DEQ Form 1 for Individual NPDES and State Construction Permit Applications (permits beginning with AR00)

version 2.40

(Submission #: HQQ-KRJN-TRTB5, version 1)

Details

Originally Started By	James Whittington
Submitted	8/12/2026 (0 days ago) by Gary Lynn Smith
AFIN	46-00237
Submission ID	HQQ-KRJN-TRTB5
Status	Submitted

Form Input

Purpose of Application

Is this application for an NPDES Permit, State Construction Permit, or Both?
State Construction Permit Only

Type of Facility
Municipal or Public Facilities Board - Wastewater Treatment Facility

Is this a major or minor facility?
Major (design flow of 1 MGD or greater)

Section A - General Information

AFIN (Enter if available)
46-00237

Legal Applicant Name
City of Texarkana - North Texarkana WWTP

Permittee Type
Municipality

Facility Name (if different from legal applicant name)
NONE PROVIDED

Is the legal applicant identified above the owner of the facility?
Yes

NPDES Individual Permit Number (If Applicable)
AR0048691

NPDES General Non-stormwater Permit Number (If Applicable)
NONE PROVIDED

NPDES General Storm Water Permit Number (If Applicable)
NONE PROVIDED

Permit Numbers and/or names of any permits issued by DEQ or EPA for an activity located in Arkansas that is presently held by the applicant or its parent or subsidiary corporation which are not listed above

Permit Name	Permit Number	Held By

Facility Physical Location

Facility Contact Person

Prefix
NONE PROVIDED

First Name **Last Name**
Gary *Smith*

Title
Executive Director

Phone Type **Number** **Extension**
Business 9037930610

Email
gsmith@txkusa.org

Address
8301 Sanderson Lane
Texarkana, AR 71854

Give driving directions to the wastewater treatment facility with respect to known landmarks if necessary (for example if the facility has no address, or if the facility can only be accessed through certain roads)
NONE PROVIDED

Facility County
Miller

Facility Location (All information must be based on the FRONT GATE or DRIVEWAY ENTRANCE of the facility). These coordinates must be in decimal degrees, not degrees/minutes/seconds.
33.503022413237076,-94.01161271921966

Has the facility previously submitted a location map?
Yes

Facility Mailing Address for permit documents (Street or Post Office Box)

Email
jeannie.sanders@txkusa.org

Address
P.O. Box 2008
Texarkana, TX 75504

Is the invoice address the same as the mailing address for permit documents?
Yes

Neighboring States within 20 miles of the permitted facility (Check all that apply)
Texas

Common SIC & NAICS Codes

Facility Type	SIC Code	NAICS Code
POTW (Publicly Owned Treatment Works)	4952	221320
Subdivision	6552	237210
Apartment Complex	6513	531110
Mobile Home Park	6515	533190
Elementary and Secondary Schools	8211	611110
Gas Station with Convenience Store	5541	447110
RV Parks and Campgrounds	7033	721211

Primary SIC Code
4952

Primary NAICS code
221320

Primary Facility Activity (such as "municipal wastewater treatment plant", "campground", "manufacturing of organic chemicals", etc.)
Treatment of municipal wastewater

Other applicable SIC codes, NAICS codes, and/or facility activities
NONE PROVIDED

Who prepared this application?

Prefix
NONE PROVIDED

First Name	Last Name
James	*Whittington*

Title
P.G. #1874

Organization Name
A. L. Franks Engineering

Phone Type	Number	Extension
Business	9032779712	

Email
jwhittington@alfranksengineering.com

Address
118 E. Broad Street
Texarkana, AR 71854

For new facilities, DEQ will inform you of the operator license requirements after the application is reviewed.

If you need to look up operator license numbers you can use the following link:
https://www.adeq.state.ar.us/water/enforcement/wwl/operators.aspx

Wastewater Operator Information

Operator Name	License Number	Municipal License Class	Industrial License Class
Brandon Tidwell	013887	II	N/A

Section B1: Specific Outfall Information (1 of 1)

Outfall: 001

Outfall Number
001

Design Flow (in MGD). May write "N/A" if the outfall does not have a design flow.
0.95

Highest Monthly Average flow over the last 2 years (in MGD)
0.784

End-of-Pipe Location (this must be in decimal degrees, not degrees/minutes/seconds)
33.5036,-94.0214

Are monitoring samples taken at the end-of-pipe location?
No

Monitoring Location (this must be in decimal degrees, not degrees/minutes/seconds)
33.5033,-94.0182

Name of Receiving Stream
McKinney Bayou

Description of Treatment System (Include all components of the treatment system)
lift station, bar screen, grit removal, aerated activated sludge, secondary clarification, post aeration, UV disinfection

How are effluent samples collected?
Both Grab and Composite

Narrative description of where samples are collected relative to the treatment system
Automatic sampler is located just down stream of Parshall Flume

How is flow measured, and where?
Sonic meter in Parshall Flume

Is the outfall equipped with a diffuser?
No

Does this outfall discharge to a lake or reservoir?
No

Section B2: General Outfall Information

Describe how influent is collected and conveyed to the treatment system
A combination of gravity flow and lift stations

Attach a process flow diagram showing all components of the treatment system
AR0048691_System Schematic.pdf - 08/06/2026 10:32 AM
Comment
NONE PROVIDED

Attach the topographic map here. Don't forget to mark the discharge point on the map.
Vicinity Map.pdf - 08/06/2026 10:33 AM
Topo Map.pdf - 08/06/2026 10:33 AM
Comment
NONE PROVIDED

Is the proposed or existing facility located above the 100-year flood level?
No

What measures are (or will be) used to protect the facility?
Aeration and Clarification chambers have concrete walls several feet above grade, discharge and sampling area were constructed in area that was built up with fill material, all electrical equipment and generator is elevated above grade. In addition, TWU emergency management personnel continuously monitor Site conditions and are prepared to respond with additional measures if needed.

Has this facility previously submitted a flood map?
Yes

Population for Municipal and Domestic Sewer Systems (may be marked "N/A" for industrial facilities that do not treat domestic waste)
7500

Are there any permanent backup generators?
Yes

How many backup generators?
1

Total Horsepower (hp)
490

Section C: Waste Storage and Disposal Information

Solids/Sludge Disposal Method (Check as many as are applicable)
Other: Waste activated sludge is pumped to the Texarkana South Regional collection system and allowed to flow to the South Regional WWTP located in Texarkana, TX

Section D: Water Supply

Water Sources which are DOWNSTREAM of the outfall location, i.e. those which could be affected by the discharge from this facility (check as many as are applicable):
Municipal Water Utility

Municipal Water Utility City Name
City of Texarkana

Municipal Utility - Distance from discharge point
within 50 miles

Section G: Modification and Construction Information

Describe the proposed construction, or the proposed changes at the facility
Add additional clarifier and aerators to increase 0.95 MGD plant to 2.0MGD plant.

Checklist
Specifications meet the 10 State Standards, except for those that are fully justified, attached
Design calculations signed and stamped, attached
Plans and drawings signed and stamped, attached
Professional Engineer registered in the State of Arkansas

Upload plans, specifications, and design calculations
Design Calcs.pdf - 08/12/2026 08:45 AM
North Texarkana WWTP Technical Specs.pdf - 08/12/2026 08:45 AM
Texarkana North WWTP Plans.pdf - 08/12/2026 08:45 AM
Comment
NONE PROVIDED

It appears this is a construction application for sanitary or domestic wastewater. If that is correct, please attach confirmation that this project has also been submitted for ADH review.
Letter to ADH.pdf - 08/12/2026 08:58 AM
Comment
NONE PROVIDED

Will the construction activity disturb 5 or more acres of land?
No

If the area disturbed is more than one acre up to, but not including, five acres, permit coverage is required, but the facility can obtain automatic coverage under the Construction Stormwater General Permit ARR150000. See the instructions at the linked website for automatic construction stormwater coverage.
https://www.adeq.state.ar.us/water/permits/npdes/stormwater/

Section H: Signatory Requirements

Cognizant Official (Duly Authorized Representative)

40 CFR 122.22(b) states that all reports required by the permit, or other information requested by the Director, shall be signed by the applicant (or person authorized by the applicant) or by a duly authorized representative of that person. A person is a duly authorized representative only if:
(1) the authorization is made in writing by the applicant (or person authorized by the applicant);
(2) the authorization specifies either an individual or a position having responsibility for the overall operation of the regulated facility or activity responsibility, or an individual or position having overall responsibility for environmental matters for the company.

Cognizant Official Designation
No Cognizant Official - the Responsible Official will sign all reports and other required documents

Responsible Official Information

Prefix
NONE PROVIDED

First Name	Last Name
Gary	*Smith*

Title
Executive Director

Phone Type	Number	Extension
Business	9037930610	

Email
gsmith@txkusa.org

Address

8301 Sanderson Lane

Texarkana, AR 71854

Supplemental Information

Supplemental Information (optional)
NONE PROVIDED
Comment
NONE PROVIDED

Attachments

Date	Attachment Name	Context	User
8/12/2026 8:58 AM	Letter to ADH.pdf	Attachment	James Whittington
8/12/2026 8:45 AM	Design Calcs.pdf	Attachment	James Whittington
8/12/2026 8:45 AM	North Texarkana WWTP Technical Specs.pdf	Attachment	James Whittington
8/12/2026 8:45 AM	Texarkana North WWTP Plans.pdf	Attachment	James Whittington
8/6/2026 10:33 AM	Vicinity Map.pdf	Attachment	James Whittington
8/6/2026 10:33 AM	Topo Map.pdf	Attachment	James Whittington
8/6/2026 10:32 AM	AR0048691_System Schematic.pdf	Attachment	James Whittington

Agreements and Signature(s)

SUBMISSION AGREEMENTS

- ☑ I am the owner of the account used to perform the electronic submission and signature.
- ☑ I have the authority to submit the data on behalf of the facility I am representing.
- ☑ I agree that providing the account credentials to sign the submission document constitutes an electronic signature equivalent to my written signature.
- ☑ I have reviewed the electronic form being submitted in its entirety, and agree to the validity and accuracy of the information contained within it to the best of my knowledge.

"By my signature below, I certify that I met the requirement to be the signatory as defined in 40 C.F.R. § 122.22."

"By my signature below, I certify that the cognizant official(s) designated in Section H is/are qualified to act as duly authorized representative(s) under the provisions of 40 CFR 122.22(b)." NOTE: If no duly authorized representative is designated in this section, the Division considers the applicant to be the responsible official for the facility and only reports, etc., signed by the applicant will be accepted by the Division.

"By my signature below, I certify that, if this facility is a corporation, it is registered with the Secretary of State in Arkansas."

"I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information including the possibility of fine and imprisonment for knowing violations. I further certify under penalty of law that all analyses reported as less than detectable in this application or attachments thereto were performed using the EPA approved test method having the lowest detection limit for the substance tested."

Signed By Gary Lynn Smith on 08/12/2026 at 3:25 PM

May 18, 2026

Engineering Plan Review
Arkansas Department of Health
4815 West Markham St, Engineering Section Slot 37
Little Rock, Arkansas 72205-3867

RE: Wastewater Treatment Plant Improvements
City of Texarkana, Miller County, Arkansas

Dear Sir or Madam:

On behalf of the City of Texarkana, Arkansas, and Texarkana Water Utilities, please accept this plan and specification submission for your review and approval for the proposed wastewater treatment plant improvement project. The project is further described herein:

Project Description & Design

Texarkana Water Utilities plans for the expansion of the North Texarkana Wastewater Treatment plant. The plant currently is designed to handle a peak flow of 3.0 MGD. The proposed expansion will double the capacity of the plant to 6.0 MGD at peak flow. This is in anticipation of growth and potential development in the north Texarkana area.

The main items being installed by the project are further summarized as follows:

- Headworks equipment replacement including bar screen and grit chamber
- Aeration Basins
- Clarifier
- Pumps
- Blower
- UV Replacement/Expansion

The construction cost is estimated at $3,000,000.

Construction Inspection and Testing

A.L. Franks Engineering will provide inspection of the proposed project in addition to oversight from Texarkana Water Utilities.

If you have any questions or require additional information, please contact me (870) 216-1906 or by email at cmudford@alfranksengineering.com

Sincerely,

A.L. FRANKS ENGINEERING

Caleb Mudford, P.E.
Project Engineer
Attachments

TECHNICAL SPECIFICATIONS



5-18-26

A.L. FRANKS ENGINEERING

118 E. Broad Street
Texarkana, Arkansas 71854
PHONE (870) 216-1906
FAX (870) 216-1907



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SECTION 01010 - SUMMARY OF WORK

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. This project consists of the expansion of a 1.0 MGD Wastewater Treatment Plant to a 2.0 MGD WWTP at the existing TEXARKANA NORTH WWTP.

B. Significant amounts of Structural, Mechanical, Civil and Electrical work are included in the project. This work will be performed under the following contracts.

Contract 1 – TEXARKANA NORTH WWTP Expansion TO 2.0 MGD

1.2 CONTRACT 1

A. Site Development: Site development work shall include all clearing and grubbing to noted limits, excavation, site dewatering and drainage as required by the work, backfill, roadways, paving, walks, grassing, fencing, yard piping, and sediment and erosion control.

B. The general treatment concept, structures, and equipment are described in the following paragraphs.

C. Influent Structure, Screening & Lift Station:

1. Influent flow will pass through a new mechanically cleaned filter screen. Screenings will be discharged directly into a dewatering compactor which will wash and transport the screenings to a roll-off dumpster to be provided by the Owner. A manually cleaned bar screen is provided in a separate channel for by-passing the mechanically cleaned bar screen.

2. The existing wet well structure will be upgraded to include a new submersible pump bringing the total to three submersible pumps with associated piping and force main.

D. Grit Removal & Flow Split:

1. After screening, flow will proceed to an elevated grit removal structure. This will be a rectangular concrete tank with gravity discharge to a grit washer/dewatering screw. Grit will be discharged directly from the washer into a roll-off dumpster provided by the Owner. Overflow from the washer will return to the influent structure.

2. Flow then enters the splitter box and is distributed to aeration basins.

E. Aeration Basin:

1. The aeration will be provided by fine bubble diffused air

F. Clarification:

1. Clarification will be provided by 65 feet diameter clarifiers with a spiral rake device.

2. Sludge will be removed from the clarifier by an air lift pump which can transfer the waste activated sludge (WAS) to the Digesters (2), return activated sludge (RAS) to the aeration basin, or waste sludge to the sludge pump at the main lift station.

3. Clarified effluent will flow to the post aeration basin.

G. Ultraviolet Disinfection Facility:

1. Effluent from the post aeration basins will pass through an ultraviolet (UV) disinfection facility. Ultraviolet light will be used to disinfect the wastewater prior to being discharged to the reuse system.

2. Flow from the UV facility will go through a parshall flume and then discharged to the receiving stream.

H. Sludge Storage and Stabilization System:

1. Waste sludge from the clarifier will flow to the waste activated sludge pump station and then be pumped to the headworks.

I. Other Work:

1. Electrical controls, panels, and miscellaneous items will be performed.

2. Grading, excavation wasting, sidewalks and associated earthwork.

3. Installation of blowers, and air piping, valves, and controls will be performed for which will be installed to existing treatment plants.

1.3 PROJECT LOCATION

A. The project is located in Miller County, Arkansas. The site location is shown on the cover sheet of the Drawings.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 01010

SECTION 01033 - ALLOWANCES

PART 1 - GENERAL

1.1 CONTRACT CONSIDERATIONS

A. Allowances:

1. Allowances shall be included in the contractor's bid as indicated on the Bid form.

2. Refer to Paragraph 11.02 of the Standard General Conditions for other considerations.

3. The Contractor shall be reimbursed for work furnished under allowances on a monthly basis by including said allowances in his monthly applications for partial payment. Supporting invoices shall be attached to each application that includes such request for reimbursement. Adjustments to allowances will be made by change order.

1.2 ALLOWANCE LIST

A. Testing Allowance:

1. Soil and Concrete Testing under Contract 1: Allow eight thousand dollars ($8,000) for soils and concrete testing and other on-site geotechnical services.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION (NOT APPLICABLE)

END OF SECTION 01033

SECTION 01060 - STANDARDS AND MATERIALS

PART 1 - GENERAL

1.1 STANDARDS AND REGULATIONS

A. Industry Standards: Referenced standards of construction industry have the same force and effect on performance of the work as if copied directly into contract documents or bound and published therewith. Standards referenced in contract documents or in governing regulations have precedence over non-referenced standards, insofar as different standards may contain overlapping or conflicting requirements. Comply with standards in effect as of date of contract documents, unless otherwise indicated.

1.2 GENERAL LIMITATIONS

A. Where possible, provide entire required quantity of each generic product, material, or equipment from a single source, and, where not possible to do so, match separate procurements as closely as possible. To extent selection process is under Contractor's control, provide compatible products, materials, and equipment. Where available and complying with requirements, provide standard products which have been used previously and successfully in similar applications, and which are recommended by the manufacturer for the applications indicated.

1.3 PRODUCT SELECTIONS

A. Comply with following for selection of products, materials, and equipment:

1. Three Products Named: Selection from named products is Contractor's option, provided selection fully complies with requirements.

2. "Or Equal" Clause: Provide unnamed product which fully complies with all requirements. See Section 01350 for "or equal" and "pre-approved equal" requirements.

3. Substitutions: Requests by Contractor for substitute products will be considered when reasonable, timely, fully documented, and submittals are received by the Engineer.

   The burden of proof of equality is the responsibility of the Supplier/Contractor.

PART 2 - PRODUCTS

2.1 NAMEPLATES

A. Provide permanent nameplates on equipment, located in conspicuous places, and containing suitable information and operational data. Provide nameplates on all exposed pipe work. Provide valve tags for all exposed valves. Owner will furnish tag data.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with manufacturer's instructions and recommendations. Anchor securely in place, accurately located and aligned with other work. Clean and protect to ensure that products, materials, and equipment will be free from damage and deterioration at time of acceptance.

END OF SECTION 01060

SECTION 01205 - PROCEDURES AND QUALITY CONTROL

PART 1 - GENERAL

1.1 COORDINATION

A. Coordination Between Prime Contractors: All Prime Contractors involved in the project shall be required to cooperate in the performance of the work and coordinate scheduling where any portion of the work of one Contractor will influence the work of the other Contractor(s). Each Contractor shall be required to give other Contractor(s) sufficient notice prior to beginning any operation that will require on-site work by other Contractor(s). The General Contractor shall be responsible for coordination of the entire project.

B. Schedules: The General Contractor, will review construction progress schedules submitted by other Prime Contractors and indicate possible conflicts in schedules between Contractors. Once schedules have been coordinated, they shall be submitted to the Engineer for approval. Once the schedules have been approved, Contractors shall be required to adhere to them with particular regard to where they require coordination between Contractors.

1.2 QUALITY CONTROL

A. Testing Piping Systems: Testing of all pipe systems shall be performed as set forth in Section 1-15001.

B. Testing Laboratory Services (for Contract 1):

1. Testing of soil and concrete shall be conducted by a testing agency as set forth under Section 1-02200 and Section 1-03310. The testing agency shall be paid by the Contractor under a testing allowance set forth in Section 01033. Additional testing required due to failing tests will be paid for by the Contractor and will not be deducted from the testing allowance.

2. The testing lab shall submit results of field tests immediately to the Resident Project Representative and the Contractor. Lab tests and final copies of all tests shall be submitted to the Engineer (2 copies), the Resident Project Representative (1 copy), and the Contractor (1 copy).

C. Structure Leakage Testing:

1. The General Contractor shall perform leakage testing for the following concrete structures: Treatment Plants, Grit Removal Structure, UV

Structure, Splitter Box, Plant Drain Pump Station, and the Re-use Pump Station.

2. Testing procedure shall include:

   a. Outlet pipes shall be temporarily plugged watertight.

   b. Tank shall be filled with clean water to the maximum level to be specified by the Engineer.

   c. Tank shall stand full of water for 24 hours. Water level shall be topped off to level specified by the Engineer.

   d. A staff gauge shall be temporarily attached to the inside of the tank wall at a location selected by the Engineer. The initial water level on the staff gauge shall be recorded.

   e. Tank shall stand full of water for a minimum of 24 hours or as determined by the Engineer. The final water level and interim levels on the staff gauge shall be recorded.

3. For acceptable test results, both sets of water levels must be essentially equal. There shall be no visible leaks or weeps, as determined by the Engineer.

4. If results are not acceptable, the Contractor shall repair leaking areas and repeat test procedure at no cost to the Owner.

5. Acceptability of test results shall be determined by the Engineer.

6. Engineer or Resident Project Representative shall be present during the test. Contractor shall schedule testing with the Resident Project Representative.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION (NOT APPLICABLE)

END OF SECTION 01205

SECTION 01340 - SUBMITTALS

PART 1 - GENERAL

1.1 SUBMITTALS

A. Each prime contractor is responsible for the minimum submittals identified below, as applicable. Include full documentation, including product data, samples where appropriate, detailed performance comparisons and evaluation, testing laboratory reports where applicable, coordination information for effect on other work and time schedule, cost information for proposed change order, Contractor's general certification of recommended substitution, location of the intended installation of each item, and similar information germane to circumstance.

B. Submittals Prior to Bid: Equipment pre-approval packages shall be submitted in accordance with Section 01350.

C. Submittals During Contract Award and Mobilization Period:

1. List of Subcontractors: Within 15 days after bid opening, by apparent low bidder and others as requested by the Owner. Ref. General Conditions, paragraph 6.06.

2. Executed Agreement and supporting documents prior to Notice to Proceed with work: Ref. General Conditions, Article 2.

3. Certificates of Insurance prior to any work on the site. Ref. General Conditions 2.05.C and Article 5.

4. Construction Schedules: Prior to preconstruction conference. Ref. General Conditions 2.05.B.1 and Supplementary Conditions - Progress Schedule.

5. Schedule of Values: With revised construction schedule and prior to first application for payment. Ref. General Conditions 2.05.B.3 , 2.06 - 2.07, and 14.01.

6. Schedule of Shop Drawings and Sample Submittals: Prior to submittal of any shop drawings for review. Ref. General Conditions 2.05.B.2.

D. Submittals During the Construction Period:

1. Shop Drawings, Samples, and Certification of Materials:

a. General: Prior to fabrication, shipment to the job site, or installation. Ref. General Conditions 6.17 and Supplementary Conditions - Shop Drawings, and Samples.

b. Prior to fabrication, the Contractor shall submit for review complete assembly drawings which show and dimension each major component of equipment and identify all materials of construction, sizes of principal members, location of electrical motor and controller connections for conduit layout.

c. Prior to fabrication of electrical power distribution centers or motor control centers which are to be installed in existing or proposed enclosed rooms, sufficient layout drawings shall be submitted to ensure that equipment provided can be installed in space provided.

d. The Contractor shall verify by written statement on the cover sheet of each submittal that the proposed product or equipment complies with the project specifications. Clearly list any exception to specification items on the shop drawings.

e. Submittals for items specified as a package, group, or system shall be made as a single bound submittal.

f. Prior to installation of all equipment, contractor shall submit complete manufacture installation instruction and drawings.

2. Operating and Maintenance Instructions:

a. The Contractor shall furnish to the Owner, via the Engineer, three copies of an operator's manual for each piece of equipment. Manuals shall be delivered prior to 70% project completion or equipment start-up. Include complete information for all equipment. The manuals shall be furnished in a three-ring binder format, including appropriate section dividers.

b. Set forth in the operator's manual shall be complete specifications for the lubricating oils and grease lubricants recommended for the specific equipment and drives. In addition to the lubricating oil's saybolt viscosity readings and grease lubricant's class numbers, the trade names of lubricants which meet the manufacturer's

specifications also shall be listed in the lubricant specifications of the operator's manual. Trade names of recommended lubricants produced by not less than four major (nationally recognized) oil companies shall be listed.

c. Complete written instructions, diagrams, charts, schedules, etc. shall be furnished by the equipment manufacturer for applying lubricants or other maintenance tasks to all components and accessories.

d. Provide assembly diagrams, parts lists, trouble shooting, and maintenance instructions for all equipment.

3. Applications for Partial Payment: Submit monthly if work is performed. Ref. General Conditions 14.02 and Supplementary Conditions - Payments to Contractor and Completion.

4. Sales Tax Report: Submit with each Application for Partial Payment. Ref. Special Conditions - Requirement for Sales and Use Tax.

5. Insurance Renewal Certificates: Submit prior to expiration of previous certificate.

6. Documentation related to change orders as required.

7. Monthly written statement summarizing progress and work scheduled for following month on project to be delivered to the Engineer at the monthly progress meeting.

E. Submittals Prior to Project Closeout:

1. List of certified beginning and ending dates for warranties for each product, system, piece of equipment, etc. List to be agreed upon in writing by the Contractor, Engineer, and Owner.

2. Record Drawings: Maintain a complete set of full-size blue/black-line prints of contract drawings and shop drawings for record mark-up purposes throughout the contract time. Mark up drawings during the course of the work to show changes and actual installation conditions, sufficient to form a complete record for Owner's purposes. Give particular attention to work which will be concealed and difficult to measure and record at a later date, particularly work which may require servicing or replacement during the life of the project. Bind prints into manageable sets, with durable paper covers, appropriately labeled, and submit them to

the Engineer when the construction is completed. Ref. General Conditions 6.12 and 14.07.A.1 and Supplementary Conditions - Record Drawings.

For the Re-use Distribution System, the Contractor shall record the northing/easting coordinates (based on NC Grid NAD 83) at 100-foot stations and at all pipe nodes (i.e., valves, vaults, manholes, bends, fittings, etc.) along the entire Re-Use line and record on the record drawings.

3. Application for Final Payment with attachments including Consent of Surety to Final Payment and Releases or Waivers of all Liens. Ref. General Conditions 14.07.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION (NOT APPLICABLE)

END OF SECTION 01340

SECTION 01350
REQUIREMENTS FOR "EQUAL" AND "PRE-APPROVED EQUAL"
EQUIPMENT AND PRODUCTS

PART 1 - GENERAL

1.1 SUMMARY

A. The Specifications for all Prime Contracts have listed, where possible, three or more satisfactory sources for equipment and other products which are considered most suitable for the anticipated service. It is recognized that equipment and products of equal quality and efficiency may be available from other than the identified sources and no attempt is made to preclude the furnishing of similar quality items by other manufacturers. The listed sources do not require pre-bid approval but must fully comply with the intent of the Specifications.

B. Specifications for equipment and products may also include either an "or equal" or "pre-approved equal" statement. The use of alternate equipment and products will be considered if it can be demonstrated that these items have equal or superior construction, performance, operating and maintenance costs; offer a present worth value equal to or less than the specified items; and do not adversely affect other system components.

1. Unless stated other equipment and products proposed as "equal" alternates do not require pre-bid approval but must comply with the intent of the Specifications and will be rejected during Shop Drawing submittal if they do not.

2. Equipment and products specified as "pre-approved equal" must receive pre-bid approval from the Engineer as described below.

3. If equipment from various manufacturers is specified as part of a package or grouping of related items as "pre-approved equal," then submittals for substitutions for any item in the package or group must receive pre-bid approval.

C. The Contractor will include in the bid price all the costs of any and all structural, piping, and electrical changes required to accommodate the alternate equipment and other products. The Contractor will be required to secure and pay for the services of a registered Professional Engineer to provide calculations and drawings to modify the project Plans to accommodate the alternate equipment. All such changes shall be submitted to and approved by the Engineer prior to fabrication of the equipment or making preparations for installation.

1.2 PRE-BID APPROVAL SUBMITTAL

A. Manufacturers and suppliers desiring equipment or products to be included as "pre-approved equal" shall submit data directly to the Engineer. Pre-bid packages not received by Engineer 21 calendar days prior to the Bid date will not be reviewed.

B. Pre-bid approval packages must include the following information or they will not be reviewed:

1. Current catalog data sheets and complete technical data to support Specification compliance.

2. A point-by-point list clearly stating all differences between named items and the proposed alternate and a separate list clearly stating all exceptions to the Specifications. If no exceptions are listed, Engineer will allow no exceptions to the Specifications during shop drawing review.

3. Installation list with name and phone number of contact person(s) for at least five (5) installations where proposed equipment has been in similar service and satisfactory operation for at least two (2) years. See Supplementary Conditions for provisions for bonds in lieu of experience.

4. Where applicable, performance test data and report by independent laboratory which shows performance meets or exceeds published performance data for specified product.

5. Pre-bid packages shall be submitted in an 8½" x 11" binder. Three (3) copies shall be submitted. Coordination with Engineer for electronic submission is an approved alternate submission method.

C. Pre-approved equipment and products that meet the Specifications will be approved by the Engineer via Addendum no later than seven (7) days prior to the bid date. Approval to include items in a Contractor's bid in no way eliminates the need for complete submittals at a later date, nor does it guarantee acceptance of the submitted package.

D. Following is the list of Specification Sections containing equipment and products requiring pre-bid approval:

1. General Construction - Contract I

Specification Section	Description
Section 11000	Mechanically Cleaned Filter Screen
Section 11219	Centrifugal Blower
Section 11310	Submersible Pumps
Section 11330	Vortex Grit Removal System
Section 11340	Vortex Grit Classifier
Section 11901	Fine Bubble Aeration System
Section 11915	Clarification Equipment
Section 11950	Ultraviolet Light Disinfection Equipment

PART 2 – PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION (NOT APPLICABLE)

END OF SECTION 01350

SECTION 01360 - MISCELLANEOUS GENERAL REQUIREMENTS

PART 1 - GENERAL

1.1 WORKMANSHIP AND MATERIALS

A. All materials and equipment to be provided by the Contractor shall be new and of the best quality for the use intended. The quality of workmanship and material entering into any and all of the items shall conform to pertinent sections, paragraphs, and sentences, both directly and indirectly applicable thereto in the specifications whether or not direct reference to such specifications occurs.

PART 2 - PRODUCTS

Not Applicable

PART 3 - EXECUTION

3.1 GENERAL

A. The Contractor shall obtain all necessary measurements and details in order that his work may fit the existing conditions and the other sections of the work. The Contractor shall further verify at the site all measurements in order that his work shall fit existing conditions.

B. All points of connection to existing pipes or other facilities will be excavated and their location and elevation verified prior to beginning the installation of new facilities. No additional payment shall be made for modifications to elevation or alignment that are within 2 feet (+/-) of the connection or location shown on the plans. Site piping alignment shown on the drawings shall always be considered schematic unless otherwise noted and shall be field routed to their points of connection as approved by the Engineer.

END OF SECTION 01360

SECTION 01500 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 DESCRIPTION OF REQUIREMENTS

A. General Contractor shall provide temporary services and facilities for use by all Prime Contractors and the Engineer except as otherwise herein specified. Do not remove temporary facilities until authorized use of permanent facilities.

1.2 USE CHARGES

A. Usage charges for temporary services or facilities shall be paid by the General Contractor.

1.3 WATER FOR TESTING

A. Contractor responsible for providing water for testing.

1.4 REGULATIONS AND LIMITATIONS

A. Comply with requirements of local laws and regulations governing construction and local industry standards, in the installation and maintenance of temporary services and facilities.

B. The Contractor shall be limited to work within the property limits of the site and shall be responsible for and take necessary precautions to avoid damage to all adjacent property.

1.5 TEMPORARY UTILITY INSTALLATION

A. Engage the local utility company to install temporary services. As early as possible change to use of permanent service, to enable removal of the temporary utility and eliminate possible interference with completion of the work.

B. Electrical Power Service: Provide weathertight, grounded temporary electrical service-entrance and distribution system, with ground-fault circuit interrupters and ground-fault interrupter features of proper types, sizes, electrical ratings and characteristics to fulfill project requirements. Comply with applicable requirements of NEMA, NECA and UL standards and governing regulations. Install temporary lighting of adequate illumination levels to perform the work specified. Temporary electric service for construction purposes shall be for use by all prime contractors.

C. Temporary Heat: Provide temporary heat where needed for performance of work, for curing or drying of recently installed work or for protection of work in place from adverse effects of low temperatures or high humidity. Provide UL or FM tested and labeled heating units known to be safe and without adverse effect upon work in place or being installed. Maintain a minimum temperature of 45 degrees F (7 degrees C) in permanently enclosed portions of the building and areas where finished work has been installed.

1. Except where use of the permanent heating system is available and authorized, provide properly vented self-contained LP gas or fuel oil heaters with individual space thermostatic control for temporary heat. Do not use open burning or salamander type heating units.

1.6 FIELD OFFICES

A. General Contractor's Field Office: Provide standard prefabricated or mobile unit to accommodate the Contractor's personnel at the site. As a minimum, the Contractor's office shall be equipped with the following services throughout the entire period of construction.

1. Telephone service, heat, lights, air conditioning.

2. Copies of drawings, specifications, addenda, change orders, and shop drawings.

C. Field Offices for Other Contractors: Each prime contractor will be required to furnish their own field office as necessary. The General Contractor will provide space for each prime contractor to have an office and shall provide and maintain all drives and parking facilities for all field offices, including those of other prime contractors.

1.8 STAGING AREAS

A. Space available on site for trailers, materials storage, and staging is as indicated on the drawings. Contractors shall obtain approval of the plant superintendent for other areas which may be used that will not interfere with plant operations.

1.9 TEMPORARY ROADS AND PAVING

A. Provide temporary graveled roads and graveled parking facilities during the course of the work. Locate in the same locations as permanent facilities.

B. Coordinate temporary drives with grading and compaction of the subgrade, installation and stabilization of subbase and installation of base and finish courses of permanent paving.

C. Construct and maintain temporary roads to support loading and to withstand exposure to traffic. Provide a graded and well compacted, well drained subgrade, and a gravel paving course of a well graded subbase material not less than 3" thick, roller compacted to a level, smooth surface.

D. Delay installation of the final course of permanent paving in areas exposed to temporary use, until immediately before substantial completion.

E. Unless noted to remain, completely remove temporary roadways in areas not to receive permanent paving, prior to seeding.

1.10 SANITARY FACILITIES

A. Sanitary facilities include temporary toilets for construction personnel of all prime contractors.

1. Supply toilet tissue, paper towels, paper cups and similar disposable materials as appropriate for each facility. Provide appropriate covered waste containers for used material.

2. Toilets: Install single occupant self-contained toilet units of the chemical, aerated recirculation or combustion type, properly vented and fully enclosed with glass fiber reinforced polyester shell. Use of pit-type privies will not be permitted.

3. Provide separate toilet facilities for male and female construction personnel at ground level.

B. Drinking Water: Provide tap-dispenser bottled-water type drinking water units for personnel of all prime contractors and subcontractors.

1.11 SECURITY AND PROTECTION FACILITIES INSTALLATION

A. Maintain site in a safe, lawful and publicly acceptable manner. Each prime contractor shall be responsible for security of their own office and storage facilities.

1.12 BARRICADES, WARNING SIGNS AND LIGHTS

A. Comply with recognized standards and code requirements for erection of substantial barricades where needed to prevent accidents. Paint with appropriate colors, graphics and warning signs to inform personnel at the site and the public, of the hazard being protected against. Provide lighting where needed, including flashing red lights were appropriate.

1.13 MAINTENANCE

A. Operate and maintain temporary services and facilities in good operating condition and in a safe and efficient manner until removal is authorized. Do not overload services or facilities. Protect from damage by freezing temperatures and similar elements. Do not allow unsanitary conditions, public nuisances or hazardous conditions to develop or persist on the site.

1.14 TERMINATION AND REMOVAL

A. Remove each temporary service and facility promptly when need has ended, or when replaced by use of a permanent facility, but no later than substantial completion. Complete, or, if necessary, restore permanent work delayed because of interference with the temporary service or facility. Repair damaged work, clean exposed surfaces and replace work which cannot be repaired.

B. At substantial completion, clean and renovate permanent services and facilities that have been used to provide temporary services and facilities during the construction period.

1.15 SAFETY MEASURES

A. In addition to complying with safety requirements set forth in the General Conditions, the Contractor shall:

1. Inform himself of and fully comply with all applicable requirements of the Williams-Steiger Occupational Safety and Health Act of 1970 in the performance of work required under this contract.

2. The Contractor shall adhere to the rules, regulations, and interpretations of the Secretary of the Department of Labor relating to safety and health for construction which are hereby incorporated into these requirements.

3. Follow all rules set out in the regulations and recommendations published by the Associated General Contractors and the Arkansas Department of Labor, and the Contractor shall use every effort to safeguard life and property throughout his operations.

1.16 SIGNS

The contractors for Contracts 1 shall each furnish and erect one project sign of exterior type high density plywood ½”x4’x8’. The sign shall be painted by a professional sign painter. The sign shall include lettering to identify Owner, Engineers and Contractors, project description and any other applicable funding agency requirements.

PART 2 – PRODUCTS (NOT APPLICABLE)

PART 3 – EXECUTION (NOT APPLICABLE)

END OF SECTION 01500

SECTION 01580 - MEASUREMENT AND PAYMENT

PART 1 - GENERAL

1.1 LUMP SUM

A. Payment for all work accomplished under the contract shall be on the basis of the LUMP SUM PRICES as stated in the Bid, except where:

1. Unit prices are identified in the contract and stated as separate pay items. These items are paid on the stated unit price for quantities actually installed as indicated below.

2. Allowance Items: These items are paid on the basis of actual invoice cost without Contractor mark-up. Invoices must be submitted with payment requests. Sales taxes are assumed to be included in the allowance.

B. Final Payment for Base Bid: Final payments to the Contractor shall be made on the basis of actual quantities of work completed, as determined by field measurements, in accordance with the following Paragraphs. Item numbers are referenced to the Bid Form.

C. Texarkana AR, North WWTP Expansion

1. Item 1, New WWTP: By percent complete of items on the approved schedule of values.

2. Item 2, Native Fill: By the number of cubic yards authorized for placement.

3. Item 3, Testing Allowance: See Section 01033 – Allowances.

D. Field measurements for quantities of work completed shall be based on the following:

1. Authorized Trench Widths: The maximum authorized trench width for use in making field measurements of select backfill or stabilization stone shall be the pipe diameter plus 2'. The maximum authorized trench width for use in making field measurements of sidewalk, aggregate base course, and pavements shall be pipe diameter plus 4’.

2. Measurements: Pipe line measurements shall be made along and to the centerline of the pipe or fittings. Measurements shall be recorded daily by

the Contractor, and the quantities shall be submitted to the Resident Observer for approval at the close of each working day.

3. Measurements: Cut and fill quantities shall be as measured in place quantities as determined by before and after surveys by the Engineers.

E. Summary: It is intended that payments noted above shall constitute full compensation for all work shown and required by the Plans and Specifications for this Contract. The cost of other auxiliary operations and/or materials required to make a completed project shall be absorbed in the appropriate Lump Sum or Unit Price items for which bids are requested.

F. Quantity Logs: The Contractor will be furnished copies of the Engineer's quantity logs which shall be the basis of payment for all work regarding the Reuse Water System.

PART 2 – PRODUCTS (NOT APPLICABLE)

PART 3 – EXECUTION (NOT APPLICABLE)

END OF SECTION 01580

SECTION 01800 - FACILITY OPERATIONS AND WORK SEQUENCE

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. General and specific requirements for facility shutdowns.

2. Operational requirements of the facility during construction.

3. Sequencing and scheduling constraints.

1.2 SUBMITTALS

A. Schedules for plant shutdowns shall be submitted as required by the Supplementary Conditions.

1.3 GENERAL FACILITY SHUTDOWN REQUIREMENTS

A. The scheduling of all shutdowns shall be subject to the approval of the Owner and the Engineer.

B. All necessary materials, equipment, and appurtenances required to complete a modification, tie-in, or other task shall be on hand and ready prior to taking any treatment unit out of service.

