewatering boxes (either of TK-3601 or -3601) as quickly as possible so that storage is available for sludge to be dewatered.

END OF PCN