C. Whenever possible, shutdowns for tie-ins or modifications should be scheduled during weekends, nights, or other low flow periods. The Contractor's bid pricing should include nonstandard working hours for events requiring facility shutdowns.

D. Operator access to operational portions of all facilities must be maintained at all times.

1.4 SPECIFIC FACILITY SHUTDOWN REQUIREMENTS

A. This specification section is not intended to describe or outline each facility shutdown, flow diversion, or temporary interruption that may occur during the progress of the construction. The intent of this section is to outline shutdowns, flow diversions, or temporary interruptions in which special requirements must be met.

B. New Air Main Connection

1. Contractor shall have the proposed air main completely installed with the exception of the final connections to the existing air mains at each end. Final connection should be coordinated to allow for a maximum blower shutdown of three (3) hours.

C. Electric Power Transfer

1. See sheet E6 for the proposed electrical layout and configuration. General Contractor should have all electrical work completed with the exception of the final connection to the existing power supply. Final connection should be coordinated to allow for a maximum power outage of four (4) hours.

D. Existing Influent Structure

1. Modifications to the existing Influent Structure will require that the Influent Structure be temporarily bypassed. This bypass can be accomplished using piping that is already in place and connecting the bypass pumps to the existing 18" force main or directly to the existing splitter box. The Contractor shall provide pumping equipment suitable for a flow of 1 MGD to 2 MGD.

PART 2 – PRODUCTS

Not Applicable

PART 3 – EXECUTION

Not Applicable

END OF SECTION 01800

SECTION 02060 - DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY OF WORK

A. The general extent of demolition work is shown on Drawings. Other demolition/cutting and patching may be required in order to fully accomplish the indicated renovations.

B. Demolition includes removal and disposal of demolished materials.

1.2 SCHEDULE

A. Submit proposed methods, operations and sequence of demolition to Engineer for review prior to start of work. Include in schedule coordination for shut-off, capping and continuation of utility services as required. The Contractor will be permitted to proceed with demolition in a manner most suitable to the expeditious execution of his work, subject to Engineer's approval, compliance with the Facility Operations and Work Sequence (Section 01800), and to the following requirements:

1. The existing WWTP and associated existing facilities will remain in operation throughout the construction period, except as provided for in the plans.

1.3 PROJECT RECORD DOCUMENTS

A. Project record drawings shall identify the location of all capped utilities.

B. Project record drawings shall indicate unanticipated structural, electrical, or mechanical conditions.

PART 2 – PRODUCTS

Not Applicable

PART 3 - EXECUTION

3.1 CONDITION OF STRUCTURES

A. The Owner assumes no responsibility for actual condition of structures to be demolished.

B. Conditions existing at time of Contractor's inspection for bidding purposes will be maintained by Owner in so far as practicable. However, variations within structures may occur by Owner's removal and salvage operations prior to start of demolition work.

3.2 PARTIAL REMOVAL

A. Items of salvageable value to contractor which are indicated to be demolished may be removed from structure as work progresses. Transport salvaged items from the site as they are removed.

B. Storage or sale of removed items on site will not be permitted.

3.3 TRAFFIC

A. Conduct demolition operations and removal of debris to ensure minimum interference with roads, streets, walks, and other adjacent occupied or used facilities.

B. Do not close or obstruct streets or walks without permission from the Owner.

3.4 PROTECTIONS

A. Ensure safe passage of persons around areas of demolition. Conduct operations to prevent injury to adjacent buildings, structures, work to remain, other facilities, and persons.

B. Provide interior and exterior shoring, bracing, or support to prevent movement, settlement or collapse of structures to be demolished and adjacent facilities to remain.

C. Provide suitable barricades to ensure safety of Contractor's personnel and Owner's personnel.

3.5 DAMAGES

A. Repair damages caused to adjacent equipment, finish surfaces, or other facilities by demolition operations within ten (10) days or as otherwise approved by the Engineer at no cost to Owner.

3.6 UTILITY SERVICES

A. Maintain existing utilities indicated to remain, keep in service, and protect against damage during demolition operations.

3.7 POLLUTION CONTROLS

A. Use water sprinkling, temporary enclosures, and other suitable methods to limit dust and dirt rising and scattering in air to lowest practical level. Comply with governing regulations pertaining to environmental protection.

B. Do not use water when it may create hazardous or objectionable conditions such as ice, flooding, and pollution.

C. Clean adjacent structures and improvements of dust, dirt, and debris caused by demolition operations, as directed by Engineer or governing authorities. Return adjacent areas to condition existing prior to start of work.

3.8 BELOW-GRADE CONSTRUCTION

A. Demolish and remove below-grade construction and concrete slabs on grade, where required.

3.9 FILLING VOIDS

A. Completely fill below-grade areas and voids resulting from demolition of structures or existing piping.

B. Use satisfactory soil materials consisting of stone, gravel, and sand, free from debris, trash, frozen materials, roots and other organic matter.

C. Prior to placement of fill materials, ensure that areas to be filled are free of standing water, frost, frozen material, trash and debris.

D. Place fill materials in horizontal layers not exceeding 8" in loose depth unless otherwise specifically approved in writing by the Engineer. Compact each layer at optimum moisture content of fill material to a density equal to original adjacent ground, unless subsequent excavation for new work is required.

E. After fill placement and compaction, grade surface to meet adjacent contours and to provide flow to surface drainage structures or to suit subsequent required construction.

3.10 DISPOSAL

A. Remove from site all debris, rubbish, and other materials resulting from demolition operations.

B. Burning of materials removed from demolished structures will not be permitted on site.

END OF SECTION 02060

SECTION 02110 - SITE CLEARING

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Site clearing includes, but is not limited to, protection of existing trees to remain, removal of stumps and other vegetation, topsoil stripping, clearing and grubbing, and removal of existing improvements as indicated or as required for new work.

1.2 PROTECTIONS

A. Provide temporary fences, barricades, coverings, or other protections to preserve existing items indicated to remain and to prevent injury or damage to persons or property.

B. Protection of Existing Trees and Vegetation: Protect existing trees and other vegetation, which is to remain in place, against unnecessary cutting, breaking, or skinning of roots, skinning and bruising of bark, smothering of trees by stockpiling construction materials or excavated materials within drip line, excess foot or vehicular traffic, or parking of vehicles within drip line. Provide temporary guards to protect trees and vegetation to be left standing.

C. Provide protection for roots over 1-1/2" diameter cut during construction operations. Coat the cut faces with an emulsified asphalt, or other acceptable coating formulated for use on damaged plant tissues. Temporarily cover exposed roots with wet burlap to prevent roots from drying out; cover with earth as soon as possible.

D. Repair or replace trees and vegetation indicated to remain which are damaged by construction operations in a manner acceptable to the Resident Project Representative.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 SITE CLEARING

A. Contractor shall clear only areas within the clearing limits or as required in highway rights-of-way. Consult the Resident Project Representative if there are

any questions concerning removal of a tree or group of trees. Remove stumps and vegetation, improvements, or obstructions interfering with installation of new construction. Remove such items elsewhere on the site or premises as specifically indicated. Removal includes stumps and roots.

B. Carefully and cleanly cut roots and branches of trees not indicated to be removed where such roots and branches obstruct new construction.

3.2 TOPSOIL

A. Topsoil is defined as friable clay loam surface soil found in a depth of not less than 4". Satisfactory topsoil is free of subsoil, clay lumps, stones, and other objects over ¾" in diameter, and without weeds, roots, gravel, and other objectionable material. All topsoil is subject to the approval of the Resident Project Representative.

B. Strip topsoil to whatever depths encountered in a manner to prevent intermingling with underlying subsoil.

C. Remove heavy growths of grass from areas before stripping.

1. Where trees are indicated to be left standing, stop topsoil stripping a sufficient distance to prevent damage to main root system.

D. Stockpile satisfactory topsoil in storage piles in areas where shown on the drawings. Placement of topsoil will be required in preparation of a seed bed. Construct storage piles to freely drain surface water. Cover storage piles if required to prevent wind-blown dust. Install silt fence around stockpiles to prevent siltation.

3.3 GRUBBING

A. Completely remove stumps, roots, and other debris protruding through the ground surface prior to commencement of earthwork operations.

1. Use only hand methods for grubbing inside drip line of trees indicated to be left standing.

B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material, unless further excavation or earthwork is indicated.

C. Place fill material in horizontal layers not exceeding 6" loose depth, and thoroughly compact to a density equal to adjacent original ground.

3.4 BURNING ON OWNER'S PROPERTY

A. Burning will not be permitted on the project site.

3.5 DISPOSAL OF WASTE MATERIALS

A. Remove waste materials including trash, stumps, trees, vegetation, debris, and all other waste except for acceptable earth material from Owner's property and legally dispose of off site.

END OF SECTION 02110

SECTION 02151 - SHEETING AND BRACING

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Where required to properly support the surfaces of the excavations to permit construction, to protect the construction work, adjacent work or workmen, adjacent pipe lines, and roadways, provide sheeting, bracing, and shoring.

B. Failure to sheet and brace trenches or other excavations shall be at the Contractor's risk, and he will be held responsible for caving, settlement, and all other damages or injuries resulting therefrom.

C. Sheeting and bracing are incidental, and the cost thereof shall be included in the appropriate lump sum or unit price bid for work under this contract.

1.2 QUALITY ASSURANCE

A. Codes and Standards: Department of Labor 29 CFR Part 1926, Occupational Safety and Health Standards or current version - Excavation.

PART 2 - PRODUCTS

2.1 SHEETING AND BRACING MATERIALS

A. Use timber or metal sheeting and bracing components as may be necessary to fulfill the requirements of this Section.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Contractor is responsible for selecting installation methods for sheeting and bracing.

3.2 REMOVAL

A. In removing sheeting and bracing after the construction has been completed, take special care to prevent any collapse of the excavation and injury to the completed work or adjacent property.

B. Trench or other excavation bracing, except that which must be left in place, may be removed when the backfilling has reached the respective levels of such bracing. Remove sheeting, except that which has been ordered left in place, as the backfilling progresses. Take special care to fill and compact voids created by removal of bracing and sheeting.

C. Sheeting, shoring, and bracing which is left in place shall be cut off or otherwise left not less than 2' below the established ground surface.

END OF SECTION 02151

SECTION 02200 - EARTHWORK

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. The extent of earthwork is as follows:

1. Excavating and constructing embankments for Grit Removal Structure, clarifier, aeration basin and pipelines.

2. Preparation of subgrade for building slabs, walks, and pavements.

3. Excavating, filling and compaction of soil for roads.

4. Backfilling of foundations and construction of embankments.

5. Placement of crushed aggregate base course for pavements.

6. Trenching and backfilling for piping and related structures.

7. Other miscellaneous excavating, filling, off-site borrow, disposal on site, and grading as required.

1.2 QUALITY ASSURANCE

A. Codes and Standards: Perform excavation work in compliance with applicable requirements of governing authorities having jurisdiction.

B. Testing and Inspection Services (Allowance Item):

1. Provide access for testing agency to perform soil testing and inspection services for quality control during earthwork operations.

2. The Owner will select the testing agency.

3. The testing agency will be paid by the General Contractor through an allowance in the Contract. See Section 01033.

C. The quantity of cut and fill for roads and embankments will be determined by company the original site survey with an Owner-performed survey after the earthwork is complete.

1.3 JOB CONDITIONS

A. Site Information: Subsurface investigation reports were prepared by S&ME. Refer to Supplementary Conditions for obtaining a copy of the report.

B. The Contractor is specifically advised that the information contained in these reports is not a part of this specification or contract documents. Data on indicated subsurface conditions are not intended as representations or warranties of accuracy of continuity between soil borings. It shall be expressly understood that neither the Engineers, Resident Project Representative, nor the Owner will be responsible for interpretations or conclusions drawn therefrom by Contractor.

C. Additional test borings and other exploratory operations may be made by Contractor at no cost to Owner.

D. Use of Explosives: The use of explosives is not permitted.

E. Carefully maintain all survey reference points, property markers, right-of-way markers, bench marks, etc. and accurately restore if disturbed.

F. The presence of groundwater in the soil will not constitute a condition for which an increase in the contract price will be made.

G. Existing Utilities:

1. The Contractor is responsible for locating all utilities and protecting them from damage. Cooperate with the Owner(s) and Utility Companies for maintaining services. Do not break any utility connection without notifying the utility or Owner(s) a minimum of 48 hours in advance and providing acceptable temporary services as required.

2. The Contractor shall be responsible for repairing any damage to existing utilities. The utilities shall be replaced as directed by the Owner(s) or Utility Company.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. Fill material used on the project will be subject to inspection and testing by the materials testing firm and will be used only if it meets the requirements for fill material listed below and is considered suitable for this project by the soil testing firm.

B. Contractor is responsible for identifying and obtaining offsite borrow.

C. Definitions:

1. Satisfactory (Acceptable) Embankment and Backfill Soil Materials: Those subsurface materials found beneath the upper layer of cohesive clays or silts that meet the following conditions:

   a. Must be free of rock or gravel larger than 2" in any dimension.

   b. Must be free of debris, organic, or other deleterious matter.

   c. Must be generally described as Sands or Silty Sands.

   d. Must be capable of providing CBR values greater than 10 when compacted to 100% compaction.

   e. Must have density greater than 95 lbs. per cubic foot when compacted to 100% compaction (ASTM D-698).

   f. Must have a liquid limit less than 50.

   g. Must have plasticity index less than 20.

   h. All materials are subject to the approval of the soils testing service.

2. Unsatisfactory Soil Material: Those materials found in the upper layer of the soil that contain cohesive clays and silts, organic, frozen, or other deleterious matter and do not meet the specific requirements listed above.

3. Crushed Aggregate Base Course (CABC): Provide crushed aggregate base course, Type ABC, in accordance with the ARDOT Standard Specifications for Roads and Structures

4. Drainage Fill or Stabilization Stone (Washed Stone): Washed, uniformly graded mixture of crushed stone, or crushed or uncrushed gravel, conforming to Coarse Aggregate No. 57 of ASTM C-33.

5. Drainage Sand: Natural or manufactured sand conforming to ASTM C-33 for fine aggregate.

6. Bedding Sand: Natural or manufactured sand.

7. Select Backfill: Satisfactory soil materials from an on-site or off-site source to be used as directed by the Resident Project Representative when unsatisfactory soils are encountered at or below subgrade levels.

8. Backfill material for trench (from top of bedding material to one foot above top of pipe):

   a. Must be free of rock or gravel larger than ¾" in any dimension.

   b. Must be free of debris, organic, or other deleterious material.

   c. Must have density greater than 95 lbs per cubic foot when compacted to 100% compaction (ASTM D-698).

   d. All materials are subject to the approval of the soil testing service.

9. Pipe Bedding Material: Coarse sands and gravels with maximum particle size of ¾", including variously graded sands and gravels containing small percentages of fines, generally granular and non-cohesive, either wet or dry.

PART 3 - EXECUTION

3.1 EXCAVATION

A. Excavation consists of removal and disposal of all material encountered when establishing required finish grade elevations.

B. Excavation Classifications: All excavation is unclassified.

1. Unauthorized excavation consists of removal of materials beyond indicated subgrade elevations or dimensions without specific direction by the Resident Project Representative. Unauthorized excavation, as well as remedial work directed by Resident Project Representative, shall be at Contractor's expense.

2. Under footings, foundation bases, or retaining walls, fill unauthorized excavation by extending indicated bottom elevation of footing or base to excavation bottom, without altering required top elevation. Lean concrete fill may be used to bring elevations to proper position when acceptable to Resident Project Representative.

3. Elsewhere, backfill and compact unauthorized excavations as specified for authorized excavations of same classification, unless otherwise directed by Resident Project Representative.

C. Additional Excavation: When excavation has reached required subgrade elevations, notify Resident Project Representative who will make an inspection of conditions.

1. If unsuitable bearing materials are encountered at required subgrade elevations, carry excavations deeper and replace excavated material as directed by Resident Project Representative.

2. Removal of unsuitable material and its replacement as directed will be paid for under the unit price items in the Bid Form.

D. Stability of Excavations: Slope sides of excavations to comply with local codes and ordinances having jurisdiction. Shore and brace where sloping is not possible because of space restrictions or stability of material excavated.

1. Maintain sides and slopes of excavations in safe condition until completion of backfilling.

E. Shoring and Bracing:

1. Provide materials for shoring and bracing, such as sheet piling, uprights, stringers and cross-braces, in good serviceable condition.

2. The Contractor or the Contractor's specialty sub-contractor shall be responsible for the design of the temporary shoring for the deeper excavations in accordance with applicable regulatory requirements. Possible obstruction within the existing fill may hinder sheet pile driving and may require the excavation of trenches through the fill along sheet pile wall locations prior to driving.

3. Maintain shoring and bracing in excavations regardless of time period excavations will be open. Carry down shoring and bracing as excavation progresses.

F. Dewatering:

1. The Contractor is responsible for the design and installation of the dewatering system:

2. Prevent surface water and subsurface or groundwater from flowing into excavations and from flooding the project site and surrounding area. Eight-inch diameter PVC sampling wells may be required up to four points around an excavation in order to monitor the location of the water table.

3. For open cut excavations, the groundwater level should be lowered at least three feet below the bottom of the proposed excavations at all times to provide base stability.

4. For deep excavations when sheet piling is used for bracing, interior sump or wells shall be used for dewatering. The groundwater level should be lowered at least two feet below the bottom of the proposed excavation at all times to provide bank stability.

5. Do not allow water to accumulate in excavations. Remove water to prevent softening of foundation bottoms, undercutting footings, and soil changes detrimental to stability of subgrades and foundations. Provide and maintain pumps, well points, sumps, suction and discharge lines, and other dewatering system components necessary to convey water away from excavations. Additional excavation and fill required due to failure to keep all water from standing in excavations will not provide a basis for claim by the Contractor for additional compensation.

6. During dewatering operations all water must be conveyed away from excavations to collection or run-off areas in accordance with the Federal Sedimentation Pollution Control Act. Establish and maintain temporary drainage ditches and other diversions outside excavation limits for each structure. Insure that drainage water flows to appropriate sediment basins or sediment control structures (designed by Contractor) which ultimately discharge off site. Discharge directly to creeks and streams will not be allowed. Do not use trench excavations as temporary drainage ditches.

G. Material Storage: Stockpile satisfactory excavated materials until required for backfill or fill. Place, grade and shape stockpiles for proper drainage and provide silt fencing around stockpiles to prevent sediment-laden run-off.

H. Locate and retain soil materials away from edge of excavations.

I. Excavation for Structures: Conform to elevations and dimensions shown within a tolerance of plus or minus 0.10', and extending a sufficient distance from footings and foundations to permit placing and removal of concrete formwork, installation of services, other construction, and for inspection.

J. Footings and Foundations:

1. In excavating for footings and foundations, take care not to disturb bottom of excavation. Excavate by hand to final grade just before concrete reinforcement is placed. Trim bottoms to required lines and grades to leave solid base to receive concrete.

2. Exposure to the environment may weaken the soils at the footing bearing level if the foundation excavations remain open for long periods of time. If the bearing soils are softened by surface or ground water intrusion or exposure, the softened soils must be removed from the foundation excavation bottom immediately prior to placement of concrete.

K. Excavation for Pavements: Cut surface under pavements to comply with cross-sections, elevations and grades as shown.

L. Excavation for Pipes (Trenching):

1. Trenching consists of the excavation of earth or rock material as required for the installation of pipes.

2. Accomplish trenching with equipment suitable for this type of service. Carry the depths of trenches as required to install pipes with the indicated flow lines and invert elevations. See Sections 15001 and 15060 for further information regarding pipe installation.

3. Construct sides of trenches as nearly vertical as possible to a point 1 foot above the crown of the pipe; taking into consideration the type of soil encountered and applicable safety requirements. Operations resulting in wide top dimensions sloping directly to the pipe shall not be permitted. The trench width from a point 1 foot above the crown of the pipe to the bed of the trench shall not exceed the diameter of the pipe bell plus 12" on each side of the bell unless special permission of the Resident Project Representative is secured. Excavate a space under and around each bell to sufficient depth to relieve it of any load and to assure solid uniform bearing for the entire body of the pipe.

4. Where the subgrade at the invert of the pipe is found to be unstable or that it lacks sufficient bearing strength to support the pipe and its superimposed loads, the Resident Project Representative may require the Contractor to consolidate the subgrade by tamping and provide dewatering as herein before specified. In the event that tamping, dewatering, or other similar measures will not prevent or cure this condition, the Resident Project Representative may require that the subgrade be undercut and that suitable stabilization material be placed in the trench.

5. Where the pipe is to be installed above the existing ground in filled material, the area shall be filled and compacted to not less than 2' above the crown of the pipe. The trench shall then be excavated in the filled material in the same manner required for pipe located beneath the existing ground.

6. Establish requirements for trench shoring and bracing to comply with local codes and authorities having jurisdiction.

7. All pipes shall be supported in a Type 4 bedding. The pipe bedding materials shall be Class II. The bedding shall have a minimum thickness beneath the pipe of 4 inches or 1/8 of the outside diameter of the pipe, whichever is greater.

8. When pipe laying is not in progress, plug the open end of the pipe to prevent entry of water, dirt, tools, or other foreign matter into the pipe line. Do not use the pipe as a means of carrying groundwater away from the work area.

M. Cold Weather Protection: Protect excavation bottoms against freezing when atmospheric temperature is less than 35 degrees F. (1 degree C).

3.2 COMPACTION

A. General: Control soil compaction during construction providing minimum percentage of density specified for each area classification.

B. Percentage of Maximum Density Requirements: Compact soil to not less than the following percentages of maximum dry density for soils which exhibit a well-defined moisture density relationship determined in accordance with ASTM D 698.

1. Structures: Compact top 12" of subgrade and each layer of backfill or fill material at 95% maximum dry density.

2. Structural Slabs: Compact top 12" of subgrade and each layer of backfill or fill material at 95% maximum dry density.

3. The upper 18 inches of fill in the tertiary filter and headworks areas shall be compacted to 98% maximum dry density.

4. Pipes and Related Structures: Backfill and compact trenches in uniform layers to 1 foot above the crown of the pipe to 95% maximum dry density. Backfill from 1 foot above the crown of the pipe to finish grade as required for the area classification or to 95% maximum dry density.

5. Lawn or Unpaved Areas: Compact top 6" of subgrade and each layer of backfill or fill material at 90% maximum dry density.

6. Walkways: Compact top 6" of subgrade and each layer of backfill or fill material at 95% maximum dry density or 90% relative dry density.

7. Pavements: Compact top 12" of subbase and each layer of backfill or fill material at 98% maximum dry density.

8. Crushed Aggregate Base Course: Compact top 12" of subgrade and each 4" layer of crushed aggregate base course material to 100% maximum dry density.

9. Embankments, Pond and Lagoon Embankments: Compact to a density no less than 95% maximum dry density at moisture contents ranging from -3 to +4 percent of optimum.

C. Moisture Control: Where subgrade or layer of soil material must be moisture conditioned before compaction, uniformly apply water to surface of subgrade, or layer of soil material, taking care to prevent free water appearing on surface during or subsequent to compaction operations.

D. Remove and replace, or scarify and air dry, soil material that is too wet to permit compaction to specified density.

1. Soil material that has been removed because it is too wet to permit compaction may be stockpiled or spread and allowed to dry. Assist drying by discing, harrowing or pulverizing until moisture content is reduced to a satisfactory value as determined by the materials testing agency.

3.3 BACKFILL AND FILL

A. General: Place acceptable soil material in layers to required subgrade elevations, for each area classification listed below.

1. In excavations and embankment fill areas, use satisfactory excavated or borrow material.

2. Under grassed areas, use satisfactory excavated or borrow material.

3. Under walks and pavements, use subbase material or satisfactory excavated or borrow material, or combination of both.

B. Backfill excavations as promptly as work permits, but not until completion of the following:

1. Acceptance of construction below finish grade including, where applicable, dampproofing, waterproofing and perimeter insulation.

2. Inspection, testing, approval, and recording locations of underground utilities.

3. Removal of concrete formwork.

4. Removal of shoring and bracing, and backfilling of voids with satisfactory materials. Cut off temporary sheet piling driven below bottom of structures and remove in manner to prevent settlement of the structure or utilities, or leave in place if required.

5. Removal of trash and debris.

6. Permanent or temporary horizontal bracing is in place on horizontally supported walls.

C. Ground Surface Preparation: Remove vegetation, debris, unsatisfactory soil materials, obstructions, and deleterious materials from ground surface prior to placement of fills. Plow, strip, or break-up sloped surfaces steeper than l vertical to 4 horizontal so that fill material will bond with existing surface.

D. After rough grade has been established in cut areas and before any fill is placed in fill areas, the exposed subgrade should be carefully inspected by the soils testing agency.

E. Prepare subgrade as required under "Compaction".

F. Proof roll the exposed subgrade after compaction has been completed with a heavy roller or loaded dump truck (+25 tons). Any areas which rut or pump should be undercut and replaced with suitably compacted fill.

G. When existing ground surface has a density less than that specified under "Compaction" for particular area classification, break up ground surface, pulverize, moisture-condition to optimum moisture content, and compact to required depth and percentage of maximum density.

H. Before compaction, moisten or aerate each layer as necessary to provide optimum moisture content. Compact each layer to required percentage of maximum dry density or relative dry density for each area classification. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.

I. Place backfill and fill materials evenly adjacent to structures, to required elevations. Take care to prevent wedging action of backfill against structures by carrying material uniformly around structure. Place backfill and fill materials in layers not more than 8" in loose depth for material compacted by heavy compaction equipment and not more than 4" in loose depth for material compacted by hand-operated tampers. Compact as required for area classification. Monitor structure walls as required by the Resident Project Representative to protect the wall. Accomplish compaction immediately behind

walls by hand tamp methods. Do not use heavy equipment within 10 feet of any wall.

K. Backfilling of Pipes:

1. Standard Trench: After the trench has been excavated as required to assure the correct invert and a space has been excavated for the pipe bells, the pipe is to be lowered into the trench. The pipe shall be placed as near to the center of the trench allowing ample room for compaction on each side. After the joint has been made, backfill with 4" to 6" of satisfactory soil material. Compact backfill by hand tamping under the haunches of the pipe barrel to assure a firm circular bearing surface for the pipe taking care not to move or raise the pipe or in any way create a non-uniform bearing surface.

2. Backfilling Sides of Pipe: Proceed with backfilling in an expeditious manner. Support sides of pipe by backfilling immediately after the joints have been made. Place sand or satisfactory soil material from pipe bedding to the crown of the pipe in even 8" layers and compact by tamping. Layers of backfill material shall be placed in even lifts on both sides of the pipe and care shall be taken not to move, injure, or disturb the pipe and to assure uniform side support throughout the length of the pipe barrel.

3. Backfilling Over the Pipe: Backfill with satisfactory soil material from top of pipe to a depth of 12" above the crown of the pipe providing sufficient care is exercised to prevent injuring or moving the pipe. Place backfill in even 8" layers and compact by hand or approved mechanical means as indicated on the drawings.

4. Backfilling to Grade: Backfill and compact from 12" above the crown of the pipe to finished grade with satisfactory soil material, compacting some to the density required for the area classification. The finished grade shall conform to elevations, slopes, and contours as indicated on the drawings. The Contractor shall be held responsible for settlement over all trenches, and he shall be required to add material and compact as directed if such settlements occur.

3.4 GRADING

A. General: Uniformly grade areas within limits of grading under this section, including adjacent transition areas. Smooth finished surface within specified tolerances, compact with uniform levels or slopes between points where elevations are shown, or between such points and existing grades.

B. Grading Outside Building Lines: Grade areas adjacent to building lines to drain away from structures and to prevent ponding.

C. Finish surfaces free from irregular surface changes, and as follows:

1. Lawn, Ponds, Lagoons, or Unpaved Areas: Finish areas to receive topsoil to within not more than 0.10' above or below required subgrade elevations.

2. Walks: Shape surface of areas under walks to line, grade and cross-section, with finish surface not more than 0.10' above or below required subgrade elevation.

3. Pavements: Shape surface of areas under pavement to line, grade and cross-section, with finish surface not more than 1/2" above or below required subgrade elevation.

D. Grading Surface of Fill Under Building Slabs: Grade smooth and even, free of voids, compacted as specified, and to required elevation. Provide final grades within a tolerance of l/2" when tested with a 10' straightedge.

E. Compaction: After grading, compact subgrade surfaces to the depth and percentage of maximum density for each area classification.

3.5 PAVEMENT SUBBASE COURSE

A. General: Subbase course consists of placing subbase material, in layers of specified thickness, over subgrade surface to support a pavement base course.

1. See other Division 2 sections for paving specifications.

B. Grade Control: During construction, maintain lines and grades including crown and cross-slope of subbase course.

C. Shoulders: Place shoulders along edges of subbase course to prevent lateral movement. Construct shoulders of acceptable soil materials, placed in such quantity to compact to thickness of each subbase course layer. Compact and roll at least a 12" width of shoulder simultaneously with compacting and rolling of each layer of subbase course.

D. Placing: Place subbase course material on prepared subgrade in layers of uniform thickness, conforming to indicated cross-section of thickness. Maintain optimum moisture content for compacting subbase material during placement operations.

E. When a compacted subbase course is shown to be 6" thick or less, place material in a single layer. When shown to be more than 6" thick, place material in equal

layers, except no single layer more than 6" or less than 3" in thickness when compacted.

3.6 BUILDING AND STRUCTURAL SLAB DRAINAGE COURSE

A. Building and Equipment Slabs: Drainage course consists of placement of drainage fill material, in a minimum thickness of 6", over subgrade surface to support all concrete building slabs or equipment slabs.

B. Sanitary Structures: For all sanitary structures place a layer of geotextile fabric on the excavated subgrade prior to placing a 12 inch layer of #57 drainage stone. The drainage stone and fabric will extend two feet out past the outside edge of the structure. The fabric will wrap around the outside end of the stone and back on top of the stone, with at least one foot of the fabric extending under the concrete to be placed. The fabric shall be Trevira 1120, Mirafi-700X, Exxon GTF-300, or equal.

C. Placing: Place drainage fill material on prepared subgrade in layers of uniform thickness, conforming to indicated cross-section and thickness. Maintain optimum moisture content for compacting material during placement operations.

3.7 FIELD QUALITY CONTROL

A. Quality Control Testing During Construction: Allow materials testing service to inspect and approve subgrades and fill layers before further construction work is performed.

1. Perform field density tests in accordance with ASTM D 1556 (sand cone method), ASTM D 2167 (rubber balloon method), or ASTM D2922 (nuclear density method) as applicable.

2. Footing Subgrade: For each strata of soil on which footings will be placed, conduct at least one test to verify required design bearing capacities. Subsequent verification and approval of each footing subgrade may be based on a visual comparison of each subgrade with related tested strata, when acceptable to Resident Project Representative.

3. Paved Areas and Building Slab or Structure Subgrade: Make at least one field density test of subgrade for every 2000 square feet of paved area or building slab, but in no case less than three tests. In each compacted fill layer, make one field density test for every 2000 square feet of overlaying building slab or paved area, but in no case less than three tests.

4. Underground Piping at Wastewater Treatment Plant Site: Make at least one field density test per 100 feet of trench length per 2 feet of backfill.

5. General Fill, Holding Pond, and Lagoons: Make at least one (1) field density test of subgrade for every 8000 square feet of general fill area.

B. Foundation Wall Backfill: Take at least two field density tests at locations and elevations as directed.

C. After testing or inspection and subsequent approval of subgrade, place concrete or base course as soon as possible. If concrete placement is not possible on same day, protect approved subgrade from freezing, thawing, and surface water runoff. All excavations for which concrete placement is delayed shall be reinspected before pouring.

D. If, in the opinion of Resident Project Representative, based on testing service reports and inspection, subgrade or fills which have been placed are below specified density, provide additional compaction and testing at no additional expense.

3.8 MAINTENANCE

A. Protection of Graded Areas: Protect newly graded areas from traffic and erosion. Keep free of trash and debris.

B. Repair and re-establish grades in settled, eroded, and rutted areas to specified tolerances.

C. Reconditioning Compacted Areas: Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, scarify surface, re-shape, and compact to required density prior to further construction.

D. Refer to Section 02400 - Erosion Control for further maintenance requirements.

3.9 DISPOSAL OF EXCESS AND WASTE MATERIALS

A. Remove waste materials including trash and debris and legally dispose of it off Owner's property.

B. Excess soil shall be disposed of on site as indicated on plans.

END OF SECTION 02200

SECTION 02400 - EROSION CONTROL

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. The work shown on the Drawings and specified herein shall constitute the erosion control plan for this contract in conformance with the Federal Water Pollution Control Act of 1972 with amendments, and Arkansas Department of Environmental Quality (ADEQ) requirements. The erosion control plan shown is based on the anticipated construction methods and sequence, and includes the permanent and temporary measures as required. The Contractor shall provide at no additional cost to the Owner any other measures as may be required to prevent erosion as a result of construction activity at the site.

B. Temporary erosion control measures shall include, but not be limited to, check dams, diversion ditches, silt fences, rip rap, grass, mulches, mats, fabric, netting, construction entrances, or any other methods or devices that are necessary to control or restrict erosion. Temporary erosion control measures may include work outside the right-of-way or construction limits where such work is necessary as a result of construction such as borrow pit operations, haul roads, plant sites, equipment storage sites, and disposal of waste or debris. The Contractor shall be liable for all damages to public or private property caused by silting or slides originating in areas used by the Contractor.

1.2 CONTRACTOR'S RESPONSIBILITY

A. Contractor shall be responsible for installing and maintaining erosion control devices as required to function properly and to satisfy the representatives of the Arkansas Department of Environmental Quality (TCEQ).

B. To ensure that the project is in compliance with the regulations, the Contractor shall perform a complete site inspection of the erosion control measures every week and when rainfall occurs on site. Required corrective/maintenance measures shall be noted and implemented within three working days.

C. Any time delays experienced due to a shutdown by the ADEQ or due to unanticipated corrective work will not receive any time extensions on the contract.

1.3 QUALITY ASSURANCE

A. Codes and Standards:

1. All construction activities required under this project shall comply with the Federal Water Pollution Control Act and ADEQ requirements and the rules and regulations promulgated pursuant to the provisions of that law.

B. In the event of conflict between the regulations listed above and the requirements of these Specifications, the more restrictive requirements shall apply.

1.4 SUBMITTALS

A. Materials and facilities for temporary erosion control measures shall have been approved by the Engineer before being used. Any facilities or materials different from those shown on the Drawings or specified herein shall be submitted to the Engineer for approval.

B. Product Data: Submit manufacturer's technical data and material samples for silt fence fabrics, ditch liner, filter cloth, matting for silt fence fabrics, and other manufactured materials if requested.

C. Material Certificates: Submit material certificates signed by manufacturer and Contractor certifying specification compliance for posts, woven wire, filter stone, rip rap, and other products if requested.

D. Drawings: Submit scaled drawings of changes in facilities shown on Drawings and additional facilities proposed by Contractor. Do not use site plans in erosion control plan provided by the Engineer.

1.5 GENERAL CONSTRUCTION SCHEDULE

A. Confirm locations of and construct or install silt fences, temporary diversion swales, temporary check dams, temporary sediment traps, inlet protection, and the construction entrance where indicated on the Drawings.

B. After all required erosion control measures are installed begin clearing, grubbing, and stripping topsoil to limits of construction and begin excavation and grading activities.

C. Stockpile topsoil and suitable fill material where indicated on the drawings and protect from siltation. Dispose of waste materials in accordance with the specifications.

D. Begin construction, install necessary temporary and permanent erosion control measures as indicated on the drawings.

E. Establish finished grades at earliest possible date. Apply temporary or permanent soil stabilization to areas within seven (7) days after final grades are established.

F. Areas to be left dormant for longer than 15 days shall be temporarily stabilized within 15 days; otherwise, permanent ground cover shall be established within 30 days.

G. All erosion and sedimentation control measures shall be inspected weekly and after each heavy runoff-producing rainfall. Any needed repairs will be made immediately.

H. Refer to Specification Section 02420 - Fertilizing, Seeding, and Mulching for permanent and temporary vegetation schedules.

I. After ground cover is well established and the entire site is stabilized, remove all temporary measures and install permanent vegetation to all areas disturbed by the temporary measures.

J. Remove temporary erosion control measures within 30 days after final site stabilization.

PART 2 - PRODUCTS

2.1 RIP RAP

A. Comply with TXDOT Standard Specifications Section 432 - Rip rap.

2.2 PERMANENT SEEDING AND MULCHING

A. Comply with Section 02420 - Fertilizing Seeding and Mulching.

2.3 TEMPORARY SEEDING

A. Comply with Section 02420 - Fertilizing Seeding and Mulching.

2.4 MATTING

A. Comply with ARDOT Standard Specification Section 626 “Erosion Control Matting .”

2.5 TEMPORARY MULCHING

A. Comply with Section 02420 - Fertilizing, Seeding, and Mulching.

2.6. CHECK DAM

A. Comply with ARDOT Standard Specifications Section 621 “Temporary Erosion Control Items and Devices.”

2.7 SILT FENCE

A. Comply with ARDOT Standard Specifications Section 621 “Temporary Erosion Control Items and Devices.”

2.8 EROSION CONTROL STONE

A. Comply with ARDOT Standard Specifications Section 621 “Temporary Erosion Control Items and Devices.”

2.9 DRAINAGE STONE

A. Drainage stone, washed, uniformly graded mixture of crushed stone, or crushed or uncrushed gravel conforming to Coarse Aggregate No. 57 or ASTM C-33 to be used as specified.

PART 3 - EXECUTION

3.1 GENERAL

A. Construct temporary and permanent erosion control measures as shown on the plans or as directed by the Resident Project Representative. All permanent erosion control work shall be incorporated into the project at the earliest practicable time. Temporary erosion control measures shall be coordinated with permanent erosion control measures and all other work on the project to assure economical, effective, and continuous erosion control throughout the construction and post construction period and to minimize siltation of rivers, streams, lakes, reservoirs and other impoundments, ground surfaces, or other property.

B. Install temporary and permanent erosion control measures in accordance with these specifications and with the ARDOT Standard Specifications for Highway Construction, latest edition.

C. Driveways, roadways, and parking areas shall be graveled immediately upon completion of grading.

D. Permanent or temporary soil stabilization, which includes seeding, mulching, or ground cover sufficient to prevent erosion, must be applied to portions of the

disturbed area within seven (7) days after final grade is reached anywhere on the site. This includes disturbed areas which are not at final grade but will remain dormant for longer than 15 days.

E. Clean sediment transported onto public roads at the end of each day. Sediment shall be removed by shoveling or sweeping and be transported to a controlled disposal area. Street washing shall be allowed after sediment is removed in this manner.

3.2 TEMPORARY EROSION CONTROL MEASURES

A. Diversion Ditch:

1. Construct sediment traps prior to construction of diversion ditches.

2. Strip topsoil and clear area in accordance with Specifications Section 02110 - Site Clearing.

3. Construct diversion ditch in locations and dimensions as shown on the Drawings and as required.

4. Construct the ditch so that the top of the dike is not lower at any point than the design depth.

5. Vegetate the ridge immediately after construction unless it will remain in place less than 30 days.

6. Line the ditch as shown on the Drawing to reduce erosion in the ditch bottoms.

B. Silt Fence:

1. Filter fabric to be of polypropylene, nylon, polyester, or polyethylene yard with a standard strength of 30 lb/lin. inch (minimum), 85% (minimum) filtering efficiency, and a slurry flow rate of 0.3 gal/sq. ft./minute (minimum). Fabric should contain ultraviolet ray inhibitors and stabilizers to provide a minimum construction life of six months.

2. Posts to be either 4" diameter pine, 2" diameter oak, of 1.33 lb/linear foot steel with a minimum length of four feet.

3. Install silt fence on low side of stockpiles and in locations shown on the Drawings. Extend fence around approximately 90% of the perimeter of the stockpile.

4. Construct silt fence as shown on the drawings.

C. Check Dams:

1. Class B erosion control stone shall be used.

2. Place filter fabric between soil and rip rap and extend across ditch.

3. Rip rap shall not exceed 24" in height at center and slope shall be 2:1.

4. Place rip rap over the ditch banks to keep water from cutting around the dam.

5. Construct check dam to dimensions shown on the Drawings.

D. Block and Gravel Inlet Protection

1. Lay concrete blocks on firm, smooth foundation excavated 3” below storm drain top. Place blocks against drain inlet for lateral support.

2. Place at least one concrete block on its side in each bottom row of blocks.

3. Place wire mesh with ½” openings over all block openings used for drainage.

4. Use No. 57 washed stone to reduce flow rate but allow drainage. Place stone on 2:1 slope to within 3” of top of block.

5. Any soil left exposed between the block and concrete drain inlet should be filled with 3” diameter stones to prevent washing when water flows over blocks into drain.

E. Fabric Inlet Protection:

1. Space 2 x 4-inch wood (or equivalent metal) stakes evenly around the perimeter of the inlet a maximum of three feet apart, and securely drive them into the ground a minimum of 24” deep.

2. To provide needed stability, frame with 2 x 4-inch wood strips around the crest of the overflow area at a maximum of 1.5 feet above the drop inlet crest.

3. Place the bottom 12 inches of fabric in a trench and backfill the trench with at least four inches of crushed stone or 12 inches of compacted soil.

4. Fasten fabric securely to the stakes and frame so that joints overlap to the next stake.

5. It may be required to build a dike on the down slope side of the inlet in order to prevent bypass flow.

F. Sediment Trap:

1. Strip topsoil and clear area in accordance with Specification Section 02110 - Site Clearing.

2. Place acceptable fill for the embankment in accordance with Specification Section 02200 - Earthwork. Over fill the embankment 6" to allow for settlement.

3. Construct the outlet section in the embankment. Place filter fabric between the soil and riprap. Extend the fabric across the spillway foundation and sides of the embankment.

4. Clear the pond area below the elevation of the crest of the spillway to facilitate sediment cleanout.

5. Construct the dam and stone spillway to the dimensions, elevations, and slopes as shown on the Drawings.

6. The Class B erosion control stone used in the stone section shall be a well-graded mixture of stone with a d_{50} size of 9" and a maximum stone size of 14". Work the small stones into the voids of the larger stones. Use No. 57 stone on the face of the spillway.

7. Construct the stone spillway outlet section downstream past the toe of the embankment until stable conditions are reached. Shape the center to confine the outflow stream.

G. Construction Entrance/Exit:

1. Strip topsoil and clear area in accordance with Specification Section 02110, Site Clearing.

2. Place gravel to the specific grade and dimensions as shown on the drawings.

H. Temporary Seeding and Mulching: See Section 02420, Fertilizing, Seeding, and Mulching.

3.3 PERMANENT EROSION CONTROL MEASURES

A. Outlet Stabilization:

1. Ensure that the subgrade for the filter and riprap follows the required lines and grades shown on the drawings. Compact any fill required in the subgrade to the density of the surrounding undisturbed soil. Low areas in the subgrade on undisturbed soil shall be filled by increasing the riprap thickness.

2. The riprap and filter shall conform to the dimensions shown on the drawings.

3. Filter cloth shall meet design requirements and be protected from puncturing and tearing during installation. Repair damage by removing the riprap and placing another piece of filter cloth over the damaged area. All connecting joints should overlap a minimum of one foot. Replace the entire filter cloth as directed by the Resident Project Representative.

4. Construct the apron on zero grade with no overfall at the end. The top of the riprap at the downstream end shall be level with the receiving area.

5. Construct the apron so that it is properly aligned with the receiving stream.

B. Permanent Seeding and Mulching: See Specification Section 02420, Fertilizing, Seeding, and Mulching.

3.4 MAINTENANCE PLAN

A. All erosion control measures shall be inspected weekly and after each heavy-runoff producing rainfall. All needed repairs shall be made immediately to prevent further damage and erosion. Structures and measures that shall be inspected include:

1. Outlet Stabilization: Check for erosion around or below the riprap and if stones have been dislodged. Make needed repairs to prevent further damage.

2. Seeding, Fertilizing, and Mulching: Seeded areas shall be inspected for failure and necessary repairs shall be made within the same season, if possible.

3. Silt Fence: Any fabric which collapses, tears, decomposes, or becomes ineffective will be replaced immediately. Remove sediment deposits behind fence when sediment accumulates to 6".

4. Rock Check Dams: Inspect for significant erosion around the edges and between dams. Install protective rip rap liners in portions of the channel where erosion occurs. Remove sediment accumulated behind the dams as required to prevent damage to channel vegetation. Add stones to dams as required to maintain design height and cross section.

5. Block and Gravel Inlet Protection: Remove sediment when six inches of sediment has accumulated in the sediment pool around the inlet.

6. Fabric Inlet Protection: Any fabric which collapses, tears, decomposes, or become ineffective will be replaced immediately. Remove sediment deposits behind fence when sediment accumulates to six inches.

7. Sediment Trap: Sediment shall be removed from the trap and the trap shall be restored to its original dimensions when 1' of sediment has accumulated in the trap. The sediment will be disposed of and the contaminated part of the gravel will be replaced. The structure shall be checked for damage and the spillway shall be maintained at a minimum of 1.5' below the low point of the embankment. Damages shall be repaired immediately and when settlement of the embankment occurs, fill shall be placed 6" above design grade. Rip rap will be replaced with displaced from the spillway.

8. Stockpiles: Stockpiles shall be checked for sedimentation and stabilization.

9. Diversion Ditches: Inspect for any erosion on the ridge and in the flow areas. Remove sediment when sediment accumulates to 4".

END OF SECTION 02400

SECTION 02410 - STORM WATER PERMIT FOR CONSTRUCTION ACTIVITIES

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Federal and State rules require a permit to discharge storm water runoff from construction sites. Construction activities are covered under the State's "Construction Activities TPDES General Permit No. ARR150000". The Owner will file the Notice of Intent to be covered under the General Permit.

1.2 CONTRACTOR'S RESPONSIBILITY

A. The Contractor is completely responsible for meeting all requirements of the General Permit. The requirements are summarized in this Section, but all requirements contained in the permit shall be met by the Contractor. A copy of the General Permit is included at the end of this Section.

1.3 SUMMARY OF PERMIT REQUIREMENTS

A. The Contractor shall implement and abide by the approved Sedimentation and Erosion Control Plan for this project. The Contractor shall keep a signed copy of the letter of approval of the Plan and a signed copy of the approved Plan on-site at all times. Deviation from the approved Plan, or approved amendment to the Plan, shall constitute a violation of the terms and conditions of the Permit.

B. The Contractor shall at all times provide the operation and maintenance necessary to operate the permitted storm water controls at optimum efficiency.

C. The Contractor shall inspect all sedimentation and erosion control facilities at least once every seven calendar days and within 24 hours after any storm event of greater than 0.5 inches of rain per 24 hour period.

D. The Contractor shall inspect storm water runoff discharges by visual observation for color, foam, outfall staining, visible sheens, dry weather flows and muddy water, at the frequency listed above, to evaluate the effectiveness of the pollution control facilities or practices. If any visible off-site sedimentation is leaving the site, corrective action shall be taken to reduce the discharge of sediments.

E. The Contractor shall keep a detailed record of inspections. Visible sedimentation found off the site shall be recorded with a brief explanation as to the measures taken to prevent future releases as well as any measures taken to clean up the sediment that has left the site. The record shall be made available to State

agencies upon request.

F. The Contractor shall not discharge any sanitary wastewater from the construction activity.

G. The Contractor shall not add any chemicals to the storm water discharge.

H. Herbicide, pesticide, and fertilizer usage during construction activity shall be restricted to those materials approved by EPA and shall be in accordance with label restrictions.

I. The Contractor shall dispose of all wastes composed of building materials in accordance with Arkansas Department of Health and Arkansas Department of Environmental Quality, and rules governing the disposal of solid waste.

J. Equipment utilized during the construction activity on a site shall be operated and maintained in such a manner as to prevent the potential or actual pollution of the surface or ground waters. Fuels, lubricants, coolants, and hydraulic fluids, or any other petroleum products, shall not be discharged on to the ground or into surface waters. Spent fluids shall be disposed of in a manner so as not to enter the surface or ground waters, and in accordance with applicable State and Federal disposal regulations. Any spilled fluids shall be cleaned up to the extent practicable and disposed of in a manner so as not to allow their entry into the surface or ground waters.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 02410

SECTION 02420 - FERTILIZING, SEEDING, AND MULCHING

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Permanent Seeding: Permanent seeding is required for all areas disturbed by construction (except for areas covered by structures, pavements, etc.) within 15 days of completion of construction in any given location. A ground cover sufficient to restrain erosion must be provided within 120 days.

B. Temporary Seeding: Temporary seeding is required for those areas disturbed by construction and left exposed for periods of 30 days or more before being brought to final grade and permanently seeded or when work is completed out of the specified planting season for the permanent seeding mixture.

1.2 QUALITY ASSURANCE

A. Codes and Standards: In general, follow procedures and guides published by the Soil Conservation Service, United States Department of Agriculture.

1.4 SUBMITTALS

A. Submit material certificates signed by the supplier that the materials used for fertilizing, seeding, and mulching comply with these specifications.

PART 2 - PRODUCTS

2.1 FERTILIZER

A. Provide fertilizer based upon guidance in ARDOT Standard Specifications Section 620 “Seeding”

2.2 SEED

A. Provide seed based upon guidance in ARDOT Standard Specifications Section 620 “Seeding”

2.3 MULCH

A. Mulch all seeded areas except where jute mesh is required. Use undamaged, air-dry, threshed small grain straw free of undesirable weed seed.

2.4 JUTE MESH

A. Use jute mesh on seeded areas where slope is steeper than three horizontal to one vertical (3:1 slope). Use woven jute yarn weighing approximately 90 lbs. per 100 sq. yds. and having 3/4" openings.

2.5 CURLED WOOD MATTING (EXCELSIOR MATTING)

A. Use curled wood matting on temporary and permanent ditches and on side slope of existing dikes as indicated on the Drawings.

PART 3 - EXECUTION

3.1 GENERAL

A. Follow procedures set forth in the ARDOT Standard Specification, latest edition, Section 621 “Temporary Erosion Control Items and Devices”

3.2 SEED BED PREPARATION

A. Remove all grass and weeds and shape overall area to even out high and low spots.

B. Spread a minimum of three (3) inches of topsoil over all disturbed areas to the finished grade as shown on the drawings.

C. Scarify soil to a depth of three (3) inches and work into a satisfactory seed bed by discing, use of cultipackers, harrows, drags or other approved means.

D. Preparation outlined above shall not be done when the soil is frozen, wet or otherwise in an unfavorable condition.

E. Begin and complete seeding operations as outlined below as soon as possible after final or intermediate grading is completed.

F. Distribute lime and fertilizer, as required, uniformly over seed bed and harrow, rake, or otherwise work same into seed bed.

G. Distribute seed uniformly over seed bed. Lightly rake surface of seed bed to cover seed to a maximum depth of one-quarter (1/4) inch.

H. Compact seed bed after covering seed with an approved roller or drag.

I. No lime, fertilizer, or seed shall be applied during a strong wind, when soil is wet or otherwise unworkable. Should rain follow seeding before rolling is begun, the bed shall not be rolled.

J. No riprap is to be placed along the banks of new fill. Maintain the area and repair any erosion damage until a permanent ground cover is established. Use mulch or mesh as required.

3.3 APPLICATION OF LIME AND FERTILIZER FOR PERMANENT SEEDING:

A. Lime with 90 lbs. per 1,000 sq. ft. before seeding.

B. Fertilize with 15 lbs. per 1,000 sq. ft. when seeding. Top dress with 10 lbs. per 1,000 sq. ft. when cover is established.

C. Provide permanent seeding to completed areas during the permanent seeding period. If grading is completed at times other than the recommended season, provide temporary seeding or other protection approved by the Engineer until the appropriate planting season begins.

3.4 APPLICATION OF FERTILIZER AND LIME FOR TEMPORARY SEEDING:

A. Fertilize with 15 lbs. per 1,000 sq. ft. when seeding. Top dress with 10 lbs. per 1,000 sq. ft. when cover is established.

B. Lime with 2,000 lb/ac before seeding.

3.5 APPLICATION OF MULCH AND JUTE MESH

A. Apply mulch for temporary and permanent seeding at the rate of 100 lbs. per 1,000 sq. ft. Anchor with asphalt.

B. Apply jute mesh according to the manufacturer's recommendations. Anchor with steel hairpin shaped wire staples.

3.6 REPAIR AND MAINTENANCE

A. Maintain the grass on the area until dense grass growth is established. Reseed bare areas and repair all eroded areas as required to establish dense vegetation.

END OF SECTION 02420

SECTION 02515 - PORTLAND CEMENT CONCRETE PAVEMENT AND PATCHING

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Extent of Portland cement concrete is shown on drawings, including walks and paving.

B. Prepared subbase is specified in “Earthwork” Section.

C. Forms:

1. Steel, wood, or other suitable material of size and strength to resist movement during concrete placement and to retain horizontal and vertical alignment until removal. Use straight forms, free of distortion and defects.

2. Use flexible spring steel forms or laminated boards to form radius bends as required.

3. Coat forms with non-staining form release agent that will not discolor or deface surface of concrete.

PART 2 - PRODUCTS

2.1 WELDED WIRE MESH

A. Welded plain cold-drawn steel wire fabric, ASTM A185.

B. Furnish in flat sheets, not rolls, unless otherwise acceptable to Resident Project Representative.

2.2 REINFORCING BARS

A. Deformed steel bars, ASTM A 615, Grade 60.

2.3 FABRICATED BAR MATS

A. Welded or clip-assembled steel bar or rod mats, ASTM A184. Use ASTM A615, Grade 40 steel bars, unless otherwise indicated.

2.4 CONCRETE MATERIALS

A. Comply with requirements of applicable Division 3 sections for concrete materials, admixtures, bonding materials, curing materials, and others as required.

2.5 EXPANSION JOINT MATERIALS

A. Comply with requirements of applicable Division 7 sections for preformed expansion joint fillers and sealers.

2.6 ANTI-SPALLING COMPOUND

A. 50% (by volume) boiled linseed oil and 50% (by volume) mineral spirits (AASHTO M233).

2.7 CURING AND SEALING COMPOUND

A. TT-C-800, with 30% solids content minimum.

2.8 CONCRETE MIX, DESIGN AND TESTING

A. Comply with requirements of applicable Division 3 Sections for concrete mix design, sampling and testing, and quality control, and as herein specified.

B. Design mix to produce normal weight concrete consisting of Portland cement, aggregate, water-reducing or high-range water-reducing admixture (super-plasticizer), air-entraining admixture and water to produce the following properties:

1. Compressive Strength: 3000 psi minimum at 28 days.

2. Slump Range: 2” - 4”.

3. Air Content: 5% to 8%.

PART 3 - EXECUTION

3.1 PREPARATION

A. Surface Preparation: Remove loose material from compacted subbase surface immediately before placing concrete.

B. Proof-roll prepared subbase surface to check for unstable areas and need for additional compaction. Do not begin paving work until such conditions have been corrected and are ready to receive paving.

3.2 FORM CONSTRUCTION

A. Set form to required grades and lines, rigidly braced and secured. Install sufficient quantity of forms to allow continuous progress of work and so that forms can remain in place at least 24 hours after concrete placement.

B. Check competed form work for grade and alignment to following tolerances:

1. Top of forms not more than 1/8" in 10'.

2. Vertical face on longitudinal axis, not more than ¼" in 10'.

C. Clean forms after each use, and coat with form release agent as often as required to ensure separation from concrete without damage.

3.3 REINFORCEMENT

A. Locate, place, and support reinforcement as specified in Division 3 sections unless otherwise indicated.

3.4 CONCRETE PLACEMENT

A. Comply with requirements of Division 3 sections for mixing and placing concrete, and as herein specified.

B. Do not place concrete until subbase and forms have been checked for line and grade. Moisten subbase if required to provide uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.

C. Place concrete using methods which prevent segregation of mix. Consolidate concrete along face of forms and adjacent to transverse joints with internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Consolidate with care to prevent dislocation of reinforcing, dowels, and joint devices.

D. Deposit and spread concrete in a continuous operation between transverse joints, as far as possible. If interrupted for more than ½ hour, place a construction joint.

3.5 JOINTS

A. Construct expansion, weakened-plane (contraction), and construction joints true-to-line with face perpendicular to surface of concrete. Construct transverse joints at right angles to centerline, unless otherwise indicated.

1. Weakened-Plane (Contraction) Joints: Provide weakened-plane (contraction) joints, sectioning concrete into areas 25' square. Construct weakened-plane joints for a depth equal to at least ¼ concrete thickness, as follows:

   a. Tooled Joints: Form weakened-plane joints in fresh concrete by grooving top portion with a recommended cutting tool and finishing edges with a jointer.

   b. Sawed Joints: Form weakened-plane joints using powered saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut joints into hardened concrete as soon as surface will not be torn, abraded, or otherwise damaged by cutting action.

   c. Inserts: Use embedded strips of metal or sealed wood to form weakened-plane joints. Set strips into plastic concrete and carefully remove strips after concrete has hardened.

2. Construction Joints:

   a. Place concrete joints at end of placements and at locations where placement operations are stopped for a period of more than ½ hour, except where such placements terminate at expansion joints.

   b. Construct joints as shown or if not shown, use standard metal keyway-section forms.

3. Expansion Joints:

   a. Provide pre-molded joint filler for expansion joints abutting concrete curbs, catch basins, manholes, inlets, structures, walks and other fixed objects, unless otherwise indicated.

   b. Locate expansion joints at 50' o.c. for each pavement lane, unless otherwise indicated.

B. Joint Fillers:

1. Extend joint fillers full width and depth of joint, and not less than ½" or more than 1" below finished surface where joint sealer is indicated. If no joint sealer, place top of joint filler flush with finished concrete surface.

2. Furnish joint fillers in one piece lengths for full width being placed, wherever possible. Where more than one length is required, lace or clip joint filler sections together.

3. Protect top edge of joint filler with metal cap or other material during the concrete placement.

3.6 FILLERS AND SEALANTS

A. Comply with the requirements of applicable Division 7 sections for preparation of joints, materials, installation, and performance.

3.7 FINISHING

A. After striking off and consolidating concrete, smooth surface by screeding and floating. Use hand methods only where mechanical floating is not possible. Adjust floating to compact surface and produce uniform texture.

B. After floating, test surface for trueness with a 10' straightedge. Distribute concrete as required to remove surface irregularities, and refloat repaired areas to provide a continuous smooth finish.

C. Work edges of slabs and formed joints with an edging tool and round to ½" radius, unless otherwise indicated. Eliminate tool marks on concrete surface.

D. After completion of floating and troweling when excess moisture or surface sheen has disappeared, complete surface finishing as follows:

1. Broom finish, by drawing a fine-hair broom across concrete surface, perpendicular to line of traffic. Repeat operation if required to provide a fine line texture.

2. Do not remove forms for 24 hours after concrete has been placed. After form removal, clean ends of joints and point up any minor honeycombed areas. Remove and replace areas or sections with major defects, as directed.

E. Curing: Protect and cure finished concrete paving, complying with applicable requirements of Division 3 sections. Use curing and sealing compound or approved moist-curing methods.

Do not use membrane forming materials where anti-spalling treatment will be applied.

F. Anti-Spalling Treatment: Apply compound to concrete surfaces no sooner than 28 days after placement. Apply to clean, dry concrete free of oil, dirt, and other foreign materials, in two (2) sprayed applications. First application at rate of 40 sq. yds. per gallon, second application at 60 sq. yds. per gallon. Allow complete drying between applications.

3.8 REPAIRS AND PROTECTION

A. Repair or replace broken or defective concrete, as directed.

B. Protect concrete from damage until acceptance of work. Exclude traffic from pavement for at least 14 days after placement. When construction traffic is permitted, maintain pavement as clean as possible by removing surface stains and spillage of materials as they occur.

C. Sweep concrete pavement and wash free of stains, discolorations, dirt and other foreign material just prior to final inspection.

END OF SECTION 02515

SECTION 02730 - MANHOLE AND VAULT CONSTRUCTION

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. The extent of number, size, and type of manholes and vaults to be constructed is shown on the Drawings.

B. Installation of manholes and vaults includes, but is not limited to, the following:

1. Preparation of subgrade.

2. Installation.

3. Pipe connection and sealing.

4. Waterproofing.

5. Frames and covers.

6. Backfilling.

C. All manholes and precast vaults are to be constructed of precast concrete sections with watertight joints.

1.2 SUBMITTALS

A. Shop Drawings: Submit Shop Drawings for the system, details of underground structures, metal accessories, fittings, connections, and anti-flotation calculations in accordance with Section 01340 of these Specifications.

PART 2 - PRODUCTS

2.1 CONCRETE MANHOLES AND VAULTS

A. Concrete Base: Precast or cast-in-place as shown on the Drawings.

B. Precast Concrete Manholes and Vaults: ASTM C 478, sized as indicated, with an eccentric cone or flat precast top as shown and O-ring joint conforming to ASTM C 493 or butyl rubber gasket conforming to AASHTO M198. Use flexible connectors with dual stainless steel pipe clamps meeting ASTM C 923 for all pipe diameters. Minimum wall thickness of precast vaults shall be 6". Minimum

manhole thickness shall be 5". All precast manholes and vaults shall be certified as sufficient for the service conditions.

2.2 ACCESSORIES

A. Manhole Frames and Covers: Grey cast iron, ASTM A 48, Class 30 B.

1. Manhole rings and covers shall comply with the following criteria:

a. Minimum Total Weight: 300 lbs.

b. Minimum Weight of Cover: 120 lbs.

c. Minimum Clear Opening: 24 inches.

d. Unvented.

e. Design Live Load: H-20.

f. Bearing Surfaces: Machined.

g. Finish: Unpainted, to be painted on site.

2. Furnish manhole covers with cast-in legend "SANITARY SEWER" or "STORM SEWER" on roadway face.

3. The manhole ring shall be secured to the manhole cone section by cast-in anchors or concrete inserts. Rings shall be fully bedded in a bitumastic sealant for a watertight joint when secured to the top of the concrete manhole cone section.

4. Provide a standard manhole ring and cover designed for H-20 loading.

B. Manhole Steps: Molded plastic, steel reinforced, integrally cast into sidewalls unless otherwise indicated.

PART 3 - EXECUTION

3.1 INSTALLATION OF CONDUIT

A. Precast Concrete Manholes:

1. Inspect precast sections before installation to detect any apparent defects. Mark defective materials with white paint and promptly remove from the site.

2. Particular care shall be taken to prevent damage to sections during handling and installation.

3. Place bell ends of manhole sections or the groove end of concrete facing down. Preparatory to making joints, all surfaces of the portion of the section to be jointed and the factory-made jointing materials shall be clean and dry.

4. Install gaskets in accordance with manufacturer's recommendations for the use of lubricants, cements, and other special installation requirements.

5. Set tops of manhole frames and covers 3" above finish surface, unless otherwise indicated.

3.2 BACKFILLING

A. See Section 02200.

3.3 TESTING

A. Perform testing of completed manholes and conduit lines in accordance with Section 15001.

END OF SECTION 02730

SECTION 03310 - CONCRETE WORK

PART 1 - GENERAL

1.1 SUMMARY OF WORK

A. Extent of concrete work is shown on Drawings.

1.2 SUBMITTALS

A. Product Data: Submit data for proprietary materials and items, including reinforcement and forming accessories, admixtures, patching compounds, waterstops, joint systems, curing compounds, dry-shake finish materials, and others as requested by Engineer.

B. Show Drawings; Reinforcement: Submit original Show Drawings for fabrication, bending, and placement of concrete reinforcement. Comply with ACI 315 "Manual of Standard Practice for Detailing Reinforced Concrete Structures" showing bar schedules, stirrup spacing, diagrams of bent bars, arrangement of concrete reinforcement. Include special reinforcement required for openings through concrete structures.

1. Engineer's review is for general architectural applications and features only. Design of formwork for structural stability and efficiency is Contractor's responsibility.

C. Concrete Mix Design: Submit laboratory test reports for concrete materials and mix design tests or data as specified.

D. Materials Certificates: Provide materials certificates in lieu of materials laboratory test reports when permitted by Engineer. Materials certificates shall be signed by manufacturer and Contractor, certifying that each material item complies with, or exceeds, specified requirements. Provide certification from admixture manufacturers that chloride content complies with Specification requirements.

1.3 QUALITY ASSURANCE

A. Codes and Standards: Comply with provisions of following codes, Specifications, and standards, except where more stringent requirements are shown or specified:

1. ACI 301 "Specifications for Structural Concrete for Buildings".

2. ACI 318 "Building Code Requirements for Reinforced Concrete".

3. Concrete Reinforcing Steel Institute (CRSI), "Manual of Standard Practice".

B. Concrete Mix Design: Employ a testing laboratory acceptable to Engineer to perform material evaluation tests and to design concrete mixes. Concrete mix design shall be at Contractor's expense. Field quality control testing of concrete is an allowance item.

C. Materials and installed work may require testing and retesting at anytime during progress of work. Retesting of rejected materials for installed work shall be done at Contractor's expense.

1.4 PROJECT CONDITIONS

A. Protection of Footings Against Freezing: Cover completed work at footing level with sufficient temporary or permanent cover as required to protect footings and adjacent subgrade against possibility of freezing; maintain cover for time period as necessary.

B. Protect adjacent finish materials against spatter during concrete placement.

PART 2 - PRODUCTS

2.1 FORM MATERIALS

A. Forms for Exposed Finish Concrete: Plywood, metal, metal-framed plywood faced, or other acceptable panel-type materials, to provide continuous, straight, smooth, exposed surfaces. Furnish in largest practicable sizes to minimize number of joints and to conform to joint system shown on Drawings.

B. Forms for Unexposed Finish Concrete: Plywood, lumber, metal, or other acceptable material. Provide lumber dressed on at least two (2) edges and one (1) side for tight fit.

C. Form Coatings: Provide commercial formulation form-coating compounds that will not bond with, stain, nor adversely affect concrete surfaces, and will not impair subsequent treatments of concrete surfaces.

D. Form Ties: Factory-fabricated, adjustable-length, removable or snap-off metal form ties with cones, designed to prevent form deflection and to prevent spalling concrete upon removal. Provide units which will leave no metal closer than 1-1/2" to surface.

1. Provide ties with cones which, when removed, will leave holes not larger than 1" diameter in concrete surface.

2.2 REINFORCING MATERIALS

A. Reinforcing Bars: ASTM A 615, Grade 60, deformed.

B. Steel Wire: ASTM A 82, plain, cold-drawn steel.

C. Welded Wire Fabric: ASTM A 185, welded steel wire fabric - flat sheets only.

D. Welded Deformed Steel Wire Fabric: ASTM A 497.

E. Supports for Reinforcement: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire fabric in place. Use wire bar type supports complying with CRSI Specifications.

1. For slabs-on-grade, use supports with sand plates or horizontal runners where base material will not support chair legs or 6,000 psi solid concrete blocks meeting CRSI requirements.

2. For exposed-to-view concrete surfaces, where legs of supports are in contact with forms, provide supports with legs which are plastic protected (CRSI, Class 1) or stainless steel protected (CRSI, Class 2).

2.3 CONCRETE MATERIALS

A. Portland Cement: ASTM C 150, Type I or II.

B. Use one (1) brand of cement throughout project, unless otherwise acceptable to Engineer.

C. Fly Ash: ASTM C 618, Type C or Type F. Amount of fly ash not to exceed 25% by weight of total cementitious material.

D. Ground Granulated Blast Furnace Slag: ASTM C-989. Amount of slag not to exceed 50% by weight of total cementitious material.

E. Normal Weight Aggregates: ASTM C 33, and as herein specified. Use No. 57 (1") or No. 467 (1-1/2") coarse aggregate. Provide aggregates from a single source for exposed concrete.

1. For exterior exposed surfaces, do not use fine or coarse aggregates containing spalling-causing deleterious substances.

F. Water: Drinkable.

G. Air-Entraining Admixture: ASTM C 260, certified by manufacturer to be compatible with other required admixtures.

1. Products: Subject to compliance with requirements, provide product equal to one (1) of the following:

    a. "Air-Mix"; Euclid Chemical Co.

    b. "Sika Aer"; Sika Corp.

    c. "MB-VR or MB-AE"; Master Builders.

    d. "Darex AEA" or "Daravair"; W.R. Grace.

    e. "Edoco 2001 or 2002"; Edoco Technical Products.

    f. "Air-Tite"; Gifford-Hill/American Admixtures.

H. Water-Reducing Admixture: ASTM C 494, Type A, and containing not more than 0.1 percent chloride ions.

1. Products: Subject to compliance with requirements, provide product equal to one (1) of the following:

    a. "WRDA Hycol"; W.R. Grace.

    b. "PSI N"; Gifford-Hill/American Admixtures

    c. "Eucon WR-75"; Euclid Chemical Co.

    d. "Pozzolith Normal"; Master Builders.

    e. "Plastocrete 160"; Sika Chemical Corp.

    f. "Chemtard"; Chem-Masters Corp.

    g. "Pro-Kete-N"; Protex Industries, Inc.

I. High-Range Water-Reducing Admixture (Super Plasticizer): ASTM C 494, Type F or Type G and containing not more than 0.1 percent chloride ions.

1. Products: Subject to compliance with requirements, provide product equal to one (1) of the following:

    a. "WRDA 19" or "Daracem"; W.R. Grace.

    b. "PSP"; Protex Industries Inc.

    c. "Super P"; Anti-Hydro.

d. "Sikament"; Sika Chemical Corp.

e. "Mighty 150"; ICI Americas Corp.

f. "Eucon 37"; Euclid Chemical Co.

g. "PSI Super"; Gifford-Hill.

h. "Rheobuild"; Master Builders.

J. Water-Reducing, Non-Chloride Accelerator Admixture: ASTM C 494, Type E, and containing not more than 0.1 percent chloride ions.

1. Products: Subject to compliance with requirements, provide product equal to one (1) of the following:

a. "Accelquard 80"; Euclid Chemical Co.

b. "Pozzolith High Early"; Master Builders.

c. "Gilco Accelerator"; Gifford-Hill/American Admixtures

K. Water-Reducing, Retarding Admixture: ASTM C 494, Type D, and containing not more than 0.1 percent chloride ions.

1. Products: Subject to compliance with requirements, provide product equal to one (1) of the following:

a. "Pozzolith Retarder"; Master Builders.

b. "Eucon Retarder 75"; Euclid Chemical Co.

c. "Daratard"; W.R. Grace.

d. "PSI R"; Gifford-Hill/American Admixtures.

e. "Plastiment"; Sika Chemical Co.

L. Prohibited Admixtures: Calcium chloride thyocyanates or admixtures containing more than 0.1 percent chloride ions are not permitted.

2.4 RELATED MATERIALS

A. Expanding Rubber Waterstops: Use expanding rubber waterstops in all joints of sanitary slabs and walls which retain water. Waterstops and accessories shall be "Adeka Ultra Seal" or equal. For pricing and availability call Adeka Ultra Seal at 1-800-999-3959.

1. At joints use Adeka Ultra Seal MC-2010M preformed rubber waterstop or equal.

2. Use Ultra Seal P-201 hydrophilic caulk (or equal) and accessories as required for proper installation of MC-2010M.

B. Vapor Barrier: Provide a vapor barrier where indicated on Drawings below slabs on grade. Use a laminated vapor barrier which is resistant to decay when tested in accordance with ASTM E 154.

1. Select one (1) of the following or an approved equal:

a. Moistop by Fortifiber Corp.

b. T-65 by Griffolyn

c. Rufco 400 by Raven Industries

C. Non-Shrink Grout: CRD-C 621 or ASTM C-1107, factory pre-mixed grout.

1. Products: Subject to compliance with requirements, provide product equal to one (1) of the following:

a. Non-metallic:

(1) "Set Grout"; Master Builders.

(2) "Sonogrout"; Sonneborn-Rexnord.

(3) "Euco-NS"; Euclid Chemical Co.

(4) "Supreme"; Gifford-Hill/American; Admixtures.

(5) "Crystex"; L & M Const. Chemical Co.

(6) "Sure-Grip Grout"; Dayton Superior Corp.

(7) "Horngrout"; A.C. Horn, Inc.

(8) "Five Star Grout"; U.S. Grout Corp.

D. Absorptive Cover: Burlap cloth made from jute or kenaf, weighing approximately 9 oz. per sq. yd., complying with AASHTO M 182, Class 2.

E. Moisture-Retaining Cover: One of the following, complying with ASTM C 171.

1. Waterproof paper.

2. Polyethylene film.

3. Polyethylene-coated burlap.

F. Curing Compound: ASTM C-309

1. Formed surfaces shall be cured with an oxidizing compound equal to Resi-Chem Clear Cure by Symons.

2. Slabs shall be cured with one (1) of the following 30% solids compounds:

a. "Masterkure" by Master Builders

b. "Super Rez-Seal" by Euclid Chemical Co.

c. "Kure-N-Seal 30" by Sonneborn Building Products

d. "Dress & Seal 30" by L & M Construction Chemicals Co.

H. Bonding Compound: Polyvinyl acetate or acrylic base.

1. Products: Subject to compliance with requirements, provide product equal to one (1) of the following:

a. Polyvinyl Acetate (Interior Only):

(1) "Euco Weld"; Euclid Chemical Co.

(2) "Weldcrete"; Larsen Products Corp.

b. Acrylic or Styrene Butadiene:

(1) "J-40 Bonding Agent"; Dayton Superior Corp.

(2) "Everbond"; L & M Construction Chemicals.

(3) "Hornweld"; A.C. Horn, Inc.

(4) "Sonocrete"; Sonneborn-Rexnord.

(5) "Acrylic Bondcrete"; The Burke Co.

(6) "SBR Latex"; Euclid Chemical Co.

(7) "Daraweld C"; W.R. Grace

I. Epoxy Adhesive: ASTM C 881, two (2) component materials suitable for use on dry or damp surfaces. Provide material "Type", "Grade", and "Class" to suit project requirements.

1. Products: Subject to compliance with requirements, provide product equal to one (1) of the following:

a. "Thiopoxy"; W.R. Grace.

b. "Epoxtite"; A.C. Horn, Inc.

c. "Edoco 2118 Epoxy Adhesive"; Edoco Technical Prod.

d. "Sikadur Hi-Mod"; Sika Chemical Corp.

e. "Euco Epoxy 452 or 620"; Euclid Chemical Co.

f. "Patch and Bond Epoxy"; The Burke Co.

g. "Concresive 1001"; Adhesive Engineering Co.

J. Concrete Repair Grout: For the repair of defective areas of concrete.

1. For vertical and overhead surfaces, use one (1) of the following:

a. "Five Star Structural Concrete V/O"; Five Star Products, Inc.

b. "Euco Verticoat"; Euclid Chemical Co.

c. "Sikatop 122"; Sika Corp.

2. For horizontal surfaces, use one (1) of the following:

a. "Five Star Structural Concrete"; Five Star Products, Inc.

b. "Concrete Coat"; Euclid Chemical Co.

c. "Sikatop 122"; Sika Corp.

K. Concrete Coating: For finishing all new formed concrete exposed to view, exterior and interior.

1. Products: Use Thoroseal by Thoro or approved equal. Color to be pearl gray to match existing concrete finishes.

2.5 PROPORTIONING AND DESIGN OF MIXES

A. Prepare design mixes for each type and strength of concrete by either laboratory trial batch or field experience methods as specified in ACI 301. If trial batch method is used, use an independent testing facility acceptable to Engineer for preparing and reporting proposed mix designs.

B. Submit written reports to Structural Engineer of each proposed mix for each class of concrete at least 25 days prior to start of work. Do not begin concrete production until mixes have been reviewed by Engineer.

C. Design mixes to provide normal weight concrete with the following properties and proportions:

1. Compressive strength shall be as shown on Drawings.

2. Design mix for sanitary structures and floor slabs shall contain either 12% to 25% fly ash or 25% to 50% ground granulated blast furnace slag as a percent of total cementitious material.

3. Maximum slump shall be as shown on Drawings and shall be measured before the addition of a H.R.W.R. See Admixtures below for where a H.R.W.R. is required.

4. Maximum water/cement ratio of 0.45 for all concrete used in sanitary structures and floor slabs.

5. Leveling grout used for filling CMU cells or as leveling grout shall be a mixture of sand and cement and shall have a compressive strength of 3000 psi at 28 days unless noted otherwise on Drawings.

6. Wall base grout used for the first lift in sanitary walls (see Paragraph 3.8, C.) shall have pea gravel for a course aggregate and a maximum water/center ratio of 0.45 and a minimum compressive strength of 4000 psi at 28 days.

D. Adjustment to Concrete Mixes: Mix design adjustments may be requested by Contractor when characteristics of materials, job conditions, weather, test results, or other circumstances warrant, at no additional cost to Owner and as accepted by Engineer. Laboratory test data for revised mix design and strength results must be submitted to and accepted by Engineer before using in work.

E. Admixtures:

1. Use water-reducing admixture or high range water-reducing admixture (H.R.W.R.) in concrete as required for placement and workability. An H.R.W.R. is required for all concrete in walls and for other concrete which is pumped. It is optional for other concrete which is not pumped.

2. Use non-chloride accelerating admixture in concrete slabs placed at ambient temperatures below 50 degrees F (10 degrees C).

3. Use air-entraining admixture in all concrete. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having total air content within following limits:

a. Concrete structures and slabs exposed to freezing and thawing, deicer chemicals, or subjected to hydraulic pressure:

(1) 5.5 ± 1 percent: No. 467 aggregate (1½")

(2) 6.0 ± 1 percent: No. 57 (1")

b. Other Concrete (not exposed to freezing, thawing, or hydraulic pressure): two (2) percent to four (4) percent air.

2.6 CONCRETE MIXING

A. Ready-Mix Concrete: Comply with requirements of ASTM C 94, and as herein specified.

B. During hot weather, or under conditions contributing to rapid setting of concrete, a shorter mixing time than specified in ASTM C 94 may be required.

1. When air temperature is between 85 degrees F (30 degrees C) and 90 degrees F (32 degrees C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes, and when air temperature is above 90 degrees F (32 degrees C), reduce mixing and delivery time to 60 minutes.

2. For concrete structures greater than 3 feet in thickness, the temperature of the mix shall be controlled by approved methods to a temperature not greater than 70 degrees F at the time of placement.

PART 3 - EXECUTION

3.1 GENERAL

A. Coordinate the installation of joint materials and vapor retarders with placement of forms and reinforcing steel.

3.2 FORMS

A. Design, erect, support, brace, and maintain formwork to support vertical and lateral, static, and dynamic loads that might be applied until such loads can be supported by concrete structure. Construct formwork so concrete members and structures are of correct size, shape, alignment, elevation, and position. Maintain formwork construction tolerances complying with ACI 347.

B. Design formwork to be readily removable without impact, shock, or damage to cast-in-place concrete surfaces and adjacent materials.

C. Construct forms to sizes, shapes, lines, and dimensions shown, and to obtain accurate alignment, location, grades, level and plumb work in finished structures. Provide for openings, offsets, sinkages, keyways, recesses, moldings, rustications, reglets, chamfers, blocking, screeds, bulkheads, anchorages and inserts, and other features required in work. Use selected materials to obtain required finishes. Solidly butt joints and provide back-up at joints to prevent leakage of cement paste.

D. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush plates or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces where slope is too steep to place concrete with bottom forms only. Kerf wood inserts for forming keyways, reglets, recesses, and the like, to prevent swelling and for easy removal.

E. Provide temporary openings where interior area of formwork is inaccessible for cleanout, for inspection before concrete placement, and for placement of concrete. Securely brace temporary openings and set tightly to forms to prevent loss of concrete mortar. Locate temporary openings on forms at inconspicuous locations.

F. Chamfer all exposed corners and edges unless noted otherwise, using wood, metal, PVC, or rubber chamfer strips fabricated to produce uniform smooth lines and tight edge joints.

G. Provisions for Other Trades: Provide openings in concrete formwork to accommodate work of other trades. Determine size and location of openings, recesses, and chases from trades providing such items. Accurately place and securely support items built into forms.

H. Cleaning and Tightening: Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, or other debris just before concrete is placed. Retightening forms and bracing after concrete placement is required to eliminate mortar leaks and maintain proper alignment.

3.3 VAPOR RETARDER INSTALLATION

A. Following leveling and tamping of granular base for slabs on grade, place vapor retarder sheeting with longest dimension parallel with direction of pour.

B. Lap joints 6" and seal with appropriate tape.

3.4 PLACING REINFORCEMENT

A. Comply with Concrete Reinforcing Steel Institute's recommended practice for "Placing Reinforcing Bars", for details and methods of reinforcement placement and supports, and as herein specified.

1. Avoiding cutting or puncturing vapor retarder during reinforcement placement and concreting operations.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other materials which reduce or destroy bond with concrete.

C. Accurately position, support, and secure reinforcement against displacement by formwork, construction, or concrete placement operations. Locate and support reinforcing by metal chairs, runners, bolsters, spacers, and hangers, as required.

D. Place reinforcement to obtain at least minimum coverages for concrete protection. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement operations. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces.

E. Install welded wire fabric in as long lengths as practicable. Lap adjoining pieces at least one (1) full mesh and lace splices with wire. Offset end laps in adjacent widths to prevent continuous laps in either direction.

3.5 JOINTS

A. Construction Joints: Locate and install construction joints as indicated or, if not indicated, locate so as not to impair strength and appearance of the structure, as acceptable to Engineer.

B. Place construction joints perpendicular to main reinforcement. Continue reinforcement across construction joints, except as otherwise indicated.

C. Waterstops: Provide waterstops in all joints of walls and slabs which retain water, whether indicated on the Drawings or not. Follow manufacturer's instructions for installation of all other type waterstops. Make provisions to support and protect exposed waterstops during progress of work. Install waterstops to form a continuous diaphragm by connecting waterstops at intersecting joints. Fabricate field joints in waterstops in accordance with manufacturer's printed instructions.

1. Allow a minimum of 2 inches of concrete cover (or more if required by manufacturer) on all sides of waterstops.

2. Over rough surfaces apply a continuous bead of caulk applied hydrophilic compound (Adeka P-201 or equal) and install the rubber waterstop over the caulk.

3. At straight intersections lap waterstop and apply hydrophilic caulk over joint.

4. At corners cut the waterstop to fit the corners closely and apply hydrophilic caulk over joint.

D. Isolation Joints in Slabs-on-Ground: Construct isolation joints in slabs-on-ground at points of contact between slabs-on-ground and vertical surfaces, such as column pedestals, foundation walls, grade beams, and elsewhere as indicated.

1. Joint filler and sealant materials are specified in Division-7 Sections of these Specifications.

E. Contraction (Control) Joints in Building Slabs-on-Grade: Construct contraction joints in slabs-on-grade to form panels of patterns as shown. Use saw cuts 1/8" x 1/4 slab depth, unless otherwise indicated.

3.6 INSTALLATION OF EMBEDDED ITEMS

A. General: Set and build into work anchorage devices and other embedded items required for other work that is attached to, or supported by, cast-in-place concrete. Use setting Drawings, diagrams, instructions, and directions provided by suppliers of items to be attached thereto.

B. Install reglets to receive top edge of foundation sheet waterproofing, and to receive thru-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, relieving angles, and other conditions.

C. Edge Forms and Screed Strips for Slabs: Set edge forms or bulkheads and intermediate screed strips for slabs to obtain required elevations and contours in finished slab surface. Provide and secure units sufficiently strong to support types of screed strips by use of strike-off templates or accepted compacting type screeds.

3.7 PREPARATION OF FORM SURFACES

A. Clean re-used forms of concrete matrix residue, repair and patch as required to return forms to acceptable surface condition.

B. Coat contact surfaces of forms with a form-coating compound before reinforcement is placed.

C. Thin form-coating compounds only with thinning agent of type, amount, and under conditions of form-coating compound manufacturer's directions. Do not allow excess form-coating material to accumulate in forms or to come into contact with in-place concrete surfaces against which fresh concrete will be placed. Apply in compliance with manufacturer's instructions.

D. Coat steel forms with a non-staining, rust-preventative form oil or otherwise protect against rusting. Rust-stained steel formwork is not acceptable.

3.8 CONCRETE PLACEMENT

A. Preplacement Inspection: Before placing concrete, inspect and complete formwork installation, reinforcing steel, and items to be embedded or cast-in. Notify other crafts to permit installation of their work; cooperate with other trades in setting such work. Moisten wood forms immediately before placing concrete where form coatings are not used.

1. Apply temporary protective covering to lower 2' of finished walls adjacent to poured floor slabs and similar conditions, and guard against spattering during placement.

B. General: Comply with ACI 304 "Recommended Practice for Measuring, Mixing, Transporting, and Placing Concrete", and as herein specified.

1. Deposit concrete continuously or in layers of such thickness that no concrete will be placed on concrete which has hardened sufficiently to cause the formation of seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as herein specified. Deposit concrete as nearly as practicable to its final location to avoid segregation.

2. Water shall not be added at the site without permission from the A/E Field Representative. Any water which is added shall be recorded on the Delivery Ticket and Test Report.

C. Placing Concrete in Forms: Deposit concrete in forms in horizontal layers not deeper than 24" and in a manner to avoid inclined construction joints. Where placement consists of several layers, place each layer while preceding layer is still

plastic to avoid cold joints. Do not drop concrete a vertical distance greater than five (5) feet. To place concrete lifts greater than five (5) feet, use a hose, drop chute, or other approved method.

1. First lift at bottom of wall is to be a 6" (minimum) layer of wall base grout (see mix design) to avoid honeycombing around key. Grout lift may be omitted at non-critical walls at the discretion of the Engineer.

2. Consolidate placed concrete by mechanical vibrating equipment supplemented by hand-spading, rodding, or tamping. Use equipment and procedures for consolidation of concrete in accordance with ACI 309.

3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations not farther than visible effectiveness of machine. Place vibrators to rapidly penetrate placed layer and at least 6" into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to set. At each insertion limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing segregation of mix.

D. Placing Concrete Slabs: Deposit and consolidate concrete slabs in a continuous operation, within limits of construction joints, until the placing of a panel or section is completed.

1. Consolidate concrete during placing operations so that concrete is thoroughly worked around reinforcement and other embedded items and into corners.

2. Bring slab surfaces to correct level with straightedge and strikeoff. Use bull floats or darbies to smooth surface, free of humps or hollows. Do not disturb slab surfaces prior to beginning finishing operations.

3. Maintain reinforcing in proper position during concrete placement operations.

E. Cold Weather Placing: Protect concrete work from physical damage or reduced strength which could be caused by frost, freezing actions, or low temperatures, in compliance with ACI 306.

1. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.

2. Do not use calcium chloride, salt, and other materials containing antifreeze agents or chemical accelerators, unless otherwise accepted in mix designs.

F. Hot Weather Placing: When the ambient air temperature is above 85 degrees F, provisions shall be made to account for hot weather.

1. During hot weather concreting, the Contractor shall submit to the A/E Field Engineer for acceptance the method of maintaining proper temperature and moisture during the mixing, placing, and curing period. In general, concrete shall be controlled as recommended in ACI 305R.

2. The temperature of the concrete as placed shall not exceed 90 degrees F. The mixing water and/or aggregates shall be cooled, if necessary, to maintain a satisfactory placing temperature.

3. See "Concrete Curing and Protection" under Part 3 of this section for curing methods required during hot weather placement.

3.9 FINISH OF FORMED SURFACES

A. Rough Form Finish: For formed concrete surfaces not exposed-to- view in the finish work or by other construction, unless otherwise indicated. This would include wall surfaces one (1) foot or greater below grade or the normal water level. This is the concrete surface having texture imparted by form facing material used, with tie holes and defective areas repaired and patched and fins and other projections exceeding 1/4" in height rubbed down or chipped off.

B. Smooth Form Finish: For formed concrete surfaces that are to be covered with a coating material applied directly to concrete, or a covering material applied directly to concrete, such as waterproofing, dampproofing, veneer plaster, or other similar system. This is as-cast concrete surface obtained with selected form facing material, arranged orderly and symmetrically with a minimum of seams. Repair and patch defective areas with fins or other projections completely removed and smoothed.

C. Concrete Coating Finish: For all new formed concrete exposed to view, exterior and interior. This would include exposed wall surfaces extending to one foot below grade or one foot below the lower limit of the normal water line. Use smooth, high quality forms. Chip away all high spots.

1. Surfaces shall be wet cured or cured with a curing compound compatible with the coating.

2. Prepare substrate by wet blasting or other approved method. Follow manufacturer's recommendations for surface preparation.

3. Apply two coats of concrete coating with each coat being 1/16" thick minimum. Follow manufacturer's recommendations for application and curing.

4. A manufacturer's representative shall be present at the site during the first application to assure that all recommendations are being followed.

D. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces occurring adjacent to formed surfaces, strike-off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

3.10 MONOLITHIC SLAB FINISHES

A. Float Finish: Apply float finish to monolithic slab surface to receive trowel finish and other finishes as hereinafter specified, and slab surfaces which are to be covered with membrane or elastic waterproofing, membrane or elastic roofing, or sand-bed terrazzo, and as otherwise indicated.

1. After screeding, consolidating, and leveling concrete slabs, do not work surface until ready for floating. Begin floating when surface water has disappeared or when concrete has stiffened sufficiently to permit operation of power-driven floats, or both. Consolidate surface with power-driven floats, or by hand-floating if area is small or inaccessible to power units. Check and level surface plane to tolerances of F_F 18 - F_L 15. Cut down high spots and fill low spots. Uniformly slope surfaces to drains. Immediately after leveling, refloat surface to a uniform, smooth, granular texture.

B. Trowel Finish: Apply trowel finish to interior monolithic slab surfaces to be exposed-to-view, and slab surfaces to be covered with resilient flooring, carpet, ceramic or quarry tile, paint, or other thin film finish coating, system.

1. After floating, begin first trowel finish operation using a power-driven trowel. Begin final troweling when surface produces a ringing sound as trowel is moved over surface. Consolidate concrete surface by final hand-troweling operation, free of trowel marks, uniform in texture and appearance, and with surface leveled to tolerances of F_F 20 - F_L 17. Grind smooth surface defects which would telegraph through applied floor covering system.

C. Trowel and Fine Broom Finish: At all interior ramps, apply trowel finish as specified, then immediately follow with slightly scarifying surface by fine brooming.

D. Float and Medium Broom (Non-Slip) Finish: Apply non-slip broom finish to exterior concrete platforms, steps, ramps, walkways, tank slabs, channel slabs, and elsewhere as indicated.

1. Immediately after float finishing, slightly roughen concrete surface by brooming with fiber bristle broom perpendicular to main traffic route. Coordinate required final finish with Engineer before application.

E. Scratch Finish: Slab surfaces to receive a grout overlay or other cementitious application shall be thoroughly raked or wire broomed after partial setting (within two (2) hours after placing) to roughen surface to insure a permanent bond between base slab and applied cementitious materials.

3.11 CONCRETE CURING AND PROTECTION

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

B. All concrete surfaces shall be cured for a minimum of 10 days by one (1) of the following methods and in accordance with ACI 301.

C. Curing Methods: Perform curing of concrete by curing compound, by moist curing, by moisture-retaining cover curing, or by combinations thereof, as herein specified.

D. Provide moisture curing by one (1) of the following methods.

1. Keep concrete surface continuously wet by covering with water.

2. Continuous water-fog spray.

3. Covering concrete surface with specified absorptive cover, thoroughly saturating cover with water and keeping continuously wet. Place absorptive cover to provide coverage of concrete surfaces and edges, with 4" lap over adjacent absorptive covers.

E. Provide moisture-cover curing as follows: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width with sides and ends lapped at least 3" and sealed by waterproof tape of adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

F. Provide curing by membrane curing compound as follows:

1. Apply one (1) coat of specified curing compound to concrete at the manufacturer's recommended rate. Apply uniformly in continuous operation by power-spray or roller. Recoat areas subjected to heavy rainfall within 3 hours after initial application. Maintain continuity of coating and repair damage during curing period.

2. Do not use membrane curing compounds on concrete surfaces which are to receive liquid floor hardener, waterproofing, dampproofing, membrane roofing, flooring (such as ceramic or quarry tile, glue-down carpet), painting, or other coatings and finish materials, unless the Contractor obtains written verification from the manufacturer that his product is compatible with the curing compound.

3. During hot weather concreting if a curing compound is used, the slab shall still be moist cured for 12 hours immediately following initial set.

G. Curing Formed Surfaces: Cure formed concrete surfaces, including undersides of beams, supported slabs, and other similar surfaces by moist curing with forms in place for full curing period. In hot weather keep the forms moist. If forms are removed before the end of the curing period, continue curing by methods specified above, as applicable. See Part 2 for type of curing compound to use on walls.

1. Hot Weather Curing: During hot weather concreting keep forms moist and covered with plastic during the curing period. If forms are removed before the end of the curing period, apply a curing compound, keep walls moist, and cover with plastic for the remainder of the curing period.

H. Curing Unformed Surfaces: Cure unformed surfaces, such as slabs, floor topping, and other flat surfaces by any of the approved curing methods.

3.12 REMOVAL OF FORMS

A. Formwork not supporting weight of concrete, such as sides of beams, walls, columns, and similar parts of the work, except gravity walls may be removed after cumulatively curing at not less than 50 degrees F (10 degrees C) for 48 hours after placing concrete, provided concrete is sufficiently hard to not be damaged by form removal operations, and provided curing and protection operations are maintained.

B. Formwork supporting weight of concrete, such as beam soffits, joists, slabs, and other structural elements, may not be removed in less than 14 days and until concrete has attained design minimum compressive strength at 28 days. Determine potential compressive strength of in-place concrete by testing field-cured specimens representative of concrete location or members.

C. Form facing material may be removed four (4) days after placement, only if shores and other vertical supports have been arranged to permit removal of form facing material without loosening or disturbing shores and supports.

3.13 RE-USE OF FORMS

A. Clean and repair surfaces of forms to be re-used in work. Split, frayed, delaminated, or otherwise damaged form facing material will not be acceptable for exposed surfaces. Apply new form coating compound as specified for new formwork.

B. When forms are extended for successive concrete placement, thoroughly clean surfaces, remove fins and laitance, and tighten forms to close joints. Align and secure joint to avoid offsets. Do not use "patched" forms for exposed concrete surfaces.

3.14 MISCELLANEOUS CONCRETE ITEMS

A. Filling-In: Fill-in holes and openings left in concrete structures for passage of work by other trades, unless otherwise shown or directed, after work of other trades is in place. Mix, place, and cure concrete as herein specified, to blend with in-place construction. Provide other miscellaneous concrete filling shown or required to complete work.

B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations, as shown on Drawings. Set anchor bolts for machines and equipment to template at correct elevations, complying with certified diagrams or templates of manufacturer furnishing machines and equipment.

1. Grout base plates and foundations as indicated, using specified non-shrink grout. Use non-metallic grout for exposed conditions, unless otherwise indicated.

D. Reinforced Masonry: Provide concrete grout for reinforced masonry lintels and bond beams where indicated on Drawings and as scheduled. Maintain accurate location of reinforcing steel during concrete placement.

3.15 REMOVAL OF EXISTING CONCRETE

A. See Drawings for locations of existing walls and slabs to be removed. See Drawings for dowels and other requirements which may not be stated below.

B. Where new concrete is to be placed against the cut surface of an existing wall or slab, then the wall or slab may be sawcut clear through or it may be sawcut 1" deep (minimum) on exposed surfaces and the remainder chipped away. If chipping is done, then the Contractor must take precautions not to damage the existing concrete which is to remain.

C. Where the cut surface of the wall or slab is to be exposed to water or earth but not exposed to view, then the wall or slab is to be sawcut clear through. At all exposed rebars, chip out the concrete around the rebar for a distance of 2" and to a depth of 1/4". Apply Five Star Structural Concrete (V.O.) to the chipped-out area with a trowel to obtain a 1/2" cover over the rebar.

D. Where the cut surface of the wall or slab is to be exposed-to-view, then the entire cut surface is to be roughened to obtain a 1/8" amplitude. Five Star Structural Concrete is to be applied with forms to achieve a smooth surface with at least 1" thickness.

3.16 CONCRETE SURFACE REPAIRS

A. Formed Surfaces: Normal form tie holes shall be filled with a sand-cement grout applied with a bonding agent. Defective areas due to spalls, air bubbles, honeycombing, or segregation with a void depth (after weak material is chipped out) greater than or equal to 1/2" shall be repaired with a concrete repair grout specified in this Section. The defective area shall be chipped out to solid concrete such that the thickness of patching material is at least 1/4" all around. Do not feather-edge. At defective areas exposed-to-view, the A/E may substitute a sand-cement grout applied with a bonding agent to more closely match the color of the wall.

B. Slabs:

1. Repair spalls and holes by sawcutting with square cuts and chipping to a minimum depth of 1/2" and patching with a concrete repair grout specified herein. Do not feather-edge.

2. Cracks which are 1/16" to 1/4" are to be filled with "Crack Fill 4" by Metzger/McGuire. Cracks greater than 1/4" are to be filled with "MM-80" by Metzger/McGuire. Follow manufacturer's recommendations.

3. Severely defective areas which cannot be repaired by one (1) of the above methods shall be removed and replaced at the Contractor's expense.

C. For surface preparation and installation of concrete repair grouts, follow manufacturer's recommended procedures.

3.17 QUALITY CONTROL TESTING DURING CONSTRUCTION

A. A testing laboratory will be employed by the Owner and paid by the Owner to perform tests and to submit test reports. The testing laboratory must be approved by the Engineer.

B. Sampling and testing for quality control during placement of concrete shall include the following, as directed by Engineer.

C. Sampling Fresh Concrete: ASTM C 172, except modified for slump to comply with ASTM C 94.

1. Slump: ASTM C 143; one (1) test at point of truck discharge for each day's pour of each type of concrete; additional tests when concrete consistency seems to have changed.

2. Air Content: ASTM C 173, volumetric method for lightweight or normal weight concrete; ASTM C 231 pressure method for normal weight concrete; one (1) for each day's pour of each type of air-entrained concrete.

3. Concrete Temperature: Test hourly when air temperature is 40 degrees F (4 degrees C) and below, and when 80 degrees F (27 degrees C) and above; and each time a set of compression test specimens made.

4. Compression Test Specimen: ASTM C 31; one (1) set of four (4) standard cylinders for each compressive strength test, unless otherwise directed. Mold and store cylinders for laboratory cured test specimens except when field-cure test specimens are required. The Contractor shall provide the testing laboratory with an approved container to store test cylinders on site for 24 hours.

5. Compressive Strength Tests: ASTM C 39; one (1) set for each day's pour exceeding five (5) cu. yds. plus additional sets for each 100 cu. yds. over and above the first 50 cu. yds. of each concrete class placed in any one (1) day; one (1) specimen tested at seven (7) days, two (2) specimens tested at 28 days, and one (1) specimen retained in reserve for later testing if required.

6. When frequency of testing will provide less than five (5) strength tests over the life of the project for a given class of concrete, conduct testing from at least five (5) randomly selected batches or from each batch if fewer than five (5) are used.

D. Test results will be reported in writing to the Engineer and Contractor within 24 hours after tests. Reports of compressive strength tests shall contain the project identification name and number, date of concrete placement, name of concrete testing service, concrete type and class, location of concrete batch in structure, design compressive strength at 28 days, concrete mix proportions and materials; compressive breaking strength and type of break for both 7-day tests and 28-day tests.

E. Additional Tests: The testing service will make additional tests of in-place concrete when test results indicate specified concrete strengths and other characteristics have not been attained in the structure, as directed by Engineer. Testing service may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42, or by other methods as directed. Contractor shall pay for such tests when unacceptable concrete is verified.

F. Substandard Concrete: Any concrete furnished under this Specification that fails to reach the required design compressive strength after 28 days as evidenced by the compressive strength test specified herein shall be considered substandard.

1. The procedure specified in ACI 318 for the Evaluation and Acceptance of Concrete shall be used to determine if the substandard concrete is to be removed and replaced. The Engineer shall make the final decision. Any substandard concrete which is removed and replaced shall be done so at the Contractor's expense.

2. For substandard concrete which is left in place, the Contractor shall reimburse the Owner an amount of $0.05 for each PSI that the actual 28-day concrete strength is below the specified compressive strength for each cubic yard of concrete in the pour. The strength of concrete for a particular pour shall be the average of all but the one (1) lowest of the 28-day compression tests for that pour. Said reimbursement shall be deducted from the Contract Amount by Change Order.

END OF SECTION 03310

SECTION 05120 - STRUCTURAL STEEL

PART 1 - GENERAL

1.1 SUMMARY

A. The work under this Section consists of furnishing all labor, materials, equipment and all other items necessary for the complete and approved fabrication and installation of the structural steel as indicated on the Contract Drawings and/or as specified herein. All work shall be in agreement with the General and Supplementary Conditions.

1.2 QUALITY ASSURANCE

A. All welding work shall be in conformance with AWS D1.1.

B. All welders, both shop and field where welding is specified or permitted, shall have satisfactorily passed the welding procedures qualification tests of AWS D1.1. The welder must have been qualified within the previous twelve (12) months, or within the previous three (3) years if certification is provided stating that the welder has been continuously employed in a similar welding capacity.

C. The Contractor shall certify that all materials are in full compliance with these Specifications.

1.3 REFERENCES

A. The publications listed below form a part of this Specification to the extent referenced. The publications are referred to in the text by the basic designation only. All publications shall be the latest edition.

1. American Institute of Steel Construction (AISC) Publications:

(a) Code of Standard Practice for Steel Buildings and Bridges.

(b) Manual of Steel Construction.

(c) Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings, including the Commentary and any Supplements, thereto as issued.

(d) Quality Criteria and Inspection Standards.

2. American National Standards Institute (ANSI) Publications: B.18.22.1 - Plain Washers.

3. American Society for Testing and Materials (ASTM) Publications:

   (a) A 36 - Structural Steel.

   (b) A 53 - Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.

   (c) A 108 - Steel Bars, Carbon, Cold-Finished, Standard Quality.

   (d) A 153 - Zinc Coating (Hot Dip) on Iron and Steel Hardware.

   (e) A 307 - Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.

   (f) A 325 - High-Strength Bolts for Structural Steel Joints.

   (g) A 490 - Heat Treated Steel Structural Bolts, 150 KSI Minimum Tensile Strength.

   (h) A 500 - Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.

   (i) A 501 - Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.

   (j) A 572 - High-Strength Low-Alloy Columbium-Vanadium Steels of Structural Quality.

   (k) A 992 - Structural Steel for Wide Flange Shapes

4. American Welding Society (AWS) Publication: D1.1 - Structural Welding Code, Steel.

5. Research Council on Riveted and Bolted Structural Joints of the Engineering Foundation (RCRBSJ) Publication: Specification for Structural Joints Using ASTM A325 or A490 Bolts.

6. Steel Structures Painting Council (SSPC) Publications:

   (a) SSPC-SP3 - Power Tool Cleaning.

   (b) SSPC-SP6 - Commercial Blast Cleaning.

1.4 SUBMITTALS

A. Make submittals in accordance with Division 1.

B. Certificates of Conformance: Submit certificates of conformance for the following upon request:

1. Steel.

2. Common Bolts.

3. High-Strength Bolts.

4. Welding Electrodes and Rods.

5. Zinc - Coating.

6. Shop Primer.

7. Welder Qualifications.

C. Shop Drawings:

1. Submit Shop Drawings in accordance with Division 1 prior to fabrication of structural steel. Shop Drawings shall:

a. Include complete details and schedules for fabrication and shop assembly of members and details of cuts, connections, camber, holes and other pertinent data. Indicate welds by standard AWS symbols and show size, length, and type of each weld.

b. Indicate primer to be used and final dry film thickness.

c. Provide setting or erection Drawings for the installation of anchor bolts and other anchorages or embedded items to be installed by others.

2. In review of Shop Drawing A/E shall not be deemed to have conducted structural analyses or detailed review of standard details prepared under fabricator's design responsibility.

D. The Contractor shall check and stamp all submittals for conformance with these Specifications and with the Drawings before submission to the A/E.

1.5 DELIVERY, STORAGE AND HANDLING

A. Handle, ship and store material in a manner that will prevent distortion of other damages. Store materials to permit easy access for inspection and identification. Place material in a clean, properly drained location out of contact with the ground. Replace all damaged material with new material or repair the damaged material in a manner approved by the A/E.

1.6 SEQUENCING/SCHEDULING

A. Shop fabrication shall be sequenced/scheduled so that delivery will expedite erection, will minimize field handling of materials, and will ensure uninterrupted progress of the work.

PART 2 - MATERIALS, PRODUCTS, AND DESIGN

2.1 MATERIALS

A. Steel and accessories shall conform to the respective specifications herein. Materials not otherwise specified shall conform to the recommendations in the AISC "Manual of Steel Construction".

1. Angles, Channels, and Plates (Carbon Grade Steel): ASTM A36.

2. Steel Pipe: ASTM A501 or ASTM A53, Types E or S, Grade B.

3. Structural Tubing: ASTM A500, Grade B.

4. Wide Flange Shapes (High-Strength Steel): ASTM A572, Grade 50 or ASTM A992, Grade 50.

5. Anchor Bolts: ASTM A36 or ASTM A307 with cut threads.

6. Common Bolts and Nuts: ASTM A307 with cut threads.

7. High-Strength Steel Bolts: ASTM (A325, Type N) (A490, Type N).

8. Circular Washers for Anchor Bolts and Common Bolts: ANSI B18.22.1.

9. Welding Electrodes and Rods: AWS Code D1.1.
10. Zinc-Coating: ASTM A123 for steel and ASTM A153 for threaded products.

11. Welded Steel Studs or Concrete Anchors: ASTM A108 Grade 1015 cold drawn steel, automatic weld type.

2.2 FABRICATION

A. Except as otherwise stated in these Specifications, fabricate structural steel with the applicable provisions of the Specifications for the Design, Fabrication, and Erection of Structural Steel for Buildings as set forth in Part 5 of the AISC "Manual of Steel Construction", with the AISC "Quality Criteria and Inspection Standards", and with the final approved Shop Drawings. Fabricate and assemble structural components in the shop to the greatest extent possible.

1. Welding: Only shielded electric arc welding shall be permitted.

2. Identification: Properly mark and match-mark materials for field assembly. Painted assembly markings shall be remote from any surface to be welded or bolted.

3. Connections: Fabricator shall be responsible for design of connections for which details are not indicated on the Drawings. The design shall be in accordance with the recommendations in the AISC "Manual of Steel Construction".

   a. Unless otherwise shown or called for on the Drawings, all shop connections shall be welded or bolted. Unless otherwise shown, all field connections shall be bolted with 3/4" diameter A325 bolts (bearing Type N). See Drawings for location of slip critical bolted connections.

   b. All columns shall have milled end bearings and cap plates.

   c. No single angle beam connections shall be used unless shown on the Drawings.

   d. Cut, drill or punch holes perpendicular to metal surfaces. Do not flame cut holes or enlarge holes by burning. Provide holes required for securing other work to structural steel framing. Oversized holes in base plates for anchor bolts shall not exceed the anchor bolt size plus 5/16". When oversized holes are used in base plates, provide 3/8" plate washers in addition to circular washers for anchor bolts.

4. Shop Painting: Except as otherwise specified, shop paint all structural steel work, except zinc-coated surfaces, slip critical connection surfaces, and steel work to be embedded in concrete.

a. Surfaces to be welded shall not be coated within 2" from the specified toe of the weld prior to welding, except that paint will be allowed on surfaces to which metal decking is to be welded.

b. Ensure that surfaces are thoroughly dry and clean when the paint is applied.

c. Apply paint in a workmanlike manner, and coat all joints and crevices thoroughly.

d. No material shall be shipped until the shop painting has dried sufficiently to prevent scarring of the prime coat.

e. Remove loose mill scale, heavy rust, splatter, slag or flux deposits, and other foreign materials from fabricated items and clean in accordance with SSPC-SP3 or SSPC-SP6.

f. See Section 09900 for paint primers.

g. Repair any damages to the painted surfaces with the same primer.

5. Galvanizing: All items specified herein or noted on the Drawings as being galvanized shall be hot-dipped galvanized. Thoroughly clean all weld slag, weld splatter, oil, grease, dirt, and other foreign matter from surfaces to be galvanized by proper SSPC cleaning methods. Before any visible rusting occurs galvanize all items in accordance with ASTM A153. Repair any damage to the surface with a galvanizing repair paint.

PART 3 - EXECUTION

3.1 INSPECTION

A. The erector must examine and check the areas and field conditions for the proper location, layout, elevation, and orientation of anchor bolts, bearing plates and other items that are embedded in concrete or masonry work to which the structural steel is to be installed. The erector must notify the Contractor and the A/E in writing of conditions detrimental to the proper and timely completion of the work. Work shall not proceed until unsatisfactory conditions have been corrected in a manner acceptable to the erector (and the A/E).

3.2 INSTALLATION/APPLICATION/ERECTION

A. Erect steel in accordance with the AISC "Manual of Steel Construction" and Code of Standard practice for Steel Buildings and Bridges. Where parts cannot be assembled or fitted properly as a result of errors in fabrication or of deformation due to handling or transportation, report such condition immediately to the Contractor and A/E and obtain approval therefrom for the methods of correction before proceeding with making any corrections.

1. All holes fabricated in the field for connections to existing structural steel, or any other required field-fabrications, shall be drilled.

2. Misaligned holes in members shall not be enlarged by burning or by the use of drift pins.

3. Gas cutting torches shall not be used in the field for correcting fabrication errors in the structural framing.

4. The erector shall provide temporary supports, such as temporary guys, braces, shoring, etc. to secure the partially assembled steel framing against loads comparable in intensity to those for which the completed structure is designed.

5. The erector shall set structural frames accurately to the lines and elevations indicated. Members forming a part of a complete frame or structure shall be aligned before permanently fastening. Bearing surfaces and other surfaces which will be in permanent contact shall be cleaned before assembly. The erector shall perform necessary adjustment to compensate for discrepancies in elevations and alignment. Temporary guy lines shall be provided to achieve proper alignment of the structure as erection proceeds.

6. The erector shall clean concrete bearing surfaces of bond reducing materials and roughen the surface to improve bond prior to setting bases and bearing plates. Set loose and attached base plates and bearing plates for structural members on steel wedges or other adjusting devices. Tighten the anchor bolts after the supported members have been positioned and plumbed. Do not use impact torque wrenches to tighten anchor bolts set in concrete. Wedges or shims shall be removed after initial grouting has set. The resulting holes shall be packed with grout. Grout the area under the plate solidly with a nonshrinking grout in accordance with Section 03300 Cast-In-Place Concrete of these Specifications.

7. High-strength bolts shall be tightened to the snug tight condition (unless noted otherwise on the Drawings) by the prescribed methods in

accordance with the RCRBSJ Specification for Structural Joints Using ASTM A325 or A490 bolts.

8. Immediately after erection, field welds, bolted connections, and abraded areas of the shop finish shall be cleaned. Exposed areas of the shop primer shall be touched-up with the same material as used for shop painting to provide the minimum dry film thickness. Zinc-coating shall be repaired with a galvanizing repair paint.

9. The erected structural steel shall be within the tolerances in accordance with the AISC Code of Standard Practice for Steel Buildings and Bridges, Specification for the Design, Fabrication and Erection of Structural Steel for Buildings, and the Quality Criteria and Inspection Standards.

3.3 FIELD QUALITY CONTROL

A. The Contractor shall inspect the erected steel for conformance with the Drawings and Specifications. He shall check alignment, plumbness, connections, completeness, paint touch-up, and any other items that interface with related work.

B. The Owner may engage an independent testing and inspection agency to inspect building alignment, high-strength bolted connections and welded connections, to perform tests, and to prepare test reports. Such inspection and testing shall not relieve the Contractor of the primary responsibility for field quality control. The testing agency shall conduct and interpret the tests and state in each report whether the results comply with the requirements, Specifications and Drawings and specifically state any deviations therefrom. The Contractor and erector shall provide access for the testing agency to places where structural steel work is being erected so that the required inspection and testing can be accomplished.

C. The erector or Contractor shall correct deficiencies in structural steel work which inspections and tests have indicated to be not in compliance with requirements, Drawings, and Specifications. The erector or Contractor, at his expense, shall perform additional inspection and testing as may be necessary to reconfirm any noncompliance of the original work and as may be necessary to show compliance of the corrected work.

3.4 PROTECTION

A. The erected steel shall be protected by the Contractor from damage by construction equipment and vehicles, and other trades involved in the project.

END OF SECTION 05120

SECTION 05500 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 CODES AND STANDARDS

A. AISC "Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings"; AWS "Structural Welding Code"; Specifications for Aluminum Structures by the Aluminum Association.

B. Comply with applicable provisions unless otherwise indicated.

1.2 SHOP DRAWINGS

A. Show complete details and instructions for fabrication, assembly, and installation. Furnish anchor bolts required for installation in other work; furnish templates for bolt installation.

PART 2 - PRODUCTS

2.1 INSERTS AND ANCHORAGES

A. Furnish inserts and anchoring devices to be built into other work for installation of miscellaneous metal items; coordinate delivery to job site to avoid delay.

2.2 STEEL

A. Steel Plates, Shapes, Bars: ASTM A 36.

B. Cold-Formed Steel Tubing: ASTM A 500, Grade B.

C. Steel Pipe: ASTM A 53, Type E or S, Grade B.

D. Structural Cold-Rolled Steel Sheets: ASTM A 570.

E. Galvanized Structural Steel Sheets: ASTM A 446, Coating Designation G235.

F. Stainless Steel: Alloy 304, ASTM A167, A269, A276 or A312.

2.3 ALUMINUM

A. Aluminum Plates: ASTM B209, Alloy 6061-T6.

B. Aluminum Shapes: ASTM B308.

C. Aluminum metal plate fabrications shall be a minimum of 1/4" thick unless otherwise specifically required.

2.4 CONCRETE INSERTS

A. Malleable iron (ASTM A 47) or cast steel (ASTM A 27) inserts, with steel bolts, washers and shims; hot dip galvanized.

2.5 SHOP PAINT

A. FS TT-P-86, Type II; or SSPC-Paint 14. Apply to cleaned and degreased steel surfaces at rate to provide a 2.0-mil dry film thickness.

2.6 GALVANIZING

A. ASTM A 386 for assembled products; A 153 for iron and steel hardware.

2.7 FABRICATION, GENERAL:

A. Use materials of size and thickness shown or, if not shown, of required size, grade and thickness to produce strength and durability in finished product. Shop-paint all items not specified to be galvanized after fabrication.

B. Weld corners and seams continuously; grind exposed welds smooth and flush.

C. Form exposed connections with hairline, flush joints; use concealed fasteners where possible.

2.8 ROUGH HARDWARE

A. Furnish custom fabricated bolts, plates, anchors, hangers, dowels, and other miscellaneous steel and iron shapes for framing and supporting and anchoring woodwork.

B. Galvanize, unless otherwise indicated.

2.9 LOOSE BEARING PLATES

A. Provide for steel items bearing on masonry or concrete, as shown. Drill plates to receive anchor bolts. Galvanize after fabrication.

B. Loose Steel Lintels: Fabricate to sizes shown.

2.10 MISCELLANEOUS

A. Miscellaneous Framing and Supports: Provide as required to complete work and not included with structural steel framework. Fabricate of welded construction in as large units as possible; drill and tap as required to receive hardware and similar items. Include required anchors for building into other work; spaced not more than 24" on center.

B. Miscellaneous Steel Trim: Fabricate to shapes and sizes as required for profiles shown; continuous welded joints and smooth exposed edges. Use concealed field splices wherever possible. Provide cutouts, fittings, and anchorages; coordinate assembly and installation with other work.

2.11 NOSINGS

A. Fabricate of shapes as shown; miter corners and weld joints. Provide anchors 6" from ends or corners and 24" on center. Galvanize after fabrication.

2.12 BENT ALUMINUM PLATES

A. Fabricate bent plates as shown.

2.13 ACCESS HATCHES (ALUMINUM)

A. Aluminum access hatches of the size and type shown shall be installed at locations indicated on the plans. Hatches shall be as manufactured by the Halliday Co., Bilco Company, Babcock Davis, or approved equal.

B. Door leaf(s) shall be 1/4" aluminum diamond plate reinforced with aluminum stiffeners as required. Hatches for interior service shall be equipped with a built-in neoprene cushion. Stainless steel hinges shall be bolted to underside and be equipped with counterbalance mechanisms for easy operation. The door shall open to 90 degrees and lock automatically in that position. A vinyl grip handle shall be provided to release the cover for closing. Doors shall be built to withstand a live load of 300 lbs. per sq. ft. (exterior service), and equipped with a snap lock and removable handle. Mill finish, with bituminous coating to be applied to exterior of frame by manufacturer. Hardware shall be cadmium plated. Installation shall be in accordance with manufacturer's instructions.

Manufacturer shall guarantee against defects in material or workmanship for a period of five (5) years.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Perform cutting, drilling and fitting required for installation; set work accurately in location, alignment and elevation, measured from established lines and levels. Provide anchorage devices and fasteners where necessary for installation to other work.

B. Set loose items on cleaned bearing surfaces, using wedges or other adjustments as required. Solidly pack open spaces with commercial non-shrink grout material.

C. Coat all aluminum surfaces in contact with concrete or dissimilar metals with alkali resistant bituminous paint.

D. Touch-up shop paint after installation. Clean field welds, bolted connections and abraded areas, and apply same type paint as used in shop. Shop paint shall be compatible with specified finish systems. Use galvanizing repair paint on damaged galvanized surfaces.

END OF SECTION 05500

SECTION 05510 - METAL STAIRS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Work under this Section includes designing, furnishing, and installing metal stairs and platforms at locations shown on the Drawings.

1.2 SUBMITTALS

A. Submittals shall be in accordance with Section 01340 of these Specifications.

B. Submittals shall include the following:

1. Plan and elevation views of each stair assembly.

2. Jointing and connections for each assembly, indicating welded connections using standard AWS symbols.

3. Sections and reinforcing details.

4. Fasteners, anchors, and accessories required for assembly and field installations.

5. Product data for all items used in fabrication and installation.

1.3 QUALITY ASSURANCE

A. Provide structural design of stair and platform assemblies sealed by a professional Engineer registered in the State of Texas.

1.4 JOB CONDITIONS

A. Fit fabrications accurately to actual construction. If it is not possible to take field measurements before fabrication, allow adequate fabrication tolerances and trim to fit.

PART 2 - PRODUCTS

2.1 GENERAL

A. All stair assemblies shall be designed to meet requirements of the most recent edition of the Southern Building Code as well as all OSHA requirements.

2.2 ALUMINUM STAIR CONSTRUCTION

A. Construct stairs to conform to sizes and arrangements indicated. All tread widths to be 3'-8". Join pieces together by welding, unless otherwise indicated. Provide complete stair assemblies, including metal framing, hangers, columns, railings, newels, balusters, struts, clips, brackets, bearing plates, and other components necessary for the support of stairs and platforms, and as required to anchor and contain the stairs on the supporting structure.

B. Comply with "Recommended Voluntary Minimum Standards for Fixed Metal Stairs" in NAAMM "Metal Stair Manual" for commercial class stairs.

C. Stair Framing: Fabricate stringers of structural aluminum channels, or plates or a combination thereof. Provide closures for exposed ends of stringers. Construct platforms of structural channel headers and miscellaneous framing members as indicated. Bolt or weld headers to strings, newels, and framing members to strings and headers; fabricate and join so that bolts, if used, do not appear on finish surface.

D. Treads to be of cast aluminum or aluminum grating construction with abrasive nosings. The treads shall be as manufactured by IKG Borden, Ohio Grating, or equal.

E. Fabricate platforms using aluminum grating and aluminum structural shapes. Grating shall be as specified in Section 05530.

F. Stair railings and handrails shall comply with Section 05520 of the Specifications.

G. All anchors and fasteners shall be 316 stainless steel.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install items in correct location, plumb and level, without rack or warp.

B. Provide temporary supports and bracing as required.

C. Anchor to substrates indicated. Provide all fasteners required.

D. Perform all field fabrication required for installation.

1. Fit joints tightly.

2. Weld joints as indicated.

a. Weld in accordance with AWS code.

b. Exposed welds: Grind flush and smooth.

E. Do not cut or weld items after fabrication that are indicated for bolted or screwed connections.

END OF SECTION 05510

SECTION 05520 - HANDRAILS AND RAILINGS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. The extent of handrails and railings is shown on the drawings and includes miscellaneous handrails and railings not included in other metal systems in other sections of these specifications.

1.2 SUBMITTALS

A. Samples, Handrails and Railings: Submit 2 samples of each type of metal finish and connection, including typical non-welded or welded connections, not less than 6" long. Samples will be reviewed for color and texture only. Compliance with all other requirements is the exclusive responsibility of the Contractor.

1.3 DELIVERY

A. Deliver railing with factory applied protective wrapping to prevent scratching during shipment. Remove protective wrap only after rail is fully installed.

B. Coat all aluminum surfaces in contact with concrete with alkali resistant bituminous paint.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Aluminum Extrusions:

1. ASTM B 221, alloy 6063-T5, except alloy 6063-T6 for pipe, unless otherwise indicated.

2. Aluminum to be satin mill finish.

B. Aluminum Sheet or Plate: ASTM B 209, alloy 6061-T4, unless otherwise indicated. Mill finish.

C. Aluminum Castings: ASTM B 108, alloy 214, unless otherwise indicated.

D. Stainless steel Finish: No. 4 unless otherwise indicated.

E. Bolts, Chains, Hardware, Anchors, and Fasteners: Stainless steel Type 316.

F. Nonshrink, Nonferrous Grout: CE CRD C588.

G. All handrails shall be designed to meet the load requirements of the most recent edition of the Arkansas Department of Labor and Licensing as well as all OSHA requirements. Post spacing or other arrangements shown on the plans are secondary to the requirements of these codes. Handrails will be a minimum 1-1/2" in diameter.

PART 3 - EXECUTION

3.1 FABRICATION

A. General: Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges. Ease exposed edges to a radius of approximately 1/32", unless otherwise shown. Form bent-metal corners to the smallest radius possible without causing grain separation or otherwise impairing the work.

B. Nonwelded Connections: When acceptable to the Engineer, intermediate post-to-rail connections may be made using internal pipe sleeve locks and Allen screw fasteners. Locking devices which do not produce flush, smooth, rigid, hairline joints will not be acceptable. Weld other connections.

C. Welded Connections:

1. Cope intersections of rails and posts, weld joints, and grind smooth. Butt weld end-to-end joints of railings or use welding connectors, at fabricator's option.

2. Weld corners and seams continuously and in accordance with the recommendations of AWS. Grind exposed welds smooth and flush to match and blend with adjoining surfaces. Discoloration of finished surfaces will not be acceptable.

3. Form exposed connections with flush, smooth, hairline joints using concealed fasteners wherever possible. Use exposed fasteners of the type shown, or if not shown, use Phillips flathead (countersunk) screws or bolts.

4. Provide for anchorage of the type shown, coordinated with the supporting structure. Fabricate and space anchoring devices as shown and as required to provide adequate support.

D. Brackets, Flanges, Toe Plate, and Anchors:

1. Provide brackets, flanges, and anchors for railing posts and for handrail supports. 4" toe plates to be provided wherever handrails are installed along walkways above tanks or other raised areas.

2. Furnish extruded metal bracket s and flanges of the same material and finish as supported rails, unless otherwise indicated. Anchor and other hardware to be stainless steel as previously specified.

3.2 INSTALLATION

A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing handrails and railing items to existing handrails and walls; including threaded fasteners for concrete and masonry inserts and other connectors as shown on the drawings.

B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installation. Set the work accurately in location, alignment, and elevation, plumb, level, true, and free of rack, measured from established lines and levels.

C. Fit exposed connections accurately together to form tight hairline joints. Weld connections which are not to be left as exposed joints but cannot be shop-welded because of shipping size limitations. Grind joints smooth and touchup shop paint coat. Do not weld, cut, or abrade the surfaces of units which have been coated or finished after fabrication and are intended for field connections.

D. Adjust railings prior to securing in place to ensure proper matching at butting joints and correct alignment throughout their length. Space posts not more than 8 feet on centers, unless otherwise shown. Plumb posts in each direction. Secure posts and rail ends to building construction as follows:

1. Anchor posts in concrete by core drilling holes 5" deep and not less than 1" greater than the outside diameter of post. Clean holes of all loose material, insert posts, and fill the space between post and concrete with nonshrink, nonferrous grout.

END OF SECTION 05520

SECTION 05530 - GRATING AND FRAMES

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. The extent of the grating work is shown on the Drawings and includes frames, grating, and support beams which are not a part of other metal systems in other Sections of these Specifications.

B. The types of grating include aluminum bar grating.

C. The supplier of these materials is responsible for the engineering design of the grating and support framing.

1.2 SUBMITTALS

A. Submittals shall be in accordance with Section 01340 of these Specifications.

B. Shop Drawings: Shop Drawings shall include erection plans and complete details and schedules for fabrication and assembly of members and grating. Indicate welds by standard AWS symbols. Provide setting or erection drawings for the installation of anchor bolts and embedded items to be installed by others.

C. Design Calculations: Design calculations shall be prepared and sealed by a professional Structural Engineer registered in the state in which the project is located.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Aluminum Bar Grating: ASTM B 221, Alloy 6061 or 6063-T6 for bearing bars; ASTM B 221 or B 210 for cross bars or bent connecting bars.

B. Extruded Aluminum Frame: ASTM B 221, Alloy 6063-T6.

C. Aluminum Support Beams and Channels: ASTM B308, Alloy 6061-T6.

2.2 ALUMINUM GRATING

A. Provide aluminum plank grating where grating is shown on Drawings. Provide full frame for each opening using an extrusion frame which provides a continuous frame anchor and a continuous recess for anchoring the grating. The strength of in-place grating shall be designed to meet or exceed live load and deflection requirements as follows:

1. 100 lbs. per sq. ft. uniform load or 500 lbs concentrated load.

2. 0.250" maximum deflection.

3. Minimum depth not less than 1-1/2".

B. The weight of individual grating sections shall not exceed 100 pounds without approval of the Engineer.

C. The grating shall be IKG Borden Aluminum plank, Style C, square, upset pattern grating or equal. Grating will be furnished with a natural aluminum finish.

D. Provide removable grating sections with end-banding bars for each panel and clip anchors as shown on the Drawings.

E. Adjacent grating panels shall be fabricated and laid out as required to maintain patterns or designs in a satisfactorily aesthetic manner.

F. Notch gratings for penetrations as indicated. Layout units to allow grating removal without disturbing items penetrating grating.

G. Provide full banding for all openings in grating of same material and size as bearing bars, unless otherwise indicated.

H. Notching of bearing bars at supports to maintain elevations will not be permitted.

2.3 ALUMINUM FRAMES AND PLATFORMS

A. Provide full frames for each opening using an extrusion containing a continuous frame anchor and a continuous recess for anchoring the grating to the frame. Miter and weld all frame corners. All aluminum surfaces in contact with concrete shall receive protective bitumastic coating at the source of fabrication. The coating shall be checked and touched up as necessary prior to installation. Frames shall be IKG Borden, WACO Type ZF, or Thompson.

B. Platforms shall comply with Specification Section 05510.

PART 3 - EXECUTION

3.1 FABRICATION, GENERAL

A. Use materials of the size and thickness shown, or if not shown, of the size recommended by product manufacturer. Work to the dimension shown or accepted on final shop Drawings, using proven details of fabrication and support. Use the type of materials shown or specified for the various components of the work. Furnish load tables, deflection values, and erection drawings for each type of grating used to Engineer.

3.2 INSTALLATION

A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where required for securing grating to supporting members or prepared openings.

B. Cutting, Fitting and Placement: Perform all cutting, drilling, and fitting required for installation. Set the work accurately in location, alignment, and elevation, plumb, level, true and free of rack.

C. Wherever gratings are pierced by pipes, ducts, and structural members, cut openings neatly and accurately to size and weld a strap collar not less than 1/8" thick to the cut ends of the bars.

D. Divide the panels into sections only to the extent required for installation wherever gratings are to be placed around previously installed pipe, ducts, and structural members.

E. Fit exposed connections accurately together to form tight hairline joints.

F. Secure removable units to supporting members or framework with clip units as shown on the Drawings.

END OF SECTION 05530

SECTION 06800 - FIBERGLASS AND PLASTIC PRODUCTS

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. Work to be accomplished under this Section consists of furnishing and installing reinforced fiberglass plastic flumes, staff gauges, and other plastic items.

1.2 QUALITY ASSURANCE

A. Provide products manufactured by a single firm specializing in the production of the type of units required. The supplier shall have adequate quality-control procedures and supply certified reports of the physical tests performed on the manufactured products.

B. Manufacturers: Furnish units manufactured by Plasti-Fab, B. F. Leopold, Warminster Fiberglass, or equal.

1.3 SUBMITTALS

A. Submit Shop Drawings and samples for all units furnished. Include details of all construction, mounting and installation requirements, and hardware schedules, properly identified to correspond to the Engineer's nomenclature. Submit product test results. Provide job site storage and handling requirements.

PART 2 - PRODUCTS

2.1 RESINS

A. Must offer superior resistance to sewage having pH range of 6.0 to 9.0.

2.2 FIBERGLASS MATERIAL

A. A maximum of 4% by weight of thixotropic agent may be added to the resin to prevent run-off. Resin with sufficient thixotropic agent added to form a paste shall be used to seal any machined edges.

B. Glass reinforcement shall consist of chemically bonded surfacing mat and either chopped strand, chopped strand mat, woven roving, or woven cloth, or any combinations thereof as required by the finished product. Surfacing mat shall be Type A or Type C, 20 mils thick, with a saline finish and a styrene-soluble binder.

The glass content of this layer shall not exceed 23% by weight. Chopped strand and chopped strand mat shall be Type E glass with saline finish and styrene-soluble binder. Strand shall not be larger than Number 130. The glass content of the finished laminate shall not be less than 30% by weight. Woven cloth or woven roving (60 end maximum) shall be Type E glass with "Volan" methacrylate chromic chloride or saline type finish.

C. Procedure to be used in determining the properties listed in Table I shall be in accordance with current ASTM standards, Part 9, and the following designations: Ultimate Tensile Strength - ASTM designation D 636-61T; Flexural Strength - ASTM designation D 790-61; Modulus of Elasticity - ASTM designation D 790-61.

D. Hardness tests shall be made of the resin-rich surface of the product. Flexural tests shall be made with the resin-rich surface in compression.

E. Test samples shall be full thickness of the item produced and shall not be machined on the surface.

F. Mechanical properties shall equal or exceed those of Table I listed below.

Table I

	Matched Die	Hand Lay-up
Laminate Physical Properties 73 Degrees F		
Ultimate Tensile Strength - (PSI x 10^3, (Min.)	14	12
Flexural Strength - (PSI x 10^3, Min.)	25	19
Flexural Modulus of Elasticity - (PSI x 10^6, Min.)	.94	.80
Barcol Hardness - (Min.)	35	35

2.3 STAFF GAUGES

A. An engraved stainless steel or molded plastic gauge shall be permanently installed at each of the following locations.

1. Each parshall flume.

2. Each sliding weir gate in the new splitter box.

B. The gauges shall be calibrated to read in feet, tenths, and hundredths of a foot.

2.4 FLUMES

A. One (1) 18" throat parshall flume without stilling well is required for flow measurement and control at the effluent structure.

B. Flume shall be of the standard dimension with both upstream and downstream diverging sections. Materials of construction shall be a reinforced polyester resin which affords maximum protection from chemical attack and is suitable for use in wastewater flumes and remains dimensionally stable. The interior surface shall be "glass like" smooth, easily cleaned and resistant to organism growth. Both ends and top shall be flanged to provide strength with non-corroding stiffener angles placed across the top. Flume shall be suitable for flow measurement using an ultrasonic flow meter.

C. An engraved stainless steel or molded plastic gauge shall be permanently installed and properly located in the upstream throat of the flume. The gauge shall be calibrated to read in feet, tenths and hundredths of a foot.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install all flumes and other items in locations shown and according to manufacturer’s recommendations.

END OF SECTION 06800

SECTION 09900 - PAINTING

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. General: Under this Section, the Contractor shall furnish all labor, materials, equipment, transportation, and shop service required for all finishing and painting, including piping, equipment, and electrical work that is exposed and visible or requires protective coating. The Contractor shall examine the Drawings and Specifications for the various other contracts and sections of the work and shall thoroughly familiarize himself with all their requirements regarding painting and finishing.

B. Work Included:

1. All exposed or submerged new work under all prime contracts shall be painted. This work shall include, but is not necessarily limited to, conduit, piping, equipment, structural and miscellaneous metal, metal frames, doors, louvers, and all other items, materials, etc. appurtenant to the plant. All work scheduled or otherwise indicated in contract documents shall be included.

2. All equipment which is delivered without a prime coat shall be cleaned and primed with one coat of the specified primer immediately after arrival on site and before being placed in storage. The remaining finish coats and additional primer touch-up will be applied after the equipment is installed.

C. Work Not Included:

1. Field prime coats will not be required on items delivered with specified and acceptable prime or shop coat already on, except for touch up with specified primer and except for items specifically designated in the specification to receive additional prime coats.

2. Exterior cast-in-place concrete surfaces will not be painted except where otherwise noted. Brick and/or concrete masonry units shall not be painted unless otherwise noted.

3. Brass, bronze, nickel, copper, aluminum, galvanized, or factory-finished items which are concealed from public view or which are in areas designated not to be painted will not be field painted except for touch up.

4. Fiberglass and stainless steel items will not be painted.

5. Field painting will not be required on buried or concealed piping.

6. Aluminum grating, handrails, and stairs shall not be painted.

7. Factory finished items shall not be painted unless indicated otherwise.

1.2 QUALITY ASSURANCE

A. Guarantee: The Contractor shall guarantee all painting for a period of 24 months after acceptance against:

1. Bleaching, fading, and changing color.

2. Peeling, cracking, or powdering.

3. Being affected by water from routine washing.

4. Rust from metals showing through painted surfaces.

5. Alligatoring effect of the painted surface.

1.3 SUBMITTALS

A. Submittals shall be in accordance with Section 01340 of these Specifications.

B. Colors shall be as selected by the Architect. Mixtures of colors shall be supplied if required. Samples showing the full range of colors as produced by the manufacturer shall be made available for color selection.

C. A painting schedule for all required items, including cleaning, priming, first coat, and finish coat. A sample schedule follows this page. Initialing of the schedule by the Resident Project Representative in no way changes the Contractor's responsibility for repair in the event that the coating does not perform satisfactorily.

1.4 STORAGE

A. Provisions will be made by the Contractor for a secure space for the storage of all paint materials and equipment for the exclusive use of the painting subcontractor who will, in turn, maintain and leave it free from fire hazards due to improperly stored rags and thinners.

PART 2 - PRODUCTS

2.1 PAINT

A. Use paints as shown in the Painting Systems Schedule at the end of this Section.

B. Painting systems listed are those of Tnemec Company. Enduron, PPG and Sherwin Williams systems are also acceptable. Any bidder desiring to use painting systems of another manufacturer shall submit for approval, at least 21 days prior to bid opening, a similar schedule of equal coatings and all necessary data for the A/E to ascertain their quality.

C. All materials not specified but required for successful application of any specified paint or coating must be of the "best grade", or "first line", made by reputable, recognized manufacturers and shall bear the manufacturer's label.

D. All materials required for painting shall be brand and quality specified or approved equal and shall be delivered in original containers with labels intact and seals unbroken.

E. Materials used in preparation of surfaces for painting and in thinning or for dilution of paints shall be in full compliance with those called for in the current standard published instructions of the paint manufacturer.

F. Colors.

1. The Contractor shall submit color cards to the Engineer for review and color selection of all paints, stains and other materials, proposed for use. Only those colors which have been reviewed and accepted by the Engineer shall be utilized in the work.

2. Pipe Color Schedule.

a. The Contractor shall color code all pipes, including insulated pipe, in accordance with the below schedule.

Material	Color
Process Air Piping	Green
Compressed Air	Green with Red Stripes
Plant (Non-Potable) Water	Blue with Black Stripes
Potable Water	Blue
Sewage (Wastewater)	Gray
Sludge	Brown
Vents	Aluminum with Green Stripes
Electric Conduit	Aluminum*
Reuse Water	Purple (Pantone 522)

* Where electrical conduit is exposed in a finished room or area, conduit shall be painted to match room finish.

b. Stripes where required shall consist of 6-inch wide bands completely around the pipe located at 36 inches on centers. On pipe runs less than 36 inches in length, one color band shall be located at the center of the run.

3. Building Components and Equipment.

The following are general color guidelines for various building components and equipment:

a. Building Components:

	Color
Interior and Exterior Doors, Door Frames and Windows	Owner Selected
Tanks, Stairs, Walkways, and Support Steel	Owner Selected
Wallboard, Roof Deck, Joists and Overhead Steel	Owner Selected

b. Equipment:

Stationary Machines and Frames	Owner Selected
Motors	OSHA Blue
Rotating Machinery Guides	OSHA Yellow
Moving Equipment	International Orange
Control Panels (Requiring Paint)	Green
Fire Protection Equipment	Safety Red
Fire Boxes	Safety Red
Extinguishers	Safety Red
Exit Signs	Safety Red
Sprinkler Piping	Safety Red
Emergency Stop Bars	Safety Red
Exposed Box Housings	Safety Orange
Exposed Edges of Pulleys, Gears, Etc.	Safety Orange
Safety Starting Button	Safety Orange
Bollards	Safety Yellow

PART 3 - EXECUTION

3.1 PROTECTION OF ADJACENT SURFACES AND EQUIPMENT

A. Provide all necessary drop cloths and/or other covers for protection of adjacent areas or equipment against cleaning operations and foreign paint. The Contractor shall be responsible for any damage he may inflict on any existing materials or equipment or any equipment or work accomplished by other contractors. He shall be responsible for the repair or cleaning of such damage to the satisfaction of the A/E.

B. Before painting, remove hardware accessories, plates, lighting fixtures, and similar items or provide ample protection of such items. Reinstall all such items upon completion of painting. Replace all such items damaged by painting operations.

3.2 SURFACE PREPARATION

A. General: The Contractor shall be held responsible for the finished appearance and satisfactory completion of his work; and, therefore, he shall not commence any painting until surfaces to be painted are in a proper condition in every respect. All surfaces shall be clean and free of dirt, grease, and any foreign matter that would adversely affect the finished appearance or protective properties of the paint applied. All surfaces to be painted shall be prepared in a workmanlike manner with the objective of obtaining a smooth, clean, and dry surface. Defective, improper, loose, or peeling previous coatings shall be completely removed. Incidental, necessary minor cleaning, sanding, vacuuming, and dusting of surfaces shall be done so that they are in perfect condition to receive each coat. If, for any reason, the surfaces cannot be properly prepared by specified and/or customary cleaning, sanding, or puttying operations, the condition shall be promptly reported to the A/E, or the Contractor shall assume the responsibility for rectifying any unsatisfactory finish resulting.

B. Specific Requirements: The Surface Preparation Requirements for each general material type are given in the following discussion and are referred to in the Painting Systems Schedule. The instructions set forth or referenced for each material type shall be strictly adhered to.

1. Metals:

a. Surface Preparation Requirements, as numbered and outlined below, correspond to the numbered requirements which are included under Metals in the Painting Systems Schedule. These requirements have been adopted from the various SSPC Surface Preparation Specifications as published by the Steel Structures Painting Council. The specifications which are described below shall be included as part of this Specification as if bound herein.

b. All equipment delivered to the site with a manufacturer's prime coat will receive a brush blast cleaning prior to being painted. Any areas which do not retain their prime coating during the brush blast will be completely cleaned and primed as specified herein.

(1) SSPC-SP1 Solvent Cleaning:

(a) Remove oil, dirt, grease, and foreign matter with solvents or commercial cleaners using various

methods of cleaning such as wiping, dipping, steam cleaning, or vapor degreasing.

(b) The removal of oil and grease by solvent cleaning is included in all other SSPC Surface Preparation Specifications.

(2) SSPC-SP2 Hand Tool Cleaning: Remove loose rust and mill scale by hand wire brushing, scraping, chipping, or sanding. Hand tool cleaning will not remove all rust residue or intact, firmly adhering, mill scale.

(3) SSPC-SP3 Power Tool Cleaning:

(a) In conjunction with hand tool cleaning, remove loose rust and mill scale by mechanical means such as power sanders, wire brushes, chipping hammers, abrasive grinding wheels, or needle guns. Use each type of cleaning to the extent required to obtain an approved surface ready for painting.

(b) Perform commercial blast cleaning, as specified below, in the shop on surfaces which receive shop coating prior to delivery to the job site.

(4) SSPC-SP6 Commercial Blast Cleaning:

(a) Remove at least 2/3 of all visible rust, mill scale, and other foreign matter from each square inch of surface by any of the recommended methods outlined in the Steel Structures Painting Council SP6.

(b) Blasting shall be done with centrifugal wheel or compressed air blast nozzles using either steel grit or flint silica sand. Abrasive should provide a I.5 mil maximum profile with a maximum depth of 2 mils. Steel grit #G-80 or flint silica sand 16-35 mesh is recommended to obtain proper profile depth. Remove all dust and sand by vacuuming.

(c) The blast cleaned surface shall be primed before any rust bloom forms.

(5) SSPC-SP10 Near-White Metal Blast Cleaning: Remove 95% of all visible rust, mill scale, and other foreign material from each square inch of surface by compressed

air nozzle blasting, centrifugal wheels, or other method recommended by Steel Structures Painting Council SP10. Use for all surfaces subject to immersion.

2. Masonry:

a. Prepare cementitious surfaces of concrete block to be painted by removing all efflorescence, chalk, dust, dirt, grease, oils, and by roughening as required to remove glaze.

b. Determine the alkalinity and moisture content of the surfaces to be painted by performing appropriate tests. If the surfaces are found to be sufficiently alkaline to cause blistering of the finish paint, correct this condition before application of paint. Do not paint over surfaces where the moisture content exceeds that permitted in the manufacturer's printed directions.

c. Correct surface defects such as fins, protrusions, bulges, and mortar spatter by grinding or scraping. Remove non-degraded release agents, oil, was, and grease by scraping off heavy deposits and solvent cleaning or washing with a hot trisodium phosphate solution (2 lbs. of trisodium phosphate to each gallon of hot water (160 degrees F.)). Repeat cleaning operations until the contamination is removed and flush the area with clean water to remove residual cleaning solution. Allow to dry thoroughly before coating.

3.3 PAINTING

A. Where new painting systems are to be applied over previously painted surfaces, appropriate tests shall be made for "lifting" and primers shall be used which will insure complete compatibility between old and new and prime and finish coats.

B. Dry paint thickness in mils shall be checked by the use of a mil thickness gage, such as any and/or all of the following gages: Elcometer (magnetic), Micro-Metrics Company (destructive), Tinkor and Rasor (holiday). Minimum allowable mil thickness for each surface shall take precedence over the indicated number of coats required, but in no case shall fewer than the indicated number of coats be required.

3.4 WORKMANSHIP

A. All materials shall be applied and cut in neatly so as to dry uniformly to the color and sheen specified, free from runs, sags, wrinkles, shiners, streaks, and brush marks.

B. During the actual application and drying of interior painting systems and until normal occupancy of buildings occurs, a minimum temperature of 60 degrees F. shall be maintained. This temperature shall be held as constant as possible to prevent condensation. Adequate ventilation shall be provided at all times so that the humidity cannot rise above the dew point at the coldest wall.

C. No exterior painting shall be undertaken at temperatures under 45 F. or immediately following rain, frost, or dew.

D. All coats of paint shall be thoroughly dry before applying succeeding coats. All primer and intermediate coats of paint shall be sanded lightly and dusted before succeeding coats of paint are applied.

E. The areas in which the Contractor has been conducting his work shall be left in a clean and orderly condition with all paint spots, rags, and discarded equipment removed.

3.5 MANUFACTURER'S INSTRUCTIONS

A. In the preparation of surfaces for painting, in thinning or dilution of paints, in method of paint application, and in all other painting operations, the Painting Contractor shall follow completely and in detail the standard published instructions of the paint manufacturer.

B. In every case the instructions of the paint manufacturer which are used shall be those which are directly relevant to: the type of surface to be painted, the conditions under which the paint is to be applied, and the conditions under which the paint is to serve.

C. In the event that the manufacturer's instructions conflict with these Specifications, comply with the most stringent requirements unless otherwise approved by the A/E.

3.6 CLEAN-UP

A. The Painting Contractor shall be responsible for removal of all spilled paint, overspray, damage, etc. due to his work. Paint shall be removed by the best method which shall leave damaged surfaces in original condition.

3.7 PAINTING SYSTEMS SCHEDULE

Item	Surface Prep. Number	Product Name	No. Coats	Dry Mill Thick Min. Per Coat
MASONRY				
Int., exposed, block masonry				
Prime	2-a,b,c	Block Filler, 561 (Modified Polyester)	1	13.3
Finish		Hi-build Epoxoline 66	2	4.0
METALS				
Ext., non-submerged non-buried, exposed-to-view piping, valves, operators, tanks, structural steel, miscellaneous steel, doors, frames, sash angles, brackets, hangers, etc.)				
Prime	1-d	Epoxoline Primer	1	4.0
Intermediate		Hi-build Epoxoline 66	1	5.0
Finish		Endura Shield, 71	1	2.0
Ext., submerged not galvanized piping, valves, brackets, angles, hangers, etc.				
Prime	1-e	Epoxoline Primer	1	4.0
Finish		Hi-Build Epoxoline 66	2	5.0

Item	Surface Prep. Number	Product Name	No. Coats	Dry Mill Thick Min. Per Coat
Ext., in vaults, non-submerged (pumps, pipe, valves, equipment, hangers, angles, brackets, etc.)				
Prime	1-d	Standard AWWA Bit. Shop coating or Topox 272 as applicable	1	6.0
Finish		Topox 272	1	6.0
Int., non-submerged (pumps, valves, structural steel, doors, frames, sash, brackets, hangers, angles, etc.)				
Prime	1-d	Series 66-1211 Epoxoline Primer	1	4.0
Intermediate		Hi-build Epoxoline 66	1	5.0
Finish		Endura Shield, 73	1	2.0
Exposed to view steel bar joists and galvanized roof deck.				
Prime	1-b	Shop Prime/Galv.		
Finish		Chem-Build 135-DC 74	1	2.5

Item	Surface Prep. Number	Product Name	No. Coats	Dry Mill Thick Min. Per Coat
Galvanized-miscellaneous exposed-to-view (Galvanized electrical conduit will be painted to match the underlying surface.)				
Prime/Finish	1-b	Hi-build Epoxoline 66	2	5.0
Interior Gypsum Board				
Prime		PVA Sealer 51-792	1	1.5
Finish		Series 7 Tneme-Cryl	1	2.0
Exterior Gypsum Board				
Interior and exterior wood excluding hardwood doors and trim receiving transparent finish				
Prime		Series 7 Tneme-Cryl	1	2.0
Finish		Series 7 Tneme-Cryl	2	2.5
Wood				
Interior doors and hardwood trim, transparent finish (shall match existing)				
Prime		PPG Rez Alkyd Oil Stain	1	2.0
Finish		PPG Rez Polyurethane Stain	2	2.5
INSULATION				
Pipe Insulation				
Prime		Hi-build Epoxoline 66	1	2.0
Finish		Hi-build Epoxoline	1	5.0

Concrete	
Exposed-to-view	See Specification Section 03310.

END OF SECTION 09900

Section 11000

MECHANICALLY CLEANED FULL PENETRATION FINE BAR SCREENS - 304 SSTL

PART 1 – GENERAL

1.1 SUMMARY

A. This section includes the furnishing of a front-cleaning, front-return link driven mechanically cleaned bar screen assembly and any auxiliary equipment or accessories to be installed in the location as indicated on the drawings and as specified herein.

Number of units: [1]

Equipment designation: Duperon® FlexRake® IQ™

Equipment location: Outdoor Installation

B. All equipment supplied under this section shall be furnished by or through a single screening system supplier who shall coordinate with the Contractor the design, fabrication, delivery, installation and testing of the screening components. The screening system supplier shall have the sole responsibility for the coordination and performance of all components of the screenings system with the performance and design criteria specified herein.

C. The Contractor shall be responsible to coordinate all details of the screening equipment with other related parts of the work, including verification that all structures, piping, wiring, and equipment components are compatible. The Contractor shall be responsible for all structural and other alterations in the work required to accommodate the equipment differing in dimensions or other characteristics from that contemplated in the Contract Drawings or Specifications.

1.2 RELATED SECTIONS

A. The following list of related sections is provided for the convenience of the Contractor and is for reference only to support commonly referenced sections that are generally applicable to all equipment supplied (for complete list of sections, see specification index).

1. All sections of Division 1 including but not limited to Submittal Procedures, Shop Drawings, Product Data and Samples, Operating and Maintenance information, Protection of Materials and Equipment, Installation, Testing, and Commissioning, Instruction of Operations and Maintenance Personnel, and Spare Parts Maintenance Manuals.
2. Section 05120-Anchorage
3. Section 09900-Coating Systems
4. Section ME1-General Requirements for Equipment
5. Section E1-Electric Motors
6. Section E1-Control Panels

1.3 REFERENCE STANDARDS

A. American National Standards Institute (ANSI)
B. American Society for Testing and Materials (ASTM)
C. American Welding Society (AWS)
D. American Institute of Steel Construction (AISC)
E. American Bearing Manufacturers Association (ABMA)
F. American Gear Manufacturers Association (AGMA)
G. National Electrical Manufacturers Association (NEMA)
H. Underwriters Laboratory (UL)
I. National Fire Prevention Association (NFPA)
J. Society of Automotive Engineers (SAE)

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1.4 SUBMITTALS

A. The equipment manufacturer shall submit the following items:

1. Six (6) Sets of General Arrangement Drawings that illustrate the layout of the equipment, equipment weight, and principal dimensions with related verifications required for installation including anchorage locations. Other related data includes descriptive literature, electrical control drawings, catalog cut sheets for individual components and drive motor data.

2. A list of recommended spare parts including any special tools required for routine maintenance of the equipment is provided in Section 2.5.

3. Six (6) Sets of Operation & Maintenance manuals including As-Built Drawings of the mechanically cleaned bar screen arrangement, controls, and accessories shall be provided in digital format after equipment ship for inclusion in the close-out submittal process.

4. For sites that have three (3) feet or greater head differential, equipment manufacturer shall provide a structural review.

1.5 QUALITY ASSURANCE

A. The mechanically cleaned bar screens shall be fully assembled and shop tested at the manufacturing facility prior to shipment. Shop testing shall include a minimum of four (4) hours of run time. The Contractor, the Engineer, the Owner, or the owner's designated representative reserves the right to witness the shop test. Travel expenses are the responsibility of the traveler. A minimum three (3) week notice shall be provided prior to the test to allow for travel coordination.

B. To assure quality and performance: All equipment furnished under this Section and related sections shall be of a single manufacturer who has been regularly engaged in the design and manufacture of the equipment and demonstrates, to the satisfaction of the Engineer, that the quality is equal to equipment made by those manufacturers specifically named herein. The screen manufacturer shall have at least 50 installations of link driven mechanically cleaned bar screen equipment that has been in successful operation, at similar installations, for at least ten (10) years. Upon request, the manufacturer shall provide a reference of such installation sites along with the relevant contact information.

C. The equipment furnished shall be fabricated, assembled, installed, and placed in proper operation condition in full conformity with approved drawings, specifications, engineering data, and/or recommendations furnished by the equipment manufacturer.

D. No screen manufacturer will be considered by the Engineer as an "or equal" by simply meeting the functional intent of the specifications.

E. The screenings system shall have operations, origin of manufactured, and aftersales service and support in the United States of America.

F. The equipment manufacturer shall have in-place a dedicated quality control / quality assurance program that conforms to the International Organization for Standardization (ISO)-9001:2015.

1.6 WARRANTY

A. Manufacturer shall provide a written one (1) year standard warranty from the date of use of the mechanically cleaned bar screen equipment to guarantee that there shall be no defects in material or workmanship in any item supplied.

B. Manufacturer shall warrant for the period of five (5) years all rotating parts of the mechanically cleaned bar screen including the gear motor, bearing, drive head, and the link system including the

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links, castings, pins and retaining rings. Manufacturer warrants that these components shall be replaced if damaged or defective in the normal use of the equipment.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

The basis of design for the Screening System shall be as manufactured by Duperon Corporation, 1200 Leon Scott Court, Saginaw, Michigan, toll-free 800.383.8479. The screens shall be the FlexRake® Model, Full Penetration Fine Screens FR IQ™ no equal.

2.2 BASIS OF DESIGN

A. The mechanically cleaned bar screen shall have a head sprocket only, with no sprockets, bearings, idlers, or similar drive components under water to trap the chain. Equipment featuring reciprocating rake arms or lower bearings/sprockets/tracks below the water is not acceptable.

B. The mechanically cleaned bar screen shall clean the entire bar screen a minimum of every 7.1 seconds at high speed.

C. The flowability of the screen area, specifically, shall be defined as follows: A composite number representing the specific flowability of a screen area is composed of the bars' hydraulic head loss coefficient shape factor, the bar width and the clear opening of the screen field per formula below.

$$\text{(Coefficient Shape Factor)} \times \left(\frac{\text{Bar Width}}{\text{(Clear Opening)}}\right) = \left(\frac{0.190}{\text{(Clear Opening)}}\right)$$

D. The mechanically cleaned bar screen shall be designed to run continuously (24/7) without an operator.

E. The equipment shall have multiple scrapers on the bar screen at one time cleaning continuously from bottom to top, the entire width of the bar screen. The drive output shaft rotation shall be constant and in one direction in order to reduce maintenance and increase product life. Units which have single raking arms or that require cycle times shall not be allowed. Cleaning mechanisms that use shock absorbers, springs or other dampening or hydraulic actuations are unacceptable.

F. The link system shall have jam evasion capability by flexing around and collecting large objects such as a 2 X 4, bowling ball, grease balls and surges of solids at peak loading times without overloading and shutting down the unit. The link system shall be such that it bends in one direction only, which allows it to become its own lower sprocket and frame and shall have a 1,000-pound lifting capacity.

G. Designs employing the use of endless moving media or cables and hydraulic cylinders to remove debris from the channel and units using proximity or limit switches for reverse cycles are not acceptable.

H. Equipment using a motor greater than 1 HP motor to complete a screen cleaning cycle is not acceptable.

I. The design shall be such to ensure that all maintenance can be accomplished at the operating floor level or above. No part of the drive system including sprockets shall be located below the water surface at maximum design flow.

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J. Design Conditions:

Site Installation Information:	
Quantity of Screens:	1
Channel Width:	4 ft
Channel Height:	5 ft
Bar Opening Size:	1/4 inch
Angle of Installation:	30°
Average Flow:	1.9 MGD
Minimum Downstream Operating Water Level for Average Flow	Provide
Number of Screens in Operation During Average Flow:	1
Maximum Flow:	6 MGD
Minimum Downstream Operating Water Level for Maximum Flow:	Provide
Number of Screens in Operation During Maximum Flow:	1
Maximum Head Differential:	4”
Equipment Location:	Outdoors
Outdoor Installation:	
Site Access Constraints:	No
Below Freezing Temperatures:	No
Installation Area NFPA Classification:	Verify with operator
Collection and Conveyance:	
Containment Height:	4’
Debris Bin:	6’x6’
Conveyor:	No
Washer/Compactor:	Yes, dual auger design

2.3 COMPONENTS

A. **Bar screen assembly**: Bar screen assembly shall be of stainless steel and designed to withstand 1 foot head differential unless noted otherwise in Section 2.2 J Design Conditions. Unless noted otherwise materials of construction shall be 304 stainless steel. A stainless steel channel bottom plate shall be an integral part of the bar screen assembly to fully engage scrapers in the bar screen at the base of the unit and assure that the raking mechanism reaches the bottom of the screen to prevent debris accumulation. The bar screen assembly shall be shipped in one piece.

1. **Screen Bars**: Bars shall be 316L stainless steel and be tear-shaped with a hydraulic coefficient shape factor of 0.76 and the minimum dimensions of 0.25 inch x 0.75 inch x 0.13 inch. Bars shall be individually replaceable without welding. Screen bars shall have a 24 inch diameter curve at the base of the screen to allow for increased flowable area.

2. **Side Fabrication**: The screen framework shall be 304 stainless steel bent plate with minimum of 3/16 inch cross section. Horizontal members shall be of stainless steel bent plate or stainless steel pipe. Support members and frame shall adequately support the bar screen based on site-specific requirements.

3. **Dead Plate:** Dead plate shall be 0.25 inch thick 304 stainless steel. The dead plate shall be flat and true; span the entire width of the unit; and transition from bar screen to discharge point.

4. **Discharge Chute:** The discharge chute shall be 11 gauge, 304 stainless steel. The discharge chute shall be bolted to the dead plate and shall be designed to allow debris to be transferred from discharge point into the debris containment.

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5. **Link Slides:** Link slide assembly shall be provided per manufacturer standard design and shall be constructed of UV Stable UHMW PE and 304 stainless steel supports and components.

B. Return Guide/Closeouts: Return guide/closeouts shall be 304 stainless steel and shall assure proper alignment of scrapers as they enter the bar screen and assure that there is no space wider than the clear opening between bars to prevent passage of larger solids than allowed through the screen.

C. Debris Blade: A 304 stainless steel and UV Stable UHMW-PE debris blade assembly, which does not require a separate drive, shall be installed to assist in removing debris from the scraper on the mechanically cleaned bar screen unit as recommended by the manufacturer. Hydraulic, shock, or spring controlled debris blade mechanisms are not acceptable.

D. Screen Enclosure: A 14 gauge #4-brushed satin finish 304 stainless steel enclosure shall be installed to cover the screen above the operating deck level. Front enclosure shall have removable panels for access to equipment. Removable panels shall be 16 gauge 304 stainless steel and shall be provided with a lift off option for "no tool required" access. Rear Enclosure shall have hinged removable doors and shall be secured with a magnetic latch.

E. Link System: The link system shall be passivated stainless steel castings and have a minimum ultimate strength of 60,000 pounds. with a minimum cross section of 1.5 inches and weighing a minimum of 5 pounds each. Parts must meet ASTM A380 specification for surface finish. Link bearing shall be SAE 841 Bronze type for unlimited life. All wear shall happen between the pin and bearing surface.

1. 304 stainless steel system includes 302 stainless steel retaining rings and 304 stainless steel pins.

F. Scrapers: Scrapers shall be spaced 24 inches apart. To provide long product life the scraper shall move at no greater than 26 inches per minute at normal operating speed of .55 rpm allowing for approximately 1.1 debris discharges per minute**.** Thru-Bar™ scrapers shall be minimum .25 inch thick x 4.2 inches x screen width 2205 super duplex stainless steel.

G. Drive Head: The drive head shall be located at the top of the mechanically cleaned bar screen.

1. **Drive Unit:** Each mechanically cleaned bar screen unit shall operate independently and shall have its own drive unit and driven components.

    a. 304 stainless steel drive sprockets and 304 stainless steel drive shaft

    b. The gearbox shall be shaft-mounted, right angle type and include spiral bevel gearing. The output shaft speed shall be controlled by a vector type inverter. It shall have at least a 1.39 or greater service factor based on machine torque requirements. The gearbox shall not be vented to the outside atmosphere. The gearbox shall be grease filled. Oil filled gearboxes are not allowed.

    c. The motor shall be AC induction type, inverter duty, and mounted to the gear reducer. The motor shall be 1 HP, and rated for Class I, Groups C & D, and NEMA design B. Service factor shall be 1.0 or greater with Class F insulation. The motor must be UL listed and designed for continuous operation.

    d. The motor shall have a built in, normally closed, thermostat to protect from overheating that is to be field wired to corresponding terminals in the Main Control Panel for overload protection.

    e. All drive head components shall be of components available in the United States.

2. **Bearing:** Bearing shall be a non-lubricated no maintenance engineered polymer Thordon® or Vesconite® bearings and shall have a PV value that is less than the limiting PV value of the material. Bearings containing grease are not acceptable.

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3. **Speed Reducer:** Speed reducer shall be a double-reduction, cycloidal style and shall comply with all applicable AGMA standards. The speed reducer shall be capable of a 6/1 speed range with variable output speeds between 0.55 to 4.13 output RPMs (in high flow conditions). The speed reducer shall produce an output torque of 11,000 in.lb. and have a gear ratio of 424:1.

H. Standard Coating: All non-stainless bar screen components shall be coated in strict accordance with the paint manufacturer's specification. Surface preparation shall be done in accordance with SSPC-SP-10 near-white. The three-part coating system shall be manufactured by Tnemec as follows: Prime Coat Series 90-97 Tneme Zinc at 2.5-3.5 mils DFT, Intermediate Coat Series 27 F.C. Typoxy at 3.0-5.0 mils DFT, and Top Coat Series 1095 Endura-Shield at 2.0-3.0 mils DFT. Standard color is 11SF Safety Blue. Material shall meet all state and federal VOC and other regulatory requirements.

Alternatives: Any alternate products must provide certified test reports when submitting products other than those specified herein. Test reports shall indicate the test method, system, and requirements for those products being submitted, and shall meet or exceed the test criteria and performance values of the specified coatings herein.

2.4 ELECTRICAL, CONTROLS, INSTRUMENTATION

A. General: Controls for each rake shall be in enclosures provided by the bar screen manufacturer. The bar screen manufacturer shall be responsible for proper sizing and function of the controls for a site supply voltage of 480V, unless specified otherwise.

1. Controls shall be designed to accept incoming power supply per plans/specs and shall include a step-down transformer if needed to achieve 120V.

2. Control enclosures shall be constructed to meet the appropriate NEMA classification requirements. The panel will be constructed by a UL certified control panel build facility and will be marked with the appropriate UL labeling.

3. Controls shall be tested prior to shipment to owner. The rake manufacturer shall verify all overload settings in the rake controller to ensure proper overload and speed settings required for the application are programmed.

4. Control enclosures shall be wired complete with a minimum of #16 MTW wire in the appropriate colors for the circuits being supplied. 120VAC control shall be red, grounded AC neutral shall be white, DC control shall be blue, DC neutral shall be white with blue tracer, equipment ground shall be green and all incoming and outgoing external power source wires shall be yellow. All AC power wiring shall be a minimum of #12 black. All wires shall be labeled at both ends with heat-shrink wire markers. Internal panel wiring shall be contained in non-flammable, covered wire way.

5. All panel(s) and panel mounted devices shall be labeled with engraved I.D. markers that refer back to the system schematics. Tags shall be white with black core and engraved as required.

6. All field wiring and power cables between the bar screen's Main Control Panel and the Local Control Station shall be provided by others under the Electrical Section. VFD rated motor cable (Belden #29502 or equal) is recommended for all motors. Motor cables shall be less than 80 feet unless otherwise specified.

B. Components:

1. **Main Control Panel (MCP)**

a. MCPs mounted outdoors require shading from the sun and shall be operated within a temperature range between 35°F and 104°F. Sunshields, visors or other

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structures needed to provide shade are by others. If the controls will experience temperatures outside this range, then special climate controls can be provided.

b. MCP shall be NEMA 4X 304 stainless steel.

c. MCP shall not be in an explosive environment per NFPA 820.

d. MCP shall be designed with a SCCR rating of 18KA at 480VAC minimum and labeled as such, unless otherwise specified.

e. All terminals used in the MCP shall be rated for 600V and 20% spare terminal space shall be provided for any potential future revisions.

f. The MCP shall include at a minimum the following

- Main fusible disconnect with lockable operator, unless otherwise specified.
- E-Stop maintained contact pushbutton.
- Physical or virtual Hand/Off/Auto (HOA) selector switch for each piece of equipment.
- Elapsed run-time meter for each piece of equipment.
- Indication for "Power On", "Forward" and necessary faults.

g. Relay Based Controls shall include the following:

- Variable Frequency Drive (VFD)
- Dry contact SCADA Interlock(s)
- Adjustable on/off cycle timers

2. Local Control Panels (LCPs)

a. Enclosures shall be NEMA 4X/7/9 rated for NFPA classified area installation**.** LCPs must be mounted (by others) according to applicable safety codes as determined by the Engineer.

b. An LCP shall be provided for each piece of equipment controlled by the MCP.

c. LCPs shall be mounted as close to the equipment as safely possible and shall be field wired by the electrical subcontractor to the corresponding terminals in the MCP. Operators using the LCPs must be able to carefully observe equipment operation.

d. Each LCP shall include Forward and Jog Reverse pushbuttons and a maintained contact E-Stop pushbutton.

3. Instrumentation: Each raking assembly shall have a separate level system that shall be installed and field wired by others per the manufacturer's instructions. Note that the HydroRanger® can be installed in the MCP or remotely and wired to the MCP.

a. Single Level/Speed Control: When the level switch trips, the rake runs. When the level switch returns to the normal position, an off-delay timer is initiated to prevent intermittent equipment starting/stopping. Cycle timing logic shall also be included that functions in parallel with the level control for optimal rake run time.

- Siemens HydroRanger® 200 with (1) Siemens Echomax ultrasonic level transducer. Transducer shall be installed upstream of the rake, at least 1 foot above the highest anticipated water elevation and the beam angle shall not have obstructions between the transducer face and the water surface. The HydroRanger® will be configured with one level set point. A mechanical float switch can be used in conjunction with the HydroRanger® as backup control.

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C. Controls Design Conditions:

Incoming Power: (Voltage/Phase)	???V / ? phase / ? Hz
Main Control Panels:	One MCP for all screening equipment
MCP installation location:	Outdoors
Approx. distance between main panel and equipment motor	10’
If indoors, climate controlled location?:	N/A
If outdoor location, choose one of the 2 options below.	MCP must be shaded. Shade provided by others
If temperatures will not regularly exceed 104° F:	MCP will include thermostat, heater and fan with grilles and NEMA 4X rain hoods for ventilation.
If temperatures will regularly exceed 104° F:	MCP will include thermostat, heater, and side-mounted NEMA 4X air conditioner.
Transducer/Float cable length:	50 feet (standard).

2.5 SPECIALTY TOOLS, SPARE PARTS, AND LUBRICATION

A. Manufacturer shall provide any specialty tools and recommend spare parts required for maintaining the equipment as follows:

1. Snap/Retaining Rings (10)
2. Link Clevis Pins (2)
3. Button Head Cap Screw (4)
4. 3/8”-16 Nylock Nut (4)
5. Snap Ring Tool (1)
6. Anti- Seize paste, 1 oz. tube (1)

PART 3 – EXECUTION

3.1 SHIPMENT

Shipment of all equipment shall be coordinated to allow the screen shipment as one complete integrated assembly unless otherwise specified by the Contractor, Engineer, Owner or Owner’s Representative.

3.2 INSTALLATION

A. Equipment shall be installed in strict conformance with the manufacturer’s installation instructions, as submitted with shop drawings, operation and maintenance manuals and/or any pre-installation checklists. Installation shall use standard torque values and be installed securely in position and neatly appearance. Installation shall include any site preparation tasks as required by the engineer or manufacturer; such as unloading, touch-up painting, etc. and any other installation tasks and materials such as wiring, conduit, controls stands as determined by the customer and/or specified by the manufacturer.

B. **Anchors:** Anchors and nuts shall be 304 stainless steel and furnished for each item of equipment by the CONTRACTOR.

1. Anchors template drawings shall be included in the submittal to permit verification of the location structural elements, new or existing in the concrete.

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2. Anchors sizes, quantity, and requirements will be indicated on the submittal drawings. Quantity is site specific but typically each bar screen assembly requires (8) to (12) 1/2" dia. x 4 1/2" Lg. embed HILTI KWIK bolt TZ for mechanical screen anchorage and typically (8) to (12) 3/8" dia. x 3 3/8" Lg. embed HILTI KWIK bolt TZ anchors for the return guide/closeouts anchorage.

3.3 TESTING

A. After completion of installation, CONTRACTOR shall provide for testing performed in strict conformance with the manufacturer's start up instructions. Testing of the bar screen shall demonstrate that the equipment is fully operational by picking up and depositing materials into specified containment.

B. Field certification shall include inspection of the following:

1. Verify equipment is properly aligned and anchored per the installation instructions and drawings. Assure the bar screen unit is square, flat, and unobstructed with required clearances maintained.

2. Assure controls and instrumentation work in all modes.

3. Check equipment for proper operation of debris blade, scrapers, etc. as well as completion of the start-up requirements in the installation guide.

3.4 ONSITE TECHNICAL ASSISTANCE

A. Manufacturer shall provide services to include installation certification, and shall include (1) day for Start-Up and (1) day for Training. Manufacturer shall be given minimum 14 days notification prior to the need for such services. To assure the best outcome for the Owner and Contractor, the Contractor shall provide certification for completion of the PRE-COMMISSIONING CHECKLIST.

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Section 11100

WASHER COMPACTOR 3.0 WC3.D2.5 (1 HP MOTOR)

PART 1 – GENERAL

1.1 SUMMARY

A. SCOPE OF WORK

Duperon Corporation shall furnish an interleaving, dual auger washer compactor assembly as shown on the drawings and as specified herein. A single unit shall provide washing and compacting action on wastewater screenings. The equipment shall be manufactured by Duperon Corporation, 1200 Leon Scott Court, Saginaw, Michigan, 48601, (800) 383-8479, in accordance with this section.

B. RELATED WORK

1. Bar Screen
2. Conveyor
3. Receptacle

C. QUALITY ASSURANCE

1. All equipment supplied under this section shall be of a single manufacturer and demonstrate, to the satisfaction of the Engineer, that the quality is equal to equipment made by those manufacturers specifically named herein.

2. The equipment furnished shall be fabricated, assembled, erected, and placed in proper operating condition in full conformity with approved drawings, specifications, engineering data, and/or recommendations furnished by the equipment manufacturer.

1.2 RELATED SECTIONS

A. The following list of related sections is provided for the convenience of the Contractor and is for reference only to support commonly referenced sections that are in-general applicable to all equipment supplied. (For complete list of sections see specification index.)

1. All sections of Division 1 including but not limited to Submittal Procedures, Shop Drawings, Product Data and Samples, Operating and maintenance information, Protection of Materials and Equipment, Installation, Testing, and Commissioning, Instruction of Operations and Maintenance Personnel, and Spare Parts Maintenance Manuals.
2. Section 05120-Anchorage
3. Section 09900-Coating Systems
4. Section ME1-General Requirements for Equipment
5. Section E1-Electric Motors
6. Section E1-Control Panels

1.3 REFERENCE STANDARDS

A. American National Standards Institute (ANSI)
B. American Society for Testing and Materials (ASTM)
C. American Welding Society (AWS)
D. American Institute of Steel Construction (AISC)
E. American Bearing Manufacturers Association (ABMA)
F. American Gear Manufacturers Association (AGMA)
G. National Electrical Manufacturers Association (NEMA)
H. Underwriters Laboratory (UL)

1.4 SUBMITTALS

A. The equipment manufacturer shall submit the following items:

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1. (4) Sets of Shop Drawings, including: Main Layout Drawings, List of Equipment Specifications, and Recommendations furnished by the Equipment Manufacturer.

2. (4) Sets As-Built Drawings of Washer Compactor Structure, Controls, and Accessories (as applicable).

3. List of Spare Parts and Special Tools (as applicable).

4. (4) Sets O&M Manuals (including As-Built Drawings) to be provided after equipment ships for inclusion in the close-out Submittal process.

1.5 QUALITY ASSURANCE

A. The Washer Compactor shall be fully assembled and shop tested at the manufacturing facility prior to shipment. Shop testing shall include a minimum of 4 hours of run time.

B. To assure quality and performance: All equipment furnished under this Section and related sections shall be of a single manufacturer who has been regularly engaged in the design and manufacture of the equipment and demonstrates, to the satisfaction of the Engineer, that the quality is equal to equipment made by those manufacturers specifically named herein. And the Washer Compactor manufacturer shall have at least 25 installations of the specified model of Washer Compactor equipment that has been in successful operation, at similar installations, for at least five (5) years. Upon request, the manufacturer shall provide a reference of such installation sites along with the relevant contact information.

Possible consideration may be given to manufacturers with less installation experience but only upon submission and approval of dimensional and installation drawings and O & M Manuals. Additionally, a complete product development plan with dates indicating all applicable alpha and beta testing shall be provided for review and acceptance.

Approval of any manufacturer that does not meet the installation experienced defined herein shall be contingent upon submission and approval of the previously defined information. Additionally, such manufacturers shall be required to provide a performance bond issued in favor of the owner, covering the full amount of the manufacturer's offering and for the entire warranty period of the project.

C. The equipment furnished shall be fabricated, assembled, installed and placed in proper operation condition in full conformity with approved drawings, specifications, engineering data, and/or recommendations furnished by the equipment manufacturer.

D. The equipment manufacturer shall have in-place a dedicated quality control / quality assurance program that conforms to the International Organization for Standardization (ISO)-9001:2015.

1.6 WARRANTY

A. Manufacturer shall provide a written one year standard warranty from the date of use of the Washer Compactor equipment to guarantee that there shall be no defects in material or workmanship in any item supplied.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Washer Compactor***[s]*** shall be as manufactured by Duperon Corporation, 1200 Leon Scott Court, Saginaw, Michigan, TF 800.383.8479.

B. Or pre-approved equal. Washer Compactor manufacturer seeking pre-approval must submit application a minimum of three (3) weeks prior to bid day. Charges for additional engineering to alter site drawings to meet the intention of the specification shall be at the cost of the manufacturer requesting such change. The necessary submission to be considered a pre-approved equal shall include the following information:

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a. Product data sheet

b. Site Specific Proposal Drawing

c. Installation drawings and instructions

d. O & M Manual

e. An employee list of in-house design engineers along with their respective locations and resumes.

f. An employee list of in-house controls engineers along with their respective locations and resumes.

g. An employee list of in-house application engineers along with their respective locations and resumes.

h. An employee list of in-house project managers along with their respective locations and resumes.

i. An employee list of in-house field service technicians along with their respective locations and resumes.

2.2 BASIS OF DESIGN

A. Compacting Action: The Washer Compactor shall have dual augers to provide positive displacement action. Augers shall be oriented on top of each other and rotate in opposing directions. Augers shall be intermeshed, with one left-hand and one right-hand lead. Augers shall be designed with a limited float on top of a strainer to allow for the accommodation of irregular debris.

B. Washing Action: The Washer Compactor shall have a wash water manifold integrated into the main housing. Two ports inside the unit shall emit a medium pressure stream. Wash water shall run continuously when the Washer Compactor is in motion. Continuous operation (non-batching) equipment is required; filling- and batching-type equipment shall not be accepted.

C. Operation: The Washer Compactor shall be continuous run, not requiring an operator. The Washer Compactor shall create compaction through debris back pressure and be designed to accept non-standard wastewater debris in its original form, including but not limited to: rocks; broken concrete; and metal (such as bolts or short pipe) up to 4 inches long. The Washer Compactor shall have the ability to process multiple pieces of clothing, variable volumes of debris, and unprocessed septage or grease. The Washer Compactor shall move at a normal operating speed of 0.5 to 2.2 RPM and shall have the ability to run intermittently to sync with upstream equipment.

D. Discharge Extension Option (DEO): Washer Compactor is equipped with a single drive motor and chute designed to transport washed and compacted screenings from the compactor to a receptacle at a maximum distance of 40 feet. Transportation of screenings are fully enclosed to contain odors and maintain site cleanliness. Equipment utilizing a separate motorized conveyance system shall not be accepted.

E. Materials:

1. **Fabrications:** All welded fabrications shall be made from stainless steel. All welded connections and welding procedures shall comply with AWS “Structural Welding Code – Sheet Steel” D1.3/D1.6.

2. **Select Parts:** Select power transmission parts to be made from cast iron; however, shall conform to standard coating as follows.

3. **Standard Coating:**

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a. Motor gearbox shall be coated in strict accordance with the paint manufacturer's specification. Surface preparation shall be done in accordance with SSPC-SP-10 near White. The three-part coating system shall be manufactured by Tnemec as follows: Prime Coat Series 90-97 Tnemec Zinc at 2.5-3.5 mils DFT; Intermediate Coat Series F.C.Typoxy at 3.0-5.0 mils DFT; and Top Coat Series 1095 Endura-Shield at 2.0-3.0 mils DFT. Standard color is 11SF Safety Blue. Material shall meet all State and Federal VOC and other regulatory requirements.

b. Alternatives: Any alternate product must provide certified test reports when submitting products other than those specified herein. Test reports shall indicate the test method, system, and requirements for those products being submitted and shall meet or exceed the test criteria and performance values of the coatings specified herein.

4. **Non-Metal:** Parts not covered in the specifications above shall be manufactured from UHMW polyethylene.

F. Design Conditions:

Washer Compactor WC3.D2.5 Data Sheet	
Peak Capacity:	30 cu.ft./hr (approx. 15 minutes)
Average Capacity (Continuous):	6.5 cu.ft./hr
Wastewater Application (¼" barscreen):	Up to 15 MGD
Water: Typical	• Utilizes filtered effluent or municipal water • Consumes 3-10 GPM • Requires 40-60 PSI • ½ inch NPT supply (female threads) • 3 inch NPT drain (male threads)
Materials of Construction:	• 304 SSTL • 17-4 Spur Gears • Delrin (or equivalent) thrust and plane bearings • UHMW Auger Supports
Strainer:	• Perforated Screen
Hopper Height (Deck to Hopper):	38"
Hopper Length (WC3.D2.5 Unit):	43"
Below Freezing Temperatures: Heat tracing required on body, transition and discharge chutes (installation and power by others)	No
Performance Data (Typical Wastewater Debris)	
Dry Solids:	30%-60%
Mass/Weight Reduction:	60%-70%
Volume Reduction:	70%-80%
Odor/Fecal:	Significantly decreases odor/fecal
Motor/Drive	
Motor Size:	1 HP
Motor Paint:	Duperon® Standard Tnemec Coating
Motor Service Factor (Minimum):	1.0
Output Speed:	2.2 RPM
Speed Reducer Ratio/Output:	809:1
Speed Reducer Paint:	Duperon® Standard Tnemec Coating
Site Power	
Phase/Voltage:	240/480 volt
Controls	
	• NEMA 4X SSTL enclosure • Main Disconnect

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	• Emergency Stop • HOA (Auto is discreet “Run” input) • Fwd/Jog Reverse/E-Stop Push Button Station • “Run” and “In Auto” discrete outputs • Explosion-Proof station (local standard)
Mounting:	• Wall • Pedestal (by others)
Project Management	
Submittal Quantity:	2 – 4
O&M Manual Quantity:	2 – 4
Warranty Period:	1 year
Shipping	
	• Main unit • Chute(s)

2.3 COMPONENTS

A. Main Housing: The main housing of the Washer Compactor shall be constructed of stainless steel (material options contained in table) with a minimum thickness of 11 gauge. Support and flange connections shall be 3/8 inch.

B. Hopper: The hopper of the Washer Compactor shall be constructed of stainless steel (material options contained in table) with a minimum thickness of 11 gauge.

C. Augers: The augers shall be of stainless steel (material options contained in table) with 8 inch diameter flights, 3/8 inch thick, with 4 inch flight pitch. The augers shall be coupled to a transmission at the drive end and be supported at the compaction end with UHMW plane bearings. This arrangement shall allow for the accommodation of irregular debris. The auger shaft shall be 2 inch stainless steel schedule 40 pipe with 2 inch solid stainless steel stub shaft.

D. Compaction Housing: The compaction housing of the Washer Compactor shall be ¼ inch stainless steel (material options contained in table). The compaction housing shall contain the auger supports.

E. Discharge Chute: The discharge chute of the Washer Compactor shall be constructed of stainless steel (material options contained in table) with a minimum thickness of 14 gauge. Support and flange connections shall be 1/4 inch. The discharge chute shall be tapered outward toward the discharge end.

F. Water Supply: The water supply shall connect at a single point with a ½ inch NPT female connector. A NEMA 7/9 Explosion proof solenoid valve is provided to limit the wash water flow to only when the washer compactor is running. Ball valves shall be provided to distribute flow to the washing and trough sprayer connections.

G. Strainer: A strainer shall be located beneath the lower auger to filter the washed solids. The strainer shall be removable via drain trough and pressed against the lower auger with spring pressure. The strainer shall be self-cleaning through continuous, even contact with the lower auger. Strainers requiring auger-mounted brushes will not be accepted.

H. Drain Trough: A removable pan shall be provided beneath the main housing to collect washwater. Washwater shall be drained through a 3 inch NPT male drain port. The pan shall be a minimum of 11 gauge stainless steel (material options contained in table).

I. Drive Assembly:

1. Each Washer Compactor unit shall operate independently, with its own drive unit and driven components. The gearbox shall not be vented to the outside atmosphere.

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2. The gearbox shall be grease lubricated and designed for 5 years (or 20,000 hours of operation) between recommended clean and re-grease services. The gearbox shall be right angle type, and shall incorporate cycloidal and spiral bevel gearing with a total ratio of 809:1. The gear reducer output shaft speed shall be 0.5 RPM minimum to 2.2 RPM maximum and controlled by a vector-type inverter (or greater service factor) based on unit torque requirements. It shall be shaft-mounted utilizing the keyless Taper-Grip® bushing.

3. The motor shall be mounted to the gear reducer by utilizing a quill, C-Face mounting style. The motor shall be AC induction type, 1 HP, 3/60/230/460 volt, explosion-proof, inverter-duty model.

4. The drive assembly shall incorporate the Duperon® standard coating system.

J. Auger Transmission:

1. The Drive Assembly shall be coupled to a dual gear transmission, which drives the augers in a counter-rotation.

2. The spur gears are contained in a stainless steel housing and supported by Delrin (or equivalent) plane bearing.

3. Grease fittings shall be located outside of the transmission housing to provide lubrication to the gears.

K. Speed Reducer: The Speed Reducer shall have a maximum output of 2.2 RPM, 809:1 reduction ratio with 18,900 in-lb. of output torque.

L. Thrust Bearings: Thrust Bearings shall be Delrin (or equivalent), self-lubricating, and be capable of withstanding a minimum of 2000 lb. of thrust load (each auger) at 2.2 RPM for life of machine.

M. Screw Supports: Screw supports shall be UHMW plane type, self-lubricating, and fastened into place using stainless steel fasteners.

2.4 ELECTRICAL, CONTROLS, INSTRUMENTATION

A. General: Controls the washer compactor shall be in enclosures provided by the washer compactor manufacturer. The washer compactor manufacturer shall be responsible for proper sizing and function of the controls at 480V, unless specified otherwise. **Note that the washer compactor controls can be integrated into the main control panel of the bar screen if provided by the same manufacturer.**

1. Main control panels require shading from the sun and shall be operated within a temperature range between 35°F and 104°F. Sunshields, visors or other structures needed to provide shade are by others. (If the controls will experience temperatures outside this range, then special climate provisions are available.)

2. Controls shall be designed to accept incoming power supply per plans/specs and shall include a step-down transformer as needed to achieve 120V.

3. Control Panel(s) shall be constructed to meet the appropriate NEMA classification requirements and will include a main, lockable disconnect. The panel will be constructed by a UL certified control panel build facility and will be supported by the appropriate UL labeling.

4. Controls shall be tested prior to shipment to owner. The washer compactor manufacturer shall verify all overload settings in the motor controller to insure proper overload and speed settings required for the application are properly programmed.

5. Control panel(s) shall be wired complete with a minimum of #16 MTW wire in the appropriate colors for the circuits being supplied. 120VAC control shall be red, grounded

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AC neutral shall be white, DC control shall be blue, DC neutral shall be blue with a white tracer, equipment ground shall be green and all incoming and outgoing external power source wires shall be a yellow configuration. All AC power wiring shall be a minimum of #12 Black. All wires shall be labeled at both ends with heat-shrink wire markers. Internal panel wiring shall be contained in non-flammable, covered wire way.

6. All panel(s) and panel mounted devices shall be labeled with engraved I.D. markers that reference back to the system schematics. Tags shall be white with black core, engraved as required.

7. All field wiring and power cables between the washer compactor Main Control Panel and the Local Push Button Station shall be provided by others under the Electrical Section. VFD rated motor cable (Belden #29502 or equal) is recommended for all motors. Motor cables shall be less than 80 ft unless otherwise specified.

B. Components:

1. Main Control Panel

a. Enclosure(s) can be NEMA 4X 304 SSTL for indoor/outdoor installations.

b. Enclosure shall not be located in a Classified area.

c. Main Control Panel shall be designed with a SCCR rating of 18KA at 480VAC minimum and labeled as such, unless otherwise specified.

d. All terminals utilized in the main panel shall be 600V rated terminals and 20% spare terminal space shall be provided for any potential future revisions.

e. The Main Control Panel shall include at a minimum the following
- Main fusible disconnect with lockable operator, unless otherwise specified.
- Physical or virtual Hand/Off/Auto (HOA) Selector and Push/pull E-Stop button.
- Elapsed run-time meter
- Indication for "Power On", "Forward" and necessary faults
- Fused connection for the washwater solenoid.

f. Relay Based Controls shall include the following:
- Variable Frequency Drive (VFD)
- Electronic torque control
- Hard contact SCADA Interlock(s)
- Adjustable off delay timer

2. Local Control Push Button Station

a. Enclosure shall be NEMA 4/7/9 rated for Classified area installation. Local push button station must be local to the equipment to maintain requirements of local safety codes as determined by the Engineer.

b. Local station shall be mounted within 10 feet or as close to the equipment as safely possible and be field wired by the electrical subcontractor to the corresponding terminal inputs in the main control panel.

c. The remote pushbutton station shall include Forward, Jog Reverse and E-Stop buttons.

3. Sequence of Operations:

a. The Washer Compactor controls shall enable the push button station installed

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near the Washer Compactor when in “Hand” mode and utilize an input signal from a remote source when in “Auto” mode. Upon receiving a disruption of “remote source” signal in “Auto” mode, the Washer Compactor shall utilize an off-delay timer to allow debris to finish depositing. The washwater solenoid is energized any time that the washer compactor is running.

b. The Duperon® Speed Controller fault shall be cleared by turning off the Washer Compactor, then waiting approximately three minutes (or time designated per current UL standards) and then turning the HOA back to the desired setting. A motor overtemp fault shall clear automatically when the motor cools to a temperature within the normal operating range.

4. Miscellaneous:

a. The following shall be provided by the electrical contractor and are not part of the Washer Compactor manufacturer scope of supply:

a. Mounting stands

b. Mounting hardware

c. Field wiring and conduit

i. VFD-rated motor cable (Belden #29502 or equal) recommended for all motors.

ii. Motor cables shall be less than 80 ft. long unless specified otherwise.

d. Junction boxes

e. Installation

b. Field wiring shall include (but not be limited to) the following connections as applicable:

a. All incoming power supply to the main control panel.

b. All required grounding of the motor and controls.

c. Motor to the main control panel.

d. VFD-rated motor cable (Belden #29502 or equal) recommended for all motors.

e. Motor cables shall be 80 ft. long unless specified otherwise.

f. Motor thermostat to the terminal inputs in the control panel.

g. Washwater solenoid wiring

h. Input and output signal wiring for remote start/stop as required by plans/specs.

c. Remote station contacts to the corresponding terminal inputs in the main control panel.

2.5 SPECIALTY TOOLS, SPARE PARTS AND LUBRICATION

A. Duperon does not typically recommend the purchase of additional spare parts, though some customers prefer to have them on hand.

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B. Plane Bearing Kit includes:

1.	Side Auger Supports	(2)
2.	Upper/Lower Auger Supports	(2)
3.	FHSCS: ¼-20 x 1.00 LG	(24)
4.	Washer: ¼ Flat SAE	(24)
5.	Nut: ¼-20 Nylock	(24)
6.	Grease Tube (14oz.)	(1)
7.	Anti-Seize Lubricant (1oz.)	(1)

C. Drop Sleeve: A flexible canvas sleeve shall be connected to the end of the Washer Compactor steel chute. The sleeve shall provide a guidance for dropping screenings. The sleeve shall help contain the debris as it falls and prevent debris from being scattered by the wind or otherwise impact the immediate environment. The sleeve shall be constructed of heavy-duty urethane canvas and be tethered to the surroundings as required (by others).

PART 3 – EXECUTION

3.1 SHIPMENT

Shipment of all equipment shall be coordinated to allow the Washer Compactor shipment as one complete integrated assembly unless otherwise specified by the customer, contractor, or engineer.

3.2 INSTALLATION

A. Equipment shall be installed in strict conformance with the manufacturer's installation instructions, as submitted with Shop Drawings, Operation and Maintenance Manuals and/or any pre-installation checklists. Installation shall utilize standard torque values and be installed secure in position and neat in appearance. Installation shall include any site preparation tasks as required by the engineer or manufacturer; such as unloading, touch-up painting, etc. and any other installation tasks and materials such as wiring, conduit, controls stands as determined by the customer and/or specified by the manufacturer. All plumbing shall be completed on site by a qualified individual in accordance with all local and national plumbing regulations.

B. **Anchors:** Anchors and nuts shall be 304 stainless steel and furnished for each item of equipment by the CONTRACTOR.

1. Anchors template drawings shall be included in the submittal to permit verification of the location structural elements, new or existing in the concrete.

2. Anchors sizes, quantity and requirements will be indicated on the submittal drawings. Quantity is site specific but typically each Washer Compactor assembly requires (4) 1/2" dia. x 4 1/2" Lg. embed HILTI HAS RODS w/ RE-500v3 Adhesive system anchors.

3.3 TESTING

A. After completion of installation, CONTRACTOR shall provide for testing and shall be performed in strict conformance with the manufacturer's start up instructions. Testing of the Washer Compactor shall demonstrate that the equipment is fully operational and that the equipment will wash, compact, and deposit materials not to exceed 4 inches.

B. Field certification shall include inspection of the following:

1. Verify Washer Compactor is properly leveled and anchored per the installation instructions and site drawings.

2. Assure controls and instrumentation work in all modes.

3. Assure proper auger rotation.

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4. Check to assure all Start-Up requirements are completed per the Installation Guide.

3.4 ONSITE TECHNICAL ASSISTANCE

A. Manufacturer shall provide services to include Installation Certification, and shall include (1) day for Start-Up and Training. Manufacturer shall be given minimum 14 days notification prior to the need for such services. To assure the best outcome for the Owner and Contractor, the Contractor shall provide certification for completion of the PRE-COMMISSIONING CHECKLIST. Duperon reserves the right to combine the start-up and training time for the Duperon® Washer Compactor with that of other Duperon® equipment, such as the Duperon® FlexRake®.

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SECTION 11219 - MULTISTAGE CENTRIFUGAL BLOWER

PART1 – GENERAL

1.1 SCOPE OF WORK

A. This specification covers the supply of multistage centrifugal air blowers to be used to provide air to the aeration basins. The principal items to be furnished shall include:
   1. One (1) multistage centrifugal blower
   2. Electric motor drivers.
   3. All accessory items and blower protection panels as described herein and as shown on the plans, which are required for proper operation of the centrifugal blowers.

1.2 SUBMITTALS

A. Drawings and Documentation
   1. An electronic set of submittals shall be provided including drawings, documentation and equipment catalog cut sheets indicating the selection of size and model where appropriate. Submittals shall include all dimensions for blower and accessories such as filters, silencers, expansion joints, couplings, valves, and other equipment that would affect equipment package layout at installation.

B. Operation and Maintenance Manuals
   1. The blower manufacturer shall furnish an electronic file containing Operation & Maintenance manuals for all the equipment specified. All manuals shall consist of Continental standard drawings, vendor drawings, and all applicable instructions for the proper installation and operation of the equipment.

1.3 WARRANTY

A. The manufacturer shall warrant the products of its manufacture to be free from defects in material and/or workmanship under normal use and service for a period of one (1) year from date of operation. Motor, accessories, and other equipment not manufactured by the blower manufacturer shall be guaranteed by their own individual manufacturer’s warranties

PART 2 – PRODUCTS

2.1 GENERAL REQUIRENMENTS

A. The equipment covered by this specification is intended to be standard equipment of proven reliability as manufactured by a reputable manufacturer having experience in the production of such equipment. The equipment furnished shall be designed, manufactured, and installed following the best practices and methods and shall operate properly when installed in accordance with the contract drawings and operated per manufacturer’s recommendations.

B. Each blower unit shall be of the multistage centrifugal type, as manufactured by Continental Blower, LLC.

C. The impellers shall be mounted on a single shaft supported on each end by ball bearings mounted in outboard bearing housings. The blower shall be built from parts cast in patterns from which previous units have been built and tested. The blower shall be of the manufacturer's standard design.

2.2 PERFORMANCE

A. Each aeration blower (Quantity 1) shall be designed for a capacity of 1,270 ICFM. Discharge pressure at the specified capacity shall be 8.2 PSIG, when operating at site conditions of 14.5 PSIA, 105 Deg F, and 80% relative humidity.

2.3 COMPONENTS

A. Blower Housings

1. The blower housings shall consist of vertically split cast iron intermediate sections held securely between cast iron inlet and outlet heads with high strength steel tie rods. Two-piece fabricated construction with rope packing is not acceptable.
2. No contact shall be made between the shaft rotor and the housing, other than through the bearings. Where the blower shaft passes through the inlet and outlet heads, suitable carbon graphite ring seals shall be provided to prevent air leakage.

B. Impellers

1. The impellers shall be high strength cast aluminum or fabricated composite aluminum construction. Impellers shall butt together directly or through one-piece metal spacers and be securely keyed to the blower shaft.
2. Impellers shall be individually statically balanced, then assembled to the shaft and the entire rotating element shall be dynamically balanced as an assembly. Blower shall be designed to operate at a maximum vibration level of 1.25 mils in the vertical plane when measured on the bearing housing.

C. Diffusers

1. Diffuser sections that receive air from the impeller and guide the air to the eye of the next impeller shall be provided. Diffusing vanes shall be provided and be an integral part of the intermediate section casting.

D. Baffle Rings

1. Units incorporating baffle rings at the inlet and intermediate sections shall be provided with one-piece stainless-steel baffle rings, securely mounted to the head and sections either directly or through one-piece stainless-steel mounting brackets.

E. Shaft

1. Blower shaft shall be fully ground high-grade carbon steel of sufficient diameter to operate at a minimum of 20% below first critical speed. Shaft speed shall not exceed 3600 RPM.

F. Bearings
   1. Each blower shall be provided with oil lubricated anti-friction ball bearings.
   2. Bearings shall be sized to provide a bearing life of minimum 10 years per AFBMA B-10 standards.

G. Bearing Housing
   1. Bearings shall be mounted in cast iron outboard mounted bearing housings designed to isolate the bearings form blower temperature. Bearing housings shall be designed to allow removal and replacement of the bearings without dismantling the machine or disconnecting piping.

H. Flexible Coupling
   1. The blower shall be connected to the motor through a flexible coupling. The installing contractor shall check, and if necessary, adjust the coupling alignment in accordance with manufacturer's instructions. Each coupling shall be provided with a suitable coupling guard in compliance with OSHA standards.

I. Baseplate
   1. Each blower and motor shall be mounted on a single full-length structural steel baseplate designed for resilient mounting on suitable vibration pads supplied by the blower manufacturer. Baseplate shall not be grouted or bolted to the concrete foundation.

J. Motor
   1. Electric motors shall be constant speed, squirrel cage design in accordance with NEMA and IEEE standards. Motors shall be designed to operate at 3600 RPM on 3 phase, 60 cycle, 460-volt electrical supply. Motor shall have a 1.15 service factor and be sized to operate below motor nameplate rating at the specified capacity and design conditions. Motor enclosure shall be TEFC. A 50 HP motor shall be provided for each aeration blower.

2.4 ACCESSORIES

A. Reinforced flexible connectors shall be provided for outlet piping.

B. Wafer style lever operated butterfly valves designed for low pressure air throttling service shall be provided for mounting in the blower inlet and discharge piping.

C. Wafer style check valve for low-pressure air service shall be provided for mounting in the blower discharge piping.

D. Suitable inlet filter/silencer shall be provided. Filter element shall be cleanable and replaceable. Filter shall be sized for the specified flow. Filter efficiency shall be minimum 98% on 10-micron particles. A differential pressure gauge shall be provided.

E. A discharge pressure gauge shall be provided for all blowers.

F. Blower Protection Panel:

a. Provide a NEMA 4X 304 stainless steel control panel at each blower.
b. Panel will be fed with 120VAC power.
c. Provide fuse holders and fuses as required.
d. Provide a digital panel meter for amps display and surge/overload control.
e. Provide a current transformer to ship loose for field mounting with the existing starters. Mounting to be provided by contractor.
f. Provide amp transducer to convert the current transformer 0-5A signal to a 4-20mA signal to send to the Amps digital meter.
g. Provide a digital panel meter for CFM display. To be programmed based on the blower performance curves.
h. Panel door devices shall include:
    i. BLOWER RUNNING pilot light.
    ii. SURGE alarm pilot light.
    iii. OVERLOAD alarm pilot light.
    iv. ALARM RESET push button.
    v. MOTOR AMPS digital panel meter
    vi. CFM digital panel meter
    vii. Nameplates as required.
i. Provide dry contacts for connection to plant SCADA system.
j. Relays/Socket as required.
k. Time delay relays as required.
l. Terminal blocks as required.
m. Control panel to be UL508A listed.
n. Digital panel meters shall be Precision Digital PD6000 series with 4-20mA input.

PART 3 - EXECUTION

3.1 TESTING

A. Each blower shall be given a mechanical run test at the manufacturer's facility for a minimum of four hours. Blower bearing vibration and temperature shall be checked to ensure compliance with manufacturers standards.

B. All tests shall conform to ASME Power Test Code and shall extend from surge to beyond rated design flow. ASME tests are not required for blowers built from parts cast in patterns from which previous units have been cast, built and tested.

3.2 INSTALLATION

A. Blower shall be installed in accordance with manufacturer's recommendations. The installing contractor shall provide qualified personnel to check the coupling alignment and make any necessary adjustments. All piping and accessories shall be fully supported to prevent the transmission of excessive forces to the blower connections. Blower shall be installed on suitable resilient foundation pads supplied by the blower manufacturer.

END OF SECTION

SECTION 11310

SUBMERSIBLE WASTEWATER PUMPS FOR WET WELL

PART 1. GENERAL

1.1. SCOPE OF WORK

A. The work in this section shall include furnishing and placing into operation 3 submersible pumps, with discharge connections, lifting chains and guide bars as specified herein and as indicated on the drawings. The complete pump station shall be submersible up to 65 feet above the inlet pipe level.

1.2. RELATED SECTIONS

A. Section ME-4 MONITORING AND CONTROL PANEL FOR SEWAGE PUMP STATION

1.3. REFERENCES

A. American Society for testing and material (ASTM) International
1. A 48: Standard Specification for Gray Iron Castings.
2. A743: Standard Specification Iron-Chromium Nickel, Corrosion Resistant,

B: American National Standards Institute (ANSI):
1. B16.1: Standard for Cast Iron Pipe Flanges and Flanged Fittings, 125 lb.

C. Hydraulic Institute: Current Standards.
1. HI 14.6: Hydrodynamic Pumps for Hydraulic Performance Acceptance Tests.
2. HI 11.6: Submersible Pump Tests

1.4. SUBMITTALS

A. Submittal data shall be provided to show compliance with these specifications, plans or other specifications that will influence the proper operation of the pump(s).

B. Standard submittal data for approval must consist of:

1. Pump Performance Curves.
2. Pump Outline Drawing.
3. Station Drawing for Accessories.
4. Electrical Motor Data.
5. Typical Installation Guides.
6. Technical Manuals and Parts List.
8. Printed Warranty.
9. Management system certificate ISO 9001.
10. Manufacturer's Equipment Storage Recommendations.
11. Manufacturer's Standard Recommended Start-Up Report Form.

C. Lack of the above requested submittal data is cause for rejection.

1.5. QUALIFICATION REQUIREMENTS

A. The manufacturer shall provide data on alternate equipment manufacturer's experience. Only Manufacturers with 20 or more years of experience who have furnished at least 5 similar lift stations shall be considered.

B. After installation, a pump station start-up shall be performed by the installing contractor under the supervision of the manufacture's authorized representative. 8 hours of field service shall be provided by an authorized, factory trained representative of the pump manufacturer. Services shall include, but not be limited to, inspection of the completed pump station installation to ensure that it has been performed in accordance with the manufacturer's instructions and recommendations, supervision of all field-testing and activation of the Pump Manufacturer's Warranty. The test shall demonstrate to the satisfaction of the Owner that the equipment meets all specified performance criteria, is properly installed and anchored, and operates smoothly without exceeding the full load amperage rating of the motor. The Contractor shall be responsible for coordinating the required field services with the Pump Manufacturer.

1.6. DELIVERY, STORAGE AND HANDLING

A. Deliver, store and handle products to site under provisions of General & Special Condition Sections.

1.7. OPERATIONAL REQUIREMENTS AND WARRANTY

A. The contractor shall supply and install 1 submersible sewage pump with discharge connections, discharge pipes, guide bars, cable holder lifting chains.

B. The submersible pump shall have a semi open multi vane self-cleaning impeller designed to transport wastewater with fibrous materials like wet wipes.

C. The impeller shall be wear resistant and made of high chromium cast iron with at least 24% chrome against sand and grit which is expected to enter the pump station with the sewage or the storm water. Impellers that have surface hardening (by thermal, coating, etc.) will not be allowed.

D. Each pump shall be capable to lift 2149 **USgpm** at a total dynamic head of 46 **feet**.

E. The hydraulic efficiency in this duty point shall be not less than **75 %** and approved accordingly

F. The pumps shall be provided with 60 months (5 years) warranty against defects in materials and or workmanship. The warranty shall cover the entire pump, not individual components. Upon warranty occurrence, the manufacturer's authorized service center shall remove the pump, repair, reinstall and provide start up on the repaired pump. A detailed failure analysis shall be submitted to the Owner for their records summarizing corrective action taken.

G. The manufacturer shall guarantee clog-free operation for a period of 24 months from the date of start-up of the pumps by the local authorized factory

representative. A certificate shall be provided to the Owner on the day of start up with the local contact information and effective date. Should the impeller clog with typical solids and/or modern trash debris normally found in domestic wastewater during this period, an authorized representative shall, either travel to the jobsite, remove the pump, clear the obstruction and reinstall the pump at no cost or reimburse the Owner for reasonable cost to provide this service. A written report shall be provided to the Owner detailing the service call with pictures for verification purposes.

PART 2. PRODUCTS

2.1. SUBMERSIBLE SEWAGE PUMPS (FLYGT NP 3202 OR EQUIVALENT)

A. Each station shall be equipped with 1 submersible, close-coupled wastewater pumps.

B. Each pump shall be equipped with a **60 HP** submersible electric motor, capable to operate on a **460** volt, 3 phases, 60 hertz voltage supply.

C. The hydraulic of the pump shall be capable of handling raw domestic wastewater and storm water with fibrous materials like wet wipes**.**

D. The impeller blades shall be self-cleaning upon each rotation as they pass across a sharp relief groove in the Insert ring and shall keep the impeller blades clear of debris. The clearance between the insert ring and the impeller leading edges shall be adjustable.

E. Due to the presence of sand the impeller shall be made of high chromium cast iron with at least 24% chrome. Impellers that have surface hardening (by thermal, coating, etc.) will not be allowed.

F. The pump shall be capable to operate without any limitation between 50% and 125% of the Best efficiency point (B.E.P) of the performance curve.

	Flow in USgpm	TDH in feet	Hydraulic efficiency %	NPSHre in feet
Required Duty Point Two Pumps Running	4,298	46	75	21.8

G. The required shaft power (P2) in the guaranteed duty point shall be less than **50 HP**. The motor speed shall be max. : **1200 rpm**. A performance chart shall be provided upon request showing curves for torque, current, power factor, input/output HP and efficiency. This chart shall also include data on starting and no-load characteristics

H. The impeller shall be mounted on the motor shaft. Couplings shall not be accepted.

I. The pump motor shall be induction type with a squirrel cage rotor, shell type design, housed in an air filled, watertight chamber. It shall be permanently submersible according standard IEC 60034 and protection class IP 68.

J. The motor shall be provided with an integral motor cooling system. A stainless steel cooling jacket shall encircle the stator housing, providing for dissipation of motor heat regardless of the type of pump installation. An impeller, integral to the cooling system and driven by the pump shaft, shall provide the necessary circulation of the cooling liquid through the jacket. The cooling liquid shall pass about the stator housing in the closed loop system in turbulent flow providing for superior heat transfer. The cooling system shall have one fill port and one drain port integral to the cooling jacket.

K. The pump shall be capable of operating in a continuous condition in a liquid with a temperature up to 104°F even when the motor is not submerged.

L. The motor shall be capable of no less than 30 evenly spaced starts per hour and be able to operate throughout the entire pump performance curve from shut-off through run-out..

M. The stator windings shall be insulated with moisture resistant Class H insulation rated for 356°F.

N. Sealing of the pumping unit to the discharge connection shall be accomplished by a machined metal to metal watertight contact. Sealing of the discharge interface with a diaphragm, O-ring or profile gasket will not be acceptable.

O. It shall be possible to lift and lower the pumps on parallel guide bars and connect them to wet well mounted discharge connection. There shall be no need for personal to enter the wet well when removing or reinstalling the pumps.

P. The pump housing shall be prepared for the assembling of a sump mixing valve. The discharge flange of the pump housing shall be **12**".

Q. The junction chamber containing the terminal board shall be hermetically sealed from the motor by an elastomeric compression seal. Connection between the cable conductors and stator leads shall be made with threaded compression type binding posts permanently affixed to a terminal board. The motor and the pump shall be produced by the same manufacturer.

R. The motor shall be protected by 3 thermal switches embedded in the stator set to open at 285°F (140°C) and one leakage sensor floating type located in the stator chamber. The sensor and the switches shall be connected to the control panel which shall stop the motor and send an alarm when the sensors are activated.

S. The cable entry shall consist of dual cylindrical elastomer sleeves, flanked by washers, all having a close tolerance fit against the cable and the cable entry. Epoxies, silicones, or other secondary sealing systems shall not be considered acceptable.

T. The pump shaft shall rotate on two bearings. Motor bearings shall be permanently

grease lubricated and have a nominal L10 lifetime of 50.000 hours. The upper bearing shall be a single deep groove ball bearing. The lower bearing shall be a two row angular contact bearing to compensate for axial thrust and radial forces. Single row lower bearings are not acceptable.

U. Each pump shall be provided with a positively driven dual, tandem mechanical shaft seal system consisting of two seal sets, each having an independent spring. The lower primary seal, located between the pump and seal chamber, shall contain one stationary and one positively driven rotating corrosion and abrasion resistant tungsten-carbide ring. The upper secondary seal, located between the seal chamber and the seal inspection chamber shall be a leakage-free seal. The upper seal shall contain one stationary and one positively driven rotating corrosion and abrasion resistant tungsten-carbide seal ring. The rotating seal ring shall have small back-swept grooves laser inscribed upon its face to act as a pump as it rotates, returning any fluid that should enter the dry motor chamber back into the lubricant chamber. All seal rings shall be individual solid sintered rings. Each seal interface shall be held in place by its own spring system. The seals shall not depend upon direction of rotation for sealing. Mounting of the lower seal on the impeller hub is not acceptable. Shaft seals without positively driven rotating members or conventional double mechanical seals containing either a common single or double spring acting between the upper and lower seal faces are not acceptable. The seal springs shall be isolated from the pumped media to prevent materials from packing around them, limiting their performance. Any leakage passing the sealing shall not pass the bearings. Before it reaches the bearings the liquid shall create an alarm via the floating leakage sensor.

V. Each pump shall be provided with a lubricant chamber for the shaft sealing system. The lubricant chamber shall be designed to prevent overfilling and to provide lubricant expansion capacity. The drain and inspection plug, with positive anti-leak seal shall be easily accessible from the outside. The seal system shall not rely upon the pumped media for lubrication. Seal lubricant shall be non-hazardous.

W. Where a seal cavity is present in the seal chamber, the area about the exterior of the lower mechanical seal in the cast iron housing shall have cast in an integral concentric spiral groove. This groove shall protect the seals by causing abrasive particulate entering the seal cavity to be forced out away from the seal due to centrifugal action.

X. The Materials of construction shall be as follows:

   a. Pump housing: ASTM A-48, Class 35B
   b. Impeller and insert ring: A 532 ALLOY III A (25% Chrome)
   c. Cooling jacket: Stainless steel AISI 316
   d. Stator housing: ASTM A-48, Class 35B
   e. Shaft: ASTM A479 S43100-T.
   f. Shaft seal: Pump side: - Corrosion resistant Tungsten carbide WCCR
   g. Shaft seal Motor side: - Corrosion resistant Tungsten carbide WCCR

Y. All castings must be blasted before coating. All wet surfaces are to be coated with two-pack oxyrane ester Duasolid 50. The total layer thickness should be at least 120 microns. Zink dust primer shall not be used.

Z. The motor shall be equipped with 32 feet of screened cable suitable for submersible pump applications. The power cable shall be sized according to NEC and ICEA. The outer jacket of the cable shall be oil resistant chlorinated polyethylene rubber. The cable shall be capable of continuous submergence underwater without loss of watertight integrity to a depth of 65 feet.

AA. Each completed and assembled pump/motor unit shall undergo the following factory tests at the manufacturer's plant prior to shipment. The Manufacturer shall provide on demand a copy of his quality control plan for these tests and an ISO 9001 factory certificate:

a. Minimum 3-point hydraulic performance test
b. No-Leak seal integrity test
c. Electrical integrity test

2.2. EQUIPMENT FOR WET WELL INSTALLATION

A. For each pump the contractor shall supply and install a discharge connection made of cast iron ASTM A-48, Class 35B.

B. The outlet flange of the discharge connection shall be **12"** drilled according ANSI B16.1-89; tab.5.

C. The pump(s) shall be automatically and firmly connected to the discharge connection, guided by no less than two parallel guide bars extending from the top of the station to the wet well mounted discharge connection. The material of the guide bars shall Stainless steel AISI 316.

D. The length of the guide bars shall be 19 feet and they shall be fasten at the top of the station with a guide bar holder made of Stainless steel AISI 316.

E. For each pump the contractor shall supply and install a cable holder made with 4 hooks of Stainless steel AISI 316.

F. There shall be no need for personnel to enter the wet-well.

G. The sealing of the pumping unit to the discharge connection shall be accomplished by a machined metal to metal contact. Sealing of the discharge interface with a diaphragm, O-ring or profile gasket will not be accepted. The entire weight of the pump/motor unit shall be borne by the pump discharge elbow. No portion of the pump/motor unit shall bear on the sump floor directly or on a sump floor mounted stand.

H.

2.3. LIFTING EQUIPMENT FOR PUMPS

A. Each pump shall be fitted with 20 feet of stainless steel lifting chain or lifting cable. The working load of the lifting system shall be 50% greater than the pump unit weight.

B. A removable davit crane shall be supplied with the pumps for pump removal, etc.

Performance Objective

Hydro International is pleased to propose the following HeadCell® grit removal, washing, and dewatering system to be installed in an existing plant which has flows of 1.9 mgd average and 6.0 mgd peak. Each component of the grit removal system's performance shall be outlined below.

Proposed Equipment Summary

HeadCell® Grit Concentrator Unit

The HeadCell® is an all-hydraulic grit concentrator, which uses vortex flow and a stacked tray design to efficiently capture and settle fine grit via large surface area and short settling distances. The unit can be installed into the process flow, downstream of screening, in any system where limited head is available. The unit requires no external power source, has no internal moving parts, is self-cleaning, and has a compact modular construction. Wide turndown ratios can be accommodated in the HeadCell® when it is combined with Hydro's high performance washing system.

Hydro has standardized on a new HeadCell® collection sump design. The sump is larger in diameter and formed from concrete/grout below the trays. The larger grit sump will allow for the intermittent grit fluidization in lieu of 24/7. The sump includes a fluidizing ring to resuspend settled grit more aggressively. It does require more water, but as it is run intermittently the resulting water usage is lower. The larger sump does allow for intermittent grit pumping in applications where overnight flows are low or other project drivers make intermittent grit pumping a benefit.

Specifications

Quantity:	1
Size:	9' diameter
Number of Tray/Unit:	6
Surface Area/Unit:	382 ft^2
Loading Rate @ Peak Flow/Unit:	10.9 gpm/ft^2
Performance @ Peak Flow:	95% removal of all grit (SG 2.65) ≥ 106 microns
Performance @ Average Flow:	95% removal of all grit (SG 2.65) ≥ 75 microns
Peak Flow/Unit:	6.0 mgd with 12" headloss
Average Flow/Unit:	1.9 mgd with 2" headloss
Discharge:	Weir
Underflow Connection:	4" flanged pipe
NPW Connection:	1.5" NPT
NPW Requirement/Unit:	Intermittent 32 gpm @ 50 psig
Material of Construction:	304 SS Support Structure/Duct/Underflow Low Density Polyethylene Trays
Weight Dry (approximate):	2,200 lbs

Hydro GritCleanse™ Grit Washing / Dewatering Unit

The Hydro GritCleanse™ is a fully automated, high efficiency unit that effectively removes, washes, and dewaters fine grit, sugar sand, and high-density fixed solids from grit slurries. The large conical clarifier with tangential inlet and internal baffle enhances the settling of fine particles and the fluidized sand bed scrubs off and separates attached organics, resulting in a dry grit with extremely low organic content suitable for landfill disposal.

Specifications

Quantity:	1
Size:	8412
Design Flow/Unit:	250 gpm with 3" headloss
Influent Solids Concentration:	≤1.5%
Influent Connection:	4" flanged pipe
Capacity:	Up to 1.5 cy/hr
Screw Diameter:	12"
Clarifier Size:	84"

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Min. Free Water Surface Area:	38.5 ft^2
Auger Motor:	2 hp, TENV, 460V/3 phase/ 60 Hz
Agitator Motor:	1 hp, TENV, 460V/3 phase/ 60 Hz
Effluent Connection:	8” flanged pipe
Organics Discharge Connection:	4” flanged pipe
Drain Connection:	3” NPT pipe
NPW Connection:	1” NPT (2 No.)
NPW Requirement Fluidized Bed:	25 gpm @ 50 psig Continuous
NPW Requirement Organics Flush:	25 gpm @ 50 psig (20-30 sec. hourly)
Operation:	Continuous or a minimum of 10-15 minutes
Body Material:	304 SS
Weight Dry/Wet (approximate):	3,600 / 10,400 lbs.
Performance:	95% removal of all grit (specific gravity 2.65) ≥ 75 microns with less than 5% volatile solids and greater than 90% total solids w/ standard intermittent screw operation and <0.5% influent solids concentration

Control Panel

The panel shall contain all timers, VFDs, switches, and indicator lights to operate one (1) HeadCell® NPW system, one (1) GritCleanse™ unit, and one (1) grit pump in either fully automated or manual mode.

Specifications

Quantity:	1
Enclosure Material:	304 SS
Enclosure Type:	NEMA 4X
Power Supply:	480V/3-phase
Control Logic:	AB Micro850 PLC w/ PanelView Plus 600 OIU
Grit Pump Control:	VFD
Hydro GritCleanse™ Motor Control:	VFDs (2 No.)

System Hydraulics

System hydraulics is the responsibility of the design engineer. Hydro International can provide information on HeadCell® hydraulics and pumping and piping FAQ’s to assist the engineer in determining system hydraulics and pump requirements, upon request.

Design Recommendations

- 1/2” or finer screening prior to the grit removal system
- Velocity through bar screen openings/slots/apertures should not exceed 4 ft/s at peak flow as recommended by industry design manuals.
- Estimated grit load at peak flow is 0.14 yd^3/hr.
- Stated output grit quality (total solids/volatile solids) is based on a minimum plant influent grit quantity of 50 pounds Fixed Solids/million gallon (FS/mg).
- All piping connected to Hydro equipment must be supported by other means than the Hydro equipment
- 2 – 3 ft/s channel velocities at peak flow as recommended by industry design manuals
- 4 – 7 ft/s grit slurry pipe velocities as recommended by industry design manuals
- Incorporate a drain line, piped to a floor drain, in the grit dumpster to allow for further dewatering prior to disposal
- A minimum 18” of access clearance around all equipment and minimum 3’ of access clearance above equipment
- Operators find that it is useful to locate a spray hose adjacent to the equipment so that they can spray all equipment down during an inspection
- Incorporate a minimal access platform to facilitate inspection access to the top of the equipment
- Equipment not recommended to be placed outdoors in freezing climates
- Discharge chutes for grit should be at a minimum 45° incline if it is open chute. If it is an enclosed chute/pipe/tube then a minimum angle of 60° is required to ensure plugging does not occur.
- Discharge from Hydro’s equipment shall be to the atmosphere. There shall be no backpressure created by downstream piping connected to Hydro’s equipment.

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- Control panels with VFD's shall be placed < 100 ft of wiring/conduit away from the equipment being controlled to prevent degradation of signal

Start-up

One (1) factory trained representative, two (2) trips, for start-up and instruction services as required totaling four (4) days.

Quote Validity: 30 days After expiration of validity Hydro International reserves the right to adjust pricing to account for any significant increases in material costs.

Exclusions

Any item(s) not specifically described above are excluded and are not to be supplied by Hydro International including but not limited to the following:

- Field assembly, erection, and installation
- Pipe connections and fittings not expressly stated above
- All pipe supports, hangers and braces
- Controls, switches, control panels and instrumentation of any kind not expressly stated above
- Wiring and conduit
- Field or touch-up paint, painting, blasting and touch-up of surface finish
- Spare parts not specifically stated above
- Unloading, hauling and storage charge
- Lubricating oil and greases
- Grit study, field performance testing, laboratory testing and sample collection and analysis
- All concrete and grouting work
- Insulation and heat tracing of any kind
- Performance, Warranty, Efficacy and/or Supply Bond(s)
- Grit dumpsters
- Translation Services
- Interconnecting piping and valving not expressly stated above including bellmouth on grit slurry suction line
- Grit pump(s) and associated piping, valving, gauges
- Covers and access hatches
- Structural / Seismic anchorage calculations
- Anchor Bolts

Options

Quotes will be provided upon request for the following optional features:

- Stainless steel valve bodies
- Additional field days for startup or training
- Explosion proof upgrade
- Upgrade 304 to 316 Stainless Steel
- Structural / Seismic anchorage calculations
- Field performance testing, laboratory testing and sample collection and analysis
- Service & maintenance contract
- Extended warranty
- Grit Pump(s)

Warranty

Hydro International's Standard Warranty shall apply per the Terms and Conditions of Sale.

Delivery

Please allow 14-16 weeks after receipt of purchase order for approval drawings. Shipment is typically a maximum of 18-20 weeks after receipt of "Approved" or "Approved as Noted, Resubmittal Not Required" submittal package. Price includes truck freight to jobsite but does not include any state, or local taxes if required. Timelines are based on typical workloads and can vary, with current market conditions timing will be longer.

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Terms & Conditions

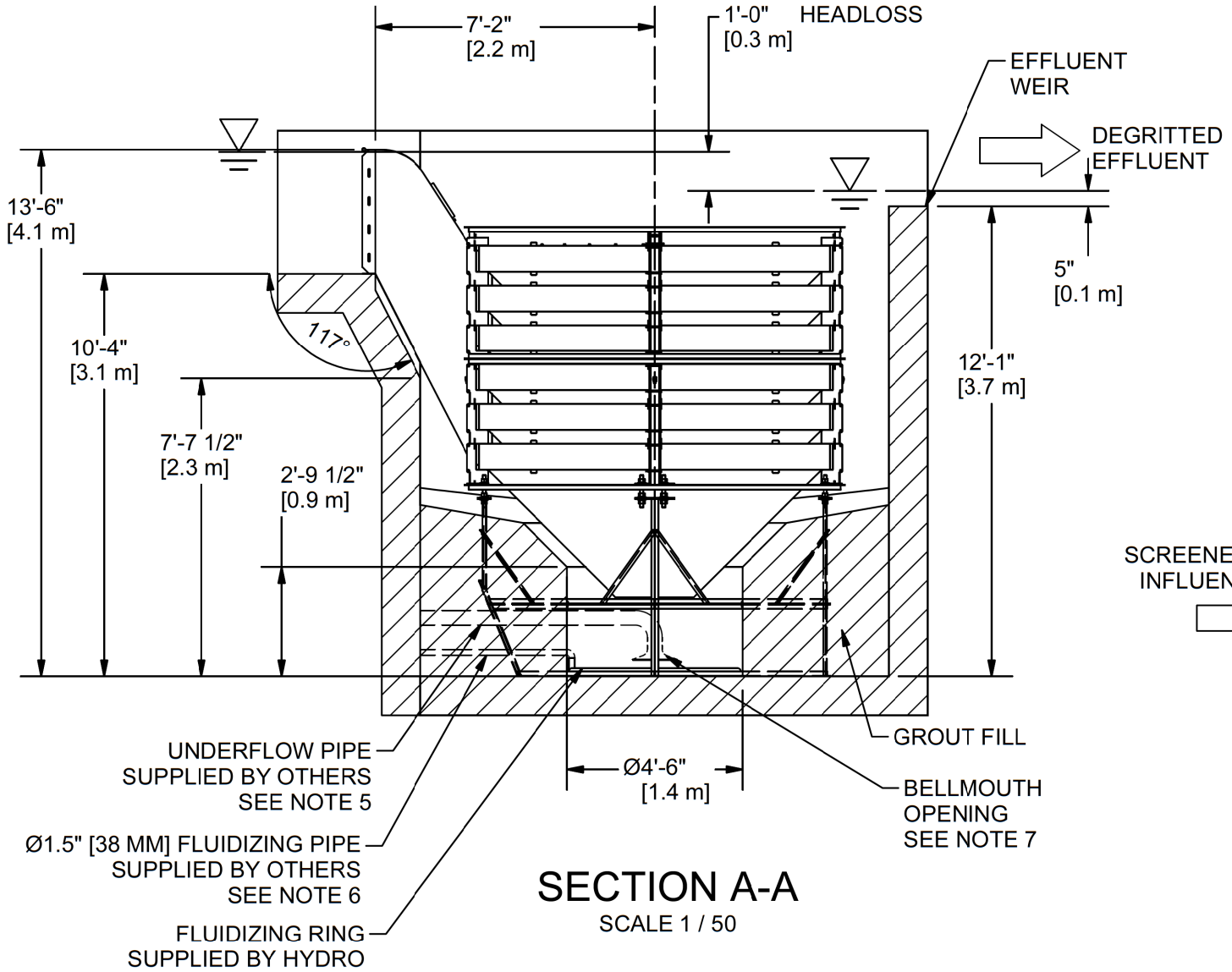
This proposal is made pursuant to Hydro International's standard Terms & Conditions of Sale, attached hereto, and made a part hereof.

Contact

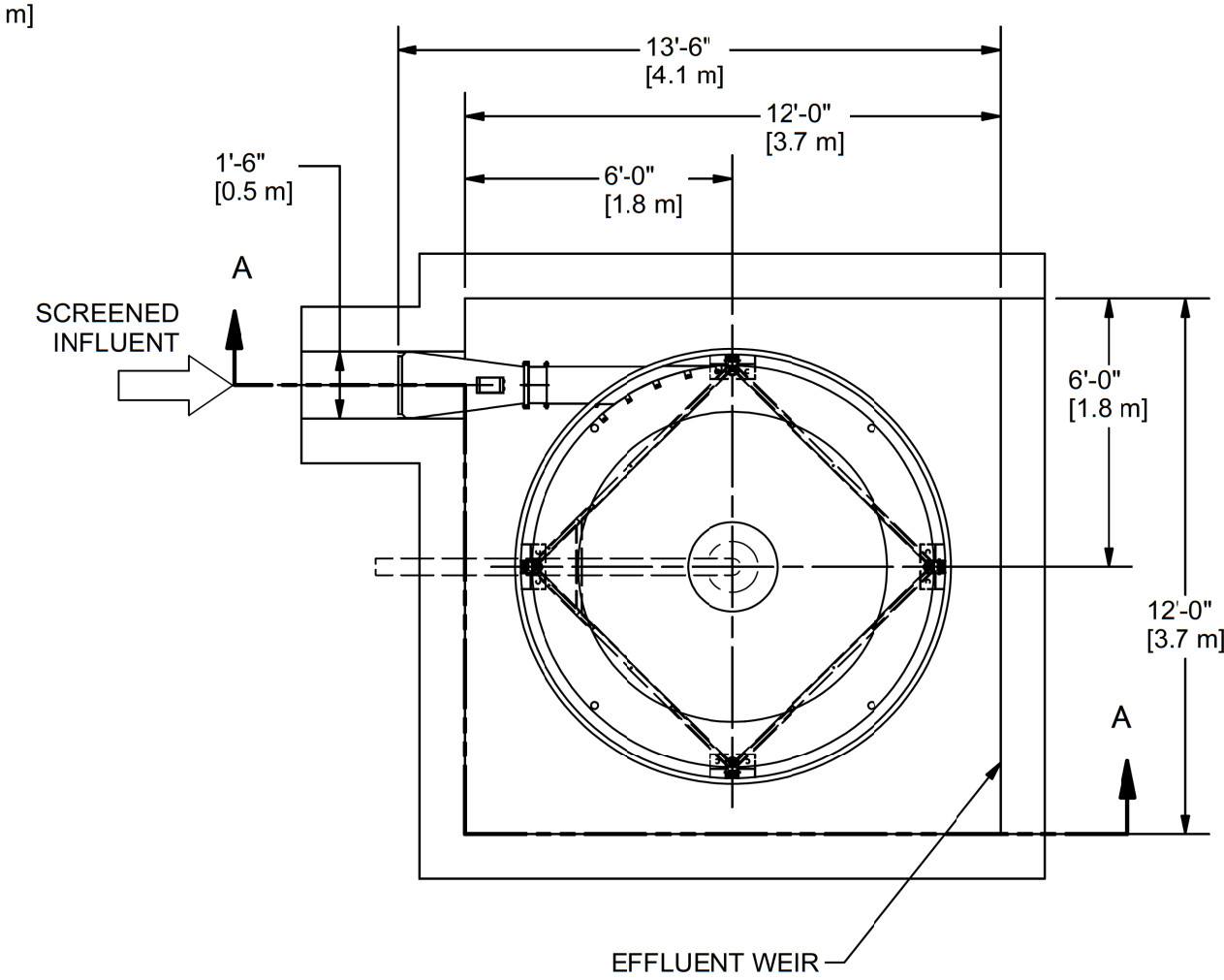
Plant Representative:
Mr. Chris Enloe
Instrument & Supply
141 Technic Circle
Hot Springs National Park, AR 71901
Ph: (501) 622-0479
cenloe@isi1980.com

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DO NOT CHANGE DUCT LAYOUT OR PIPE ORIENTATION
WITHOUT CONSULTING HYDRO INTERNATIONAL



SECTION A-A
SCALE 1 / 50



1. ALLOW GRIT PUMP TO FULLY DRAIN HEADCELL TANK.

2. PLANT FLOW BYPASS RECOMMENDED TO ALLOW THE HEADCELL TO BE TAKEN OUT OF SERVICE FOR MAINTENANCE.

3. CLOCKWISE & COUNTERCLOCKWISE UNITS ARE AVAILABLE. CW SHOWN.

4. ALTERNATE EFFLUENT CONFIGURATIONS ARE AVAILABLE.

5. THE GRIT PUMP SUCTION PIPE SHOULD BE DESIGNED FOR A 4-7 FT/S [1.2-2.2 M/S] PIPE VELOCITY.

6. FLUIDIZING WATER REQUIREMENTS INTERMITTENT 32 GPM [2.0 L/S] AT 50 PSIG

7. DISTANCE BETWEEN BELL MOUTH AND BOTTOM OF TANK 1.25 X SUCTION PIPE DIAMETER

PROJECTION

IF IN DOUBT ASK

DATE:	SCALE:
10/25/2022	1 / 50

DRAWN BY:	CHECKED BY:	APPROVED BY
LS	AS	LS

Title

HEADCELL
PROPOSAL
9' DIAMETER
6 TRAY

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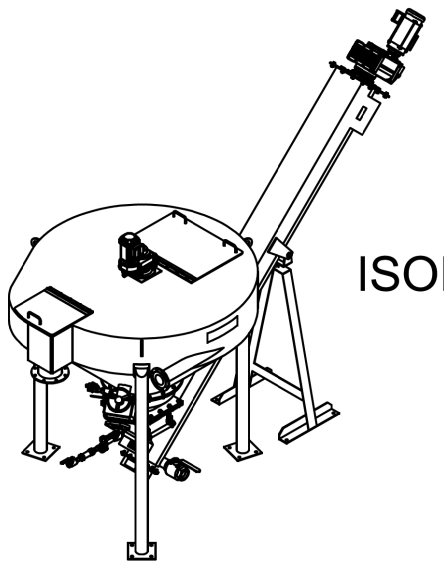
ANY WARRANTY GIVEN BY HYDRO INTERNATIONAL WILL APPLY ONLY TO THOSE ITEMS SUPPLIED BY IT. ACCORDINGLY HYDRO INTERNATIONAL CANNOT ACCEPT ANY RESPONSIBILITY FOR ANY STRUCTURE, PLANT, OR EQUIPMENT, (OR THE PERFORMANCE THERE OF) DESIGNED, BUILT, MANUFACTURED, OR SUPPLIED BY ANY THIRD PARTY. HYDRO INTERNATIONAL HAVE A POLICY OF CONTINUOUS DEVELOPMENT AND RESERVE THE RIGHT TO AMEND THE SPECIFICATION. HYDRO INTERNATIONAL CANNOT ACCEPT LIABILITY FOR PERFORMANCE OF ITS EQUIPMENT, (OR ANY PART THEREOF), IF THE EQUIPMENT IS SUBJECT TO CONDITIONS OUTSIDE ANY DESIGN SPECIFICATION. HYDRO INTERNATIONAL OWNS THE COPYRIGHT OF THIS DRAWING, WHICH IS SUPPLIED IN CONFIDENCE. IT MUST NOT BE USED FOR ANY PURPOSE OTHER THAN THAT FOR WHICH IT IS SUPPLIED AND MUST NOT BE REPRODUCED, IN WHOLE OR IN PART, WITHOUT PRIOR PERMISSION IN WRITING FROM HYDRO INTERNATIONAL.

WEIGHT:	MATERIAL:
2143 lbmass	

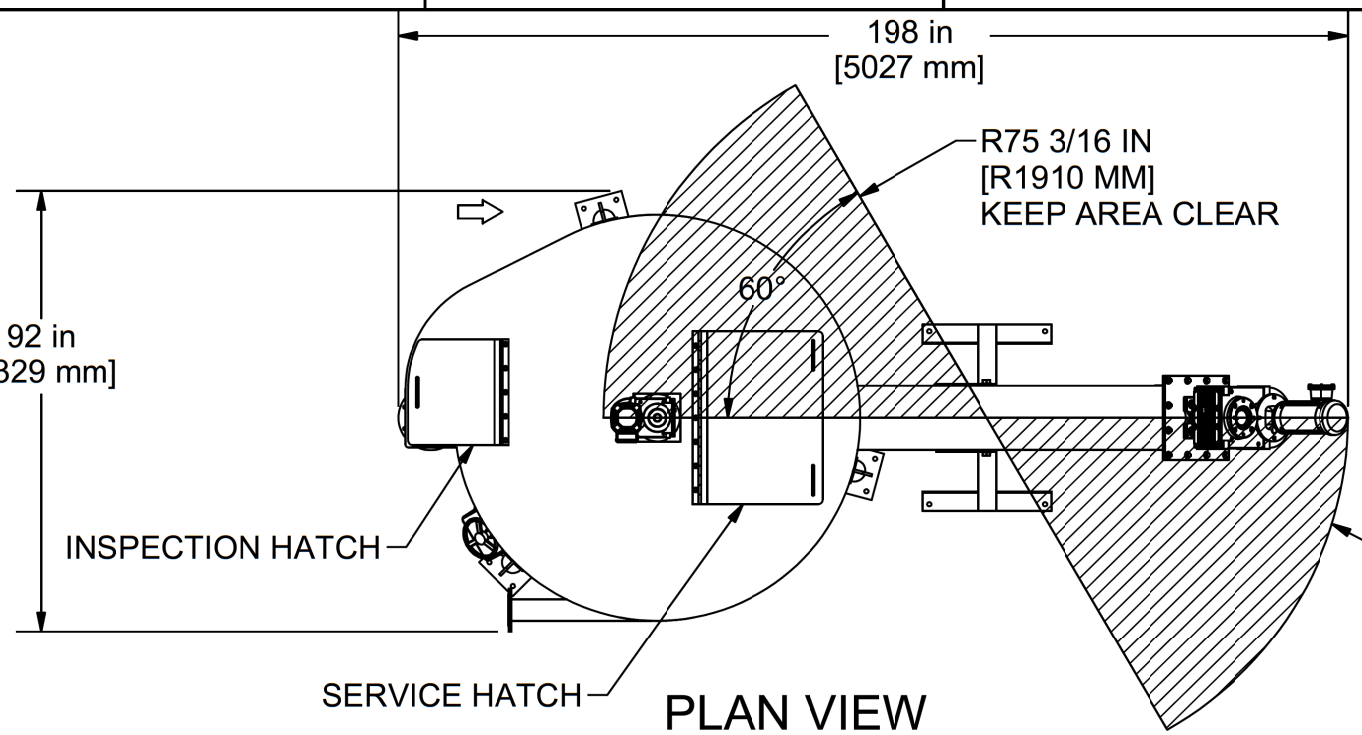
STOCK NUMBER:

DRAWING NO.:
9' 6T 1.08 INT

SHEET SIZE:	SHEET:	Rev:
B	1 OF 1	-



ISOMETRIC VIEW
NTS

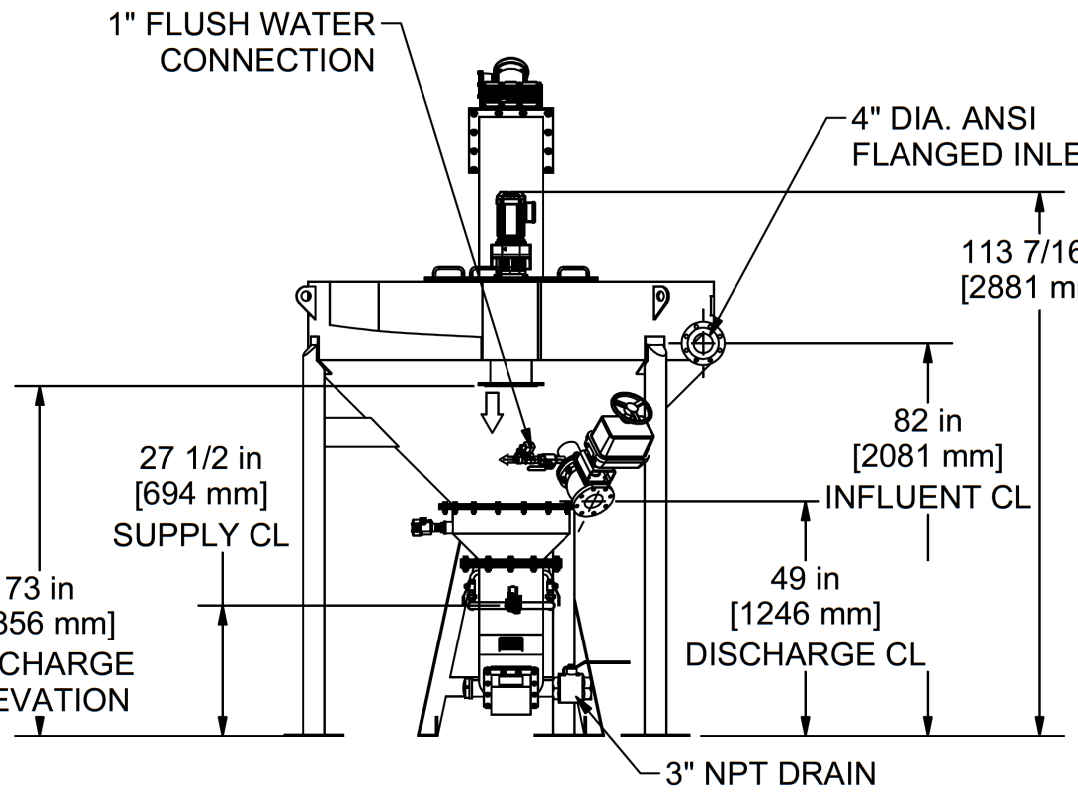


PLAN VIEW

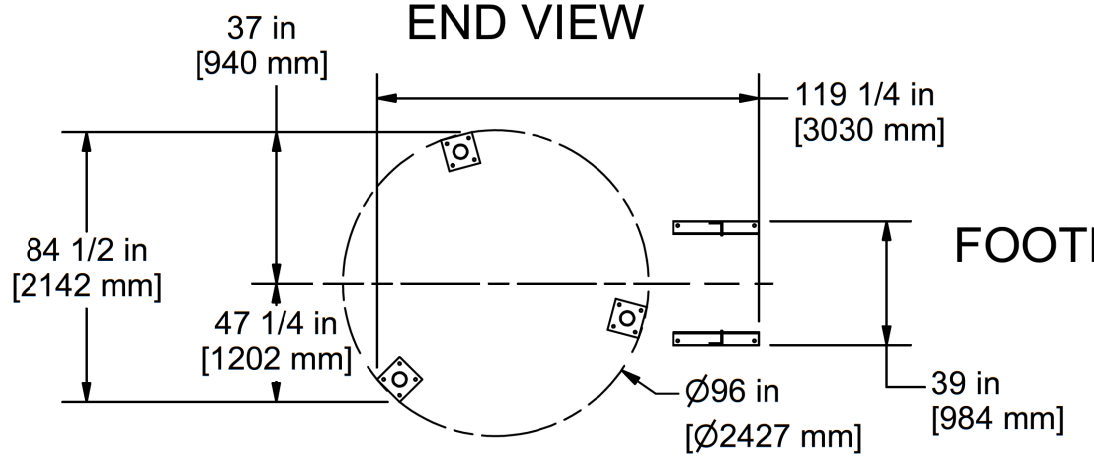
1. PROVIDE ADEQUATE CLEARANCE FOR SERVICE AND MAINTENANCE ACCESS

2. NPW REQUIREMENTS:
25 GPM @ 50 PSI CONTINUOUS
50 GPM @ 50 PSI INTERMITTENT

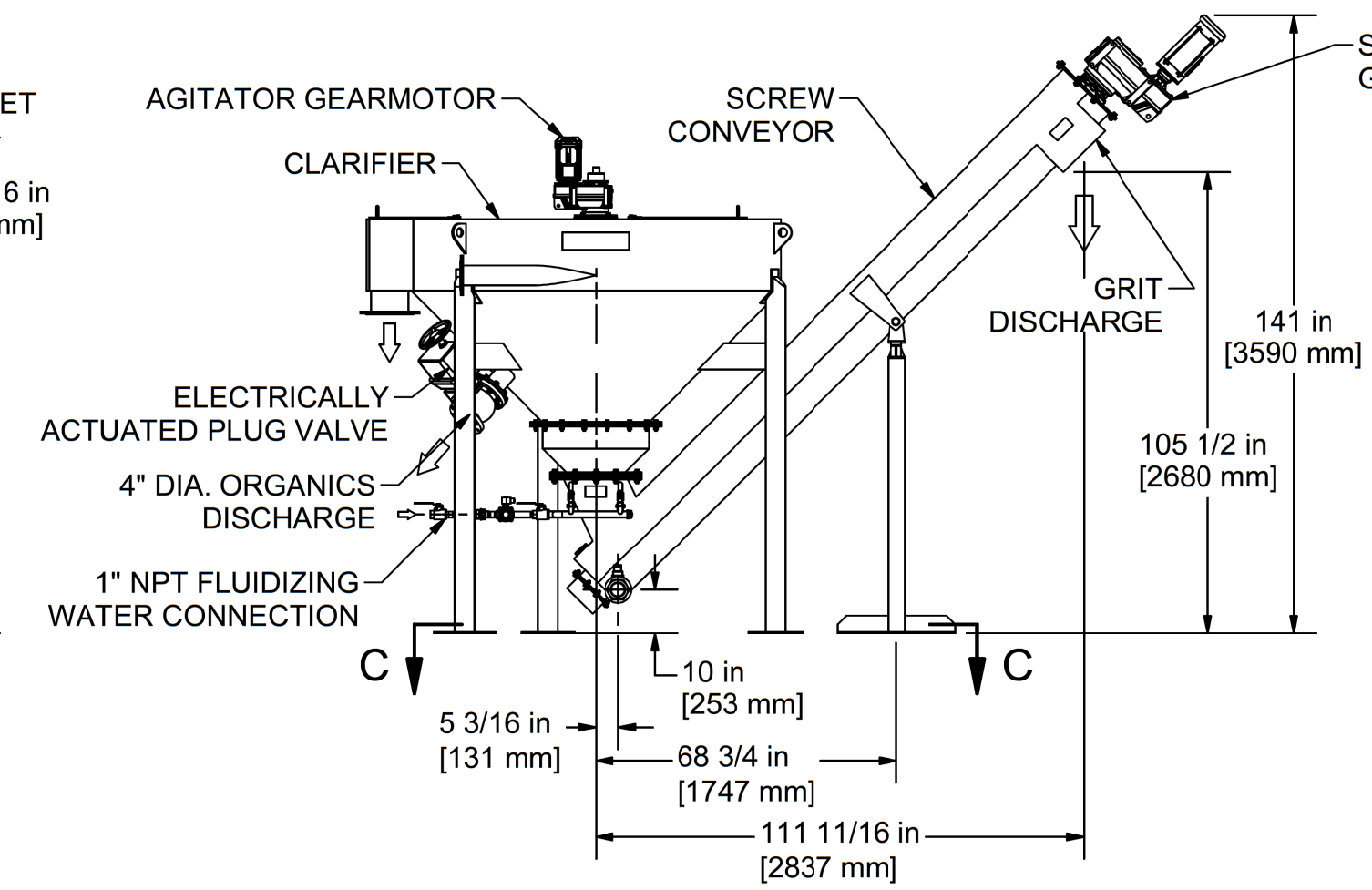
3. EQUIPMENT WEIGHTS:
DRY: 3,600 LBS [1,630 KG]
WET: 10,400 LBS [4,700 KG] (MAX)



END VIEW



FOOTPRINT C-C
NTS



SIDE VIEW

REVISION HISTORY			
REV	BY	DESCRIPTION	DATE
	SR	3-INCH DRAIN	17-Jul-19
-		FIRST RELEASE	

PROJECTION

IF IN DOUBT ASK

DATE: 5/11/2023	SCALE: 1 / 40
DRAWN BY: SR	CHECKED BY: LS
APPROVED BY: LS	

Title
PROPOSAL

8412 GRITCLEASE
COUNTERCLOCKWISE

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hydro-int.com

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WEIGHT: 3513 lbmass	MATERIAL:
STOCK NUMBER: N/A	
DRAWING NO.: 8412 GCL 4 CCW-SUBMITTAL	
SHEET SIZE: B	SHEET: 2 OF 2
Rev:	

North American Grit Gradations

Hydro International is pleased to announce the availability of national and regional grit gradation data. This data, which has been compiled from over 120 tests across North America, contains average physical size data as well as settling velocity (SES) data, making it the most comprehensive information available on grit and its behavior.

Virtually all conventional grit removal processes rely on gravity sedimentation to achieve the separation of grit from wastewater. Most conventional grit removal processes are designed based on the assumption that grit is spherical and has a specific gravity 2.65. However, not all grit maintains a specific gravity of 2.65 and other factors such as shape and encapsulation by fats, oils and grease significantly impact its settling velocity. Therefore, the best means to analyze grit is to determine the settling velocity for given particle size ranges. Settling velocity data can be correlated to the measured settling velocity of a clean sand sphere. The settling velocity is expressed as the Sand Equivalent Size (SES), which is the sand particle size having the same settling velocity as the more buoyant grit particle. The correlated particle size, or Sand Equivalent Size can then be used for design of the grit removal process.

When settling velocity is considered in the design actual removal efficiency of grit particles can be estimated more realistically.

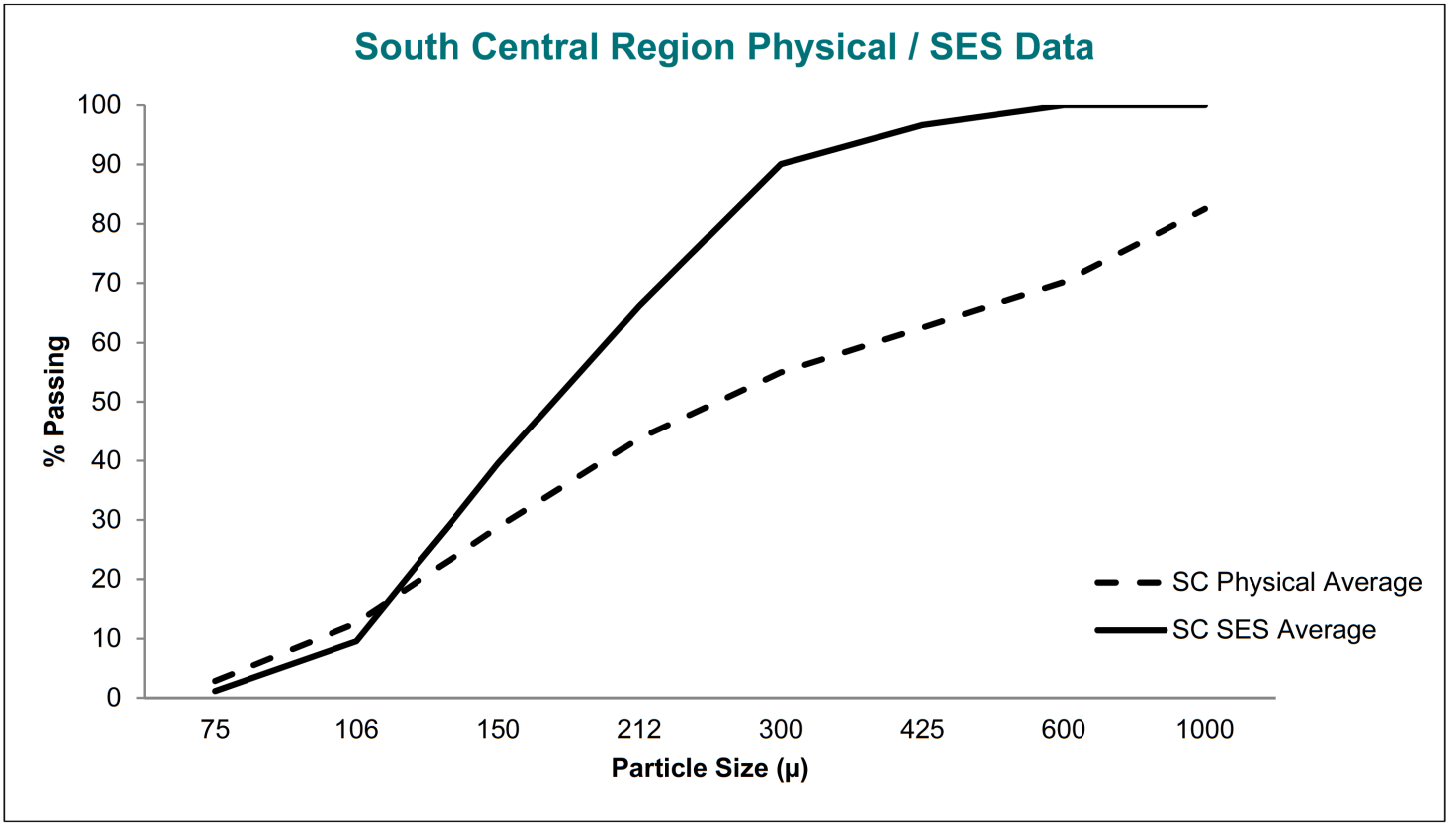
Data is available for the following regions:

Region	States / Provinces Included
Northeast	ME, VT, NH, MA, RI, NY, CT
Mid-Atlantic	PA, NJ, MD, DE, DC, VA, WV
Southeast	NC, SC, GA, AL, FL, MS
North Central	MO, KS, KY, IN, OH, IL, MI, WI, IA, MN, ND, SD, NE
South Central	TN, AR, OK, TX, LA
West	WA, OR, CA, AK, HI, AZ, NV, NM, CO, ID, MT, UT, WY
Western Canada	AB, MB, SK
Ontario Canada	ON

State data is available for individual states where more than 5 data points are available; those states currently include: Georgia, Texas, Florida, California, and Virginia.

Hydro International
2925 NE Aloclek Suite 140 · Hillsboro, OR 97124
Tel: (866) 615-8130 Fax: (503) 615-2906 Web: hydro-int.com

South Central Regional Gradation



Micron	% Passing								
	75	106	150	212	300	425	600	1000	
SC Physical Average	1.9	7.1	21.2	42.6	62.7	71.9	81.2	93.2	*Physical*
SC SES Average	1.7	7.9	31.9	56.6	83.4	90.3	94.1	97.9	*SES*

The above table shows the % of grit passing through various sieve sizes based on physical size (unshaded) and Sand Equivalent Size (SES) (shaded). SES provides the settling velocity distribution of the grit particles.

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Standard Terms and Conditions of Sale

1. **DEFINITIONS.** "Hydro" is Hydro International with an address of 2925 NE Aloclek Drive #140 in Hillsboro, Oregon. "Buyer" is the party purchasing the goods from Hydro.

2. **ENTIRE AGREEMENT**. Hydro's agreement is based on these terms and conditions of sale. This document, together with any additional writings signed by Hydro, represents a final, complete, and exclusive statement of the agreement between the parties and may not be modified, supplemented, explained, or waived by parol evidence, Buyer's purchase order, any course of dealing, Buyer's payment or acceptance, or in any other way except in writing signed by Hydro through its authorized representative. These terms and conditions are intended to cover all activity of Hydro and Buyer hereunder, including sales and use of products, parts, and work, and all related matters (references to products include parts and references to work include construction and installation). Hydro's obligations hereunder are expressly conditioned on Buyer's assent to these terms and conditions. Hydro objects to any terms that are different from, or additional to, these terms and conditions. Any applicable detail drawings and specifications are hereby incorporated and made a part of these Terms and Conditions of Sale insofar as they apply to the material supplied hereunder.

3. **SPECIFICATIONS.** Products are supplied in accordance with information received by Hydro, or its duly authorized agent, from Buyer. Hydro shall have no responsibility for products created or sold based upon inaccurate and/or incomplete information supplied to it. Buyer shall ensure that Hydro receives all relevant information in time to enable it to supply the appropriate products.

4. **INSTALLATION AND APPLICATION OF PRODUCTS.** Products supplied hereunder shall be installed and used only in the application for which they were specifically designed. Buyer should not presume that any products supplied by Hydro may be utilized for any applications other than those specified; nor shall Hydro's obligations, including, without limitation, any warranty obligations, survive Buyer's transfer of products supplied hereunder to third parties unless the products are transferred with Hydro's consent. In addition, Buyer shall not use any product supplied hereunder at any location other than at the location for which Hydro has previously received notice from Buyer. Any breach of any of the foregoing restrictions may amount to an infringement of the patent for the products in question and will in any event void all express or implied warranties relating to the products supplied hereunder.

5. **PURCHASE PRICE AND PAYMENT TERMS.** All prices are in U.S. dollars and all payments shall be made in U.S. dollars. Payment terms are as follows:

	Incremental Payment	Cumulative Payment
Upon Approval of Shop Drawings	10%	10%
Upon Delivery of Equipment to Site	80%	90%
Upon Final Acceptance or 45 days following completion of equipment start up	10%	100%

If payments are not made in conformance with the terms stated herein, any unpaid balance shall be subject to interest at a rate 1½% per month, but not to exceed the maximum amount permitted by law. If shipment is delayed by Buyer, the previously agreed date of readiness for shipment shall be deemed to be the date of shipment for payment purposes. If manufacture is delayed by Buyer, a payment shall be made based on purchase price and percentage of completion, with the balance payable in accordance with the terms as stated. If at any time in Hydro's judgment Buyer may be or may become unable or unwilling to meet the terms specified, Hydro may require satisfactory assurance or full or partial payment as a condition to commencing, or continuing manufacture, or in advance of shipment.

Until payment in full has been received by Hydro, this Standard Terms and Conditions of Sale shall constitute a security agreement and Buyer hereby grants Hydro a purchase money security interest in and to the products produced by Hydro hereunder, and any products or proceeds thereof. In particular:

a. Hydro will retain an express purchase money security interest in and to the products and all proceeds thereof.

b. Until full payment for the products is received by Hydro, Hydro reserves the right to retake possession of the products at any time and for this purpose Buyer authorizes Hydro or its duly authorized agent to enter upon land or premises where it believes the product may be.

c. Proceeds of any disposal of the products shall be held in trust for Hydro pursuant to the terms of the Maine Uniform Commercial Code.

d. Buyer grants Hydro a power of attorney for the purpose of filing a UCC-1 financing statement in the name of Buyer to evidence Hydro's security interest in the products.

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6. **BACKCHARGES.** In the event that Buyer is required to make repairs, corrections or modifications to the goods supplied by Hydro, it shall only do so upon written approval from Hydro. Backcharges shall be limited to the costs directly associated in making the repairs, corrections or modifications to the goods supplied by Hydro. The costs of such backcharges shall be subject to approval by Hydro and shall be limited to: (1) directly related labor and material costs, (2) directly related equipment and tool rental at prevailing rates in the project location and (3) Buyer's overhead & supervision costs to make repairs, corrections or modifications to the goods supplied by Hydro. Buyer shall submit complete documentation to Hydro's satisfaction including but not limited to labor time sheets, material lists, and rental fees detailing the nature of the back charges. Backcharges shall be in the form of an adjustment to the contract price or reduction in retained payments and not a direct payment. No incidental or consequential backcharges shall be allowed.

7. **DELIVERY.** The goods are sold DDP (Incoterms 2020) jobsite, freight prepaid to Buyer at job site. Except as outlined in Paragraph 8 below, the risk of loss passes to Buyer after Hydro delivers the goods to the jobsite. Hydro reserves the right to select the method of shipment and carrier. Delivery dates are approximate only and are not a guarantee of delivery on a particular day. Hydro is not liable for failure or delays in deliveries of any cause whatsoever beyond the control of Hydro.

8. **TITLE & INSURANCE:** Title to the product(s) and risk of loss or damage shall pass to Buyer upon delivery to a carrier as outlined in Paragraph 7 above, or, in the event Buyer delays shipment, by the previously agreed date of readiness for shipment, except that a security interest in the product(s) or any replacement shall remain in Hydro's name, regardless of the mode of attachment to realty or other property, until the full price has been paid in cash. Buyer agrees to protect Hydro's interest by adequately insuring the product(s) against loss or damage from any external cause with Hydro named as insured or co-insured.

9. **ERECTION:** Unless otherwise stated in writing, the goods provided hereunder shall be assembled and erected by and at the expense of Buyer.

10. **CANCELLATION & BREACH:** Orders placed cannot be canceled, nor shipments of goods made up, or in process, be deferred beyond the original shipment dates specified, except with Hydro's written consent and upon terms which shall indemnify Hydro against all loss. In the event of cancellation or the substantial breach of Buyer's obligations, as by failing to make any of the payments when due, the parties agree that Hydro will suffer a serious and substantial damage that will be difficult, if not impossible, to measure, both as of the time of entering into this purchase agreement and as of the time of such cancellation or breach. Therefore, the parties agree that, upon such cancellation or breach, Buyer shall pay to Hydro the sums set forth herein below, which sums the parties do hereby agree shall constitute agreed and liquidated damages in such event:

    a. If cancellation or breach shall occur after the acceptance of the purchase order but prior to mailing of submittal documents by Hydro to Buyer, liquidated damages shall be 10% of the selling price.

    b. If cancellation or breach shall occur within thirty (30) days from the mailing of submittal documents by Hydro to Buyer, the liquidated damages shall be 20% of the selling price.

    c. If the cancellation or breach occurs after thirty (30) days from the mailing of submittal documents by Hydro to Buyer, but prior to notification that the order is ready for shipment, the liquidated damages shall be the total of 30% of the selling price plus the expenses incurred, cost of material, and reasonable value of the work expended to fill the order involved herein by Hydro's engineers and other employees, agents and representatives after the mailing of general arrangement drawings by Hydro to Buyer, said sums to be determined at the sole reasonable discretion of Hydro; provided, however, that the total liquidated damages under this provision shall not exceed the total selling price.

    d. If cancellation or breach shall occur after Hydro has notified Buyer that the order is ready for shipment, then the liquidated damages shall be the total selling price, less costs associated with startup or field testing.

11. **MATERIALS OF CONSTRUCTION, PAINTS AND COATINGS**: Buyer is responsible for determining the suitability of, and for giving final approval of, the materials of construction, paints, coatings, etc. to be used by Hydro.

12. **WARRANTY:** Any product that proves defective in material, workmanship or design within twelve (12) months after delivery (or entry into storage) will be, at the discretion of HYDRO, modified, repaired or replaced, or Buyer's payment for the products will be refunded. This shall be Buyer's sole remedy. HYDRO EXPRESSLY EXCLUDES AND DISCLAIMS ANY WARRANTY OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR OTHER WARRANTIES, EXPRESS OR IMPLIED.

    This warranty does not cover any defects or costs caused by: (1) normal wear and tear of equipment from designed operation. (2) modification, alteration, repair or service of the goods by anyone other than Hydro; (3) physical abuse to, or misuse of, the goods, or operation thereof in a manner contrary to Hydro's instructions; (4) any use of the goods other than that for which they were intended; (5) chemicals or components which were not disclosed to Hydro; (6) storage contrary to Hydro's instructions; or (7) failure to maintain the goods in accordance with Hydro's instructions.

    This warranty does not apply to component parts of the goods that were not both originally designed and manufactured by Hydro, including, but not limited to, valves and controls. These component parts do not carry any warranties by Hydro, and only carry the warranties, if any, of their manufacturers.

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In order for Buyer to make a claim under this warranty, Buyer must promptly, and within the warranty period, notify Hydro in writing of any defect(s) in the goods covered by this warranty. If any defect(s) in the goods covered by this warranty are visible at the time of delivery, Buyer must notify Hydro of the defect(s) in writing within five working days. To make any claim under this warranty, Buyer must also fully comply with written authorization and return instructions from Hydro.

13. **FIELD SERVICE:** Startup/Field Service will only be scheduled upon written request. Buyer shall notify Hydro of schedule requirements at least ten (10) working days in advance, or additional charges may be added to cover late-scheduled travel costs. Additional costs will be limited to those arising out of late-scheduled costs. Should Buyer have outstanding balances due Hydro, no startup / field service will be scheduled until such payments are received by Hydro. Hydro will send documents to Buyer defining the service or startup requirements. Buyer assumes all responsibility for the readiness of the system when it requests startup service. Should Hydro's Field Service Engineer arrive at the jobsite and determine that the system cannot be started up within a reasonable time, Hydro shall have the option to bring the Field Service Engineer home and bill Buyer for time, travel and living expenses. Additional field service is available from Hydro at the prevailing per-diem rate at the time of the request for service plus all travel and living expenses, portal-to-portal. A purchase order or change order will be required prior to scheduling this additional service.

14. **LIMITATION OF HYDRO'S LIABILITY.** Hydro assumes no liability or responsibility for the misuse of its products by Buyer, Buyer's employees, agents or assigns, or other use inconsistent with the use appropriate to the performance specification requirements submitted to Hydro, and Buyer agrees to indemnify and hold harmless Hydro for any loss, costs, expense or liability that it may incur or be put to as a result of misuse or inconsistent use of the products. In addition, Hydro shall have no liability to Buyer for any consequential or incidental damages incurred by Buyer in connection with the contract documents or the products purchased by Buyer. Hydro shall not be liable for any loss which results from delay in delivery caused by any reason beyond its control, including, but not limited to, acts of God, casualty, civil disturbance, labor disputes, strikes, transportation or inability to obtain materials or services, any interruption of its facilities, or act of any governmental authority. The total liability of Hydro to Buyer in the form of liquidated damages for any loss, indemnity, damage or delay of any kind will not under any circumstances exceed 25% of the Contract Sum.

15. **DELAYS AND EXTENSIONS OF TIME**. In the event of any delay in delivery caused by any reason beyond Hydro's control, including, but not limited to, acts of God, casualty, civil disturbance, labor disputes, strikes, pandemics, transportation or inability to obtain materials or services, including related to supply chain disruptions, any interruption of its facilities, or act of any governmental authority, the time for delivery shall be automatically extended during the continuance of such conditions.

16. **INTELLECTUAL PROPERTY**. Hydro shall retain sole ownership of all of its intellectual property used or produced in connection with the Project, including but not limited to all drawings, specifications, software, written materials, manuals, marks, business methods, and all other property that is capable of protection by a patent, copyright or trademark (whether or not such protection has actually been sought). Buyer shall not use such intellectual property except for the purpose of confirming the quality of design and/or manufacturing of the products and services set forth in the Proposal. Buyer shall not photocopy, duplicate or in any way copy such intellectual property except for the Buyer's internal purposes only (but not for rendering services or selling products to third persons). Buyer shall not sell, license, assign or transfer the intellectual property protected by this paragraph to anyone. Buyer shall ensure that Owner is in possession of valid licenses for all third-party software (not provided by Hydro) used for the Project, and shall indemnify and hold harmless Hydro against all claims by licensors of such software. Hydro makes no warranty regarding the effect of such third-party software on the performance of the software to be developed by Hydro for the Project and Hydro shall be released from any warranties given to Buyer to the extent that such software causes or contributes to problems. Following acceptance and final payment to Hydro, Hydro will grant to the Owner a non-transferable, non-exclusive license to use the software for the Owner's internal purposes only in the form of the license agreement attached as Exhibit A. Patent: www.hydro-int.com/patents

17. **TAXES.** Prices stated herein do not include any tax, excise, duty or levy now or hereafter enacted or imposed, by any governmental authority on the manufacture, sale, delivery and/or use of any item delivered. An additional charge will be made therefore and paid by Buyer unless Hydro is furnished with a proper exemption certificate relieving Hydro of paying or collecting the tax, excise, duty or levy in question.

18. **INTERPRETATION OF CONTRACT.** This contract shall be construed according to the laws of the State of Maine.

19. **CHOICE OF FORUM**. Buyer and Hydro hereby consent and agree that the United States District Court for the District of Maine or the District Court or Superior Court located in the City of Portland, County of Cumberland, Maine will have exclusive jurisdiction over any legal action or proceeding arising out of or relating to the contract documents, and each party consents to the personal jurisdiction of such Courts for the purpose of any such action or proceeding. Buyer and Hydro further hereby consent and agree that the exclusive venue for any legal action or proceeding arising out of or relating to the contract documents will be in the County of Cumberland, Maine. Each party hereby waives all rights it has or which may hereafter arise to contest such exclusive jurisdiction and venue.

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20. **ATTORNEYS' FEES.** If any judicial or non-judicial proceeding is initiated for the purpose of enforcing a provision of this contract, the prevailing party shall be awarded reasonable attorneys' fees in addition to all other costs associated with the proceeding, whether or not the proceeding advances to judgment.

21. **SEVERABILITY.** If any provisions of this contract are held invalid by a court of competent jurisdiction, the remainder of this contract shall not be rendered invalid, and such invalid provisions shall be modified, in keeping with the letter and spirit of this contract, to the extent permitted by applicable law so as to be rendered valid.

22. **ANTI-BRIBERY.** Hydro International will not engage in any form of bribery or corruption. The offering, giving or receiving of bribes is contrary to Hydro International's values and can play no part in the way in which it carries out its business. Hydro requires you to support our approach and implement provisions consistent with our policy through your own organization and your supply chain. Please find a copy of our Anti-Bribery and Corruption Policy on our website at: https://hydro-int.com/sites/default/files/hydro-international-anti-bribery-and-corruption-policy-february-2022.pdf

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of two (2) beams diagonally and cross-braced to resist the specified torque and wind loads. The walkway surface shall be 1-1/4" aluminum grating.

2. A center drive platform shall be provided. It shall be a minimum of 8' x 10' to provide clearance around the center assembly and drive control for maintenance and service. It shall consist of 3/16" thick aluminum checkered floor plate with necessary stiffeners and supports, resting on the center assembly and provided with connections to the walkway.
3. Handrails shall be 42" high of mechanically-fastened 1-1/2" diameter Schedule 40 double-row horizontal aluminum pipe and shall and placed along both sides of the walkway and surrounding the center drive operating platform. A 4" x ¼" thick aluminum toe board shall be provided around the drive platform and walkway handrails.
4. Steel bearing plates, UHMW polyethylene slide plates and anchor bolts for the wall supports shall be supplied by the manufacturer.

G. Center Column:
   1. A minimum 18" diameter x 1/4" wall stationary center column shall be provided. One end shall have a 1-1/4" thick support flange for bolting to the foundation, with a minimum of eight (8) 3/4" diameter anchor bolts. A similar flange shall be provided at the top of the column for securing the center drive assembly.
   2. Influent openings shall be provided in the upper portion of the column to allow unrestricted passage of the flow into the influent well. Influent velocity shall be reduced by providing a total inlet port area a minimum of 135 percent of the center column cross sectional area.
   3. Prior to the center column being grouted in place, the drive unit shall be installed, positioned and leveled.

H. Center Cage:
   1. The center cage shall be of stainless steel box truss construction, a minimum of 3'-0" square. It shall be provided with the connections for the one (1) sludge removal arm, one (1) counterweight/skimmer support arm and influent well. The cage top shall be bolted to the main gear, which shall rotate the cage with the attached arms. The minimum angle size used for the cage and rake arms shall be 2" x 2" x 1/4".

I. Influent Feedwell:
   1. The feedwell shall be fabricated out of 3/16" steel plate.
   2. Sufficient reinforcing rim angles shall be provided as required. The well shall be rotating and supported by the center cage.
   3. Well diameter and side depth shall be as shown on the Plans.

J. Sludge Removal Arm:
   1. The mechanism shall include one (1) sludge removal suction header fabricated from ¼" steel and supported by a full radius truss arm.
   2. The clarifier mechanism shall be designed to meet the following design criteria:
      a. Hydraulics:
         1. Minimum RAS flow: __0.55_ MGD
         2. Design RAS flow: __1.20_ MGD
         3. Maximum RAS flow: __1.55_ MGD

b. Suction Header:
   1. Maximum headloss: 1.5 ft.
   2. Minimum velocity: 0.5 FPS
   3. Minimum orifice diameter 1.5 in.

3. The suction header shall be rectangular shaped, full tapered sections varying in size from maximum near the tank center to minimum at the outer end for uniform sludge draw-off velocities. The header is to be hot dip galvanized after fabrication in accordance with ASTM A123.
4. The longitudinal cross section axis of the header is to be mounted at a 45° angle with the tank bottom to provide a peaked top. The leading edge of the header shall have an neoprene squeegee, extending downward 6" to provide a fluidizing vane as an integral part of the header and to direct the sludge into the area of influence of the orifices.
5. The orifices shall be located at 30" centers and shall be designed for uniformly removing the proportionate volume of sludge from the entire tank floor at the specified flow range. The orifices shall vary in size with minimum diameter near the tank center to a maximum at the outer end of the header.
6. The header shall have a center scraper with a neoprene blade for cleaning the tank bottom around the manifold.
7. A full radius truss type counterweight arm shall be provided 180° from the sludge removal arm. The counterweight arm shall be so designed to offset the weight of the sludge removal arm.
8. Combined cage and arms shall be designed such that they do not exceed the AISC allowable stress at twice the specified design torque.

K. Sludge Manifold:
1. The manifold unit for the sludge removal header shall be constructed of minimum 1/4" steel plate, suitably reinforced as required to operate under a static head of 20 feet. The manifold unit shall consist of a stationary ring attached to the center column, a stationary outer housing anchored to the tank bottom and a rotating ring with inner and outer seal assemblies.
2. The rotating manifold ring shall be attached to the drive cage in a manner that will permit field adjustment of the horizontal and vertical alignment to insure proper seal seating and to compensate for the applied hydraulic load conditions after the tank is filled.
3. The manifold shall be self-cleaning. Designs lacking this important maintenance feature are not acceptable.
4. The manifold seal assemblies shall be located at least 8" off the tank bottom to minimize seal wear due to abrasive material in the sludge. All seals are to be oriented horizontally and riding flat. Seals riding vertically or partially vertical shall not be acceptable. The seal assemblies shall be designed so that replacement can be made without disassembling the manifold. A 10-year seal warranty shall be provided.
5. Each seal assembly shall consist of two (2) ¼" thick fabric-reinforced neoprene seals riding on a stationary UHMW polyethylene plate and shall include a steel backup plate.

SECTION 11950 – ULTRAVIOLET DISINFECTION EQUIPMENT

PART 1 - GENERAL

1.01 GENERAL:

The Contractor shall provide all labor, materials, tools, and equipment required to furnish and install a vertical format UV disinfection system including startup, commissioning and performance testing and shall be suitable for continuous service as shown on the plans and as specified herein.

A. Work and Components to be provided by UV System Manufacturer (But Not Limited To):

1. Vertical UV disinfection modules.
2. Power distribution/data center (PDDC) and interconnecting power and data Cables to modules.
3. UV Intensity Monitoring System.
4. UV eye shields.
5. Personnel safety equipment.
6. Automatic dose/flow pacing energy conservation system (Row-By-Row).
7. Automatic fault compensation (Row-By-Row).
8. Effluent level control device (flap gate), 1 new if not already installed
9. Spare Parts.
10. Start-up, testing, and personnel training.
11. Module lifting frame.
12. Automatic module cleaning (wiping) system.
13. Cleaning plate exerciser.
14. Stepdown transformer (480/400).

B. Work to be Provided by the Contractor (But Not Limited To):

1. Foundations, concrete channels, conduits, handrails and stairs.
2. Removal of existing equipment.
3. UV channel cleanup.
4. Installation of new equipment.
5. Main electrical power supply including a properly grounded neutral.
6. Control wiring and installation for remote signals.
7. Piping, channel drains and valves.
8. Walkway Grating.
9. Channel isolation gates and motorized gate actuators.
10. Lifting crane and hoist (reuse existing).
11. Stainless steel tank for cleaning station (reuse existing)
12. Interconnect conduits between the wireways and the PDDC.

C. Manufacturer:

1. The process design and equipment layout specified and as shown on the contract drawings is based upon the Aquaray® 40 “HO” High Output Vertical Lamp System as manufactured by Veolia. If an alternate UV system manufacturer is proposed, the Contractor is responsible for all costs associated with the system evaluation and redesign including all electrical, mechanical,

structural and civil aspects of installation. No alternate shall be considered unless pre-approved by the owner/engineer 14 days prior to bid opening.

2. Any alternate “approved as equal” manufacturers shall only be reviewed following bid submittal if elected by the Engineer and Owner.
   a. To be considered, the manufacturer will be regularly engaged in the manufacture of UV systems with a proven track record of at least fifty (50) installations of 10 MGD or more in Continental United States
   b. The manufacturer will provide documentation of previous experience with at least 5 references – location, names and contacts - of municipal UV disinfection systems in wastewater applications with the same type and model of equipment proposed.
   c. Alternate submittals from manufacturers will include a complete and detailed proposal of equipment offered, including the number of lamps proposed and a detailed description of any exceptions taken to the specification.
   d. To be considered, the alternate manufacturer will submit a bioassay evaluation for the proposed UV system. This bioassay must follow protocols described in the NWRI (National Water Research Institute) Ultraviolet Disinfection Guidelines for Drinking Water and Water Reuse, Third Edition (August 2012), for MS2 bioassays, without exception. The manufacturer’s bioassay report must demonstrate that the proposed UV system design and number of lamps will deliver the specified dose.
   e. Independent certification of fouling factor and lamp aging factor must be submitted if values other than the specified default values are being proposed.
   f. Documentation of UV manufacturer's service capabilities including location and experience.
   g. Sample disinfection performance guarantee including scope and duration of guarantee.

D. UV System Requirements:

1. Provide a UV disinfection system complete with UV modules, Power Distribution Data Center(s), UV intensity sensor(s), module cleaning system, and eye shields as shown on the contract drawings and as herein specified.

2. The disinfection system shall be designed for maximum energy conservation and partial system shutdown by automatic flow pacing in increments not to exceed 10% in response to plant flow and UVT meter signals.
3. System sizing and dose calculations shall be based on a third-party bioassay. Dose calculations based on the Point Source Summation model, or any UV intensity model, will not be accepted.

E. Lamp Array Configuration:

1. The lamp array configuration shall be vertical, with a uniform staggered array, with all lamps parallel to each other and 90^{o} perpendicular to the flow. The

lamps shall be spaced in vertical rows with centerline spacing which will ensure effective disinfection and low system head loss.

2. System with inclined or horizontal lamp array configurations that are not 90^{o} perpendicular to the flow direction shall not be allowed.

1.02 SUBMITTALS:

A. The Contractor shall furnish the following information to insure a successful fast track completion of this project. Failure to comply with these requirements may result in the rejection of submittal.

1. UV system manufacturer references for a minimum of fifty (50) installations of 10 MGD or greater within the Continental United States using the same vertical lamp concept.

2. An Independent third party bioassay based on the 40 lamp vertical UV High Output Lamp arrangement and specific to the equipment being supplied shall be provided. This bioassay must follow protocols described in the NWRI (National Water Research Institute) Ultraviolet Disinfection Guidelines for Drinking Water and Water Reuse, Third Edition (August 2012), for MS2 bioassays.

B. The manufacturer shall provide 5 copies of shop drawing submittals, these shall include interconnections and interface requirements, dimensions and locations of all major elements of the UV system and critical clearance requirements. Once approved no changes may be made without the written consent of the engineer and the UV equipment supplier. Information should include the following:

1. Complete description in sufficient detail to permit a thorough comparison with the appropriate specification section(s).

2. Major component dimensions and installation requirements.

3. Complete description in sufficient detail to permit a thorough comparison with the appropriate specification section(s)

4. Descriptive summary of the UV system provided.

5. Electrical and major component layouts.

6. Head loss calculations demonstrating compliance with the specified hydraulic characteristics.

7. UV dosage calculations. Dose calculations shall be based on bioassay third-party calculations.

8. Preliminary UV equipment O & M manuals prepared for this project.

C. Project Specific Operation and Maintenance Manuals:

Final Operation and Maintenance (O&M) manuals for this specific project shall be submitted to the Engineer upon approval of shop drawings and delivery of the equipment. The O&M manuals shall include instructions on equipment storage, installation, start-up, and operation and maintenance, together with a thorough troubleshooting guide and recommended spare parts list.

1.03 WARRANTY AND REMEDIES:

A. Seller warrants that Equipment shall be delivered free from defects in material, workmanship and title and that Services shall be performed in a competent, diligent manner in accordance with any mutually agreed specifications for one (1) year from start-up or eighteen (18) months from shipment, whichever occurs first. Seller's warranty does not cover the results of improper handling, storage, installation, commissioning, operation or maintenance of the Equipment by Buyer or third parties, repairs or alterations made by Buyer without Seller's written consent or fair wear and tear.

1.04 QUALITY ASSURANCE:

A. The vertical UV disinfection system shall be capable of disinfecting the specified flows based on the minimum influent water quality specified in Section 1.04A.

B. Acceptance Test. The UV manufacturer shall provide a test protocol for the UV system to be followed after initial start-up and following a minimum of 10 days of continuous plant operation. The installing contractor shall notify the Owner and UV manufacturer in writing, that he is prepared to begin the acceptance test. The Owner shall then provide written notification to the Contractor to proceed with the acceptance testing. Results of the test done by the contractor will be supplied for review to the UV manufacturer.

1.05 DESIGN CRITERIA:

A. Provide equipment which shall disinfect an effluent with the following characteristics:

Peak Flow:	6 MGD
Total Suspended Solids:	<30 mg/L (30-day geometric mean)
	<45 mg/L (Single sample maximum)
Ultraviolet Transmittance	
@ 253.7 nm:	65% (Assumed minimum)
Effluent Standards to be achieved:	
Fecal Coliform:	<200 MPN/100 mL (Monthly average)
	< 400 MPN/100 mL (7-day average)

B. The system shall be installed in an open channel having the following dimensions.

Length:	Existing
Width:	Existing

Depth: Existing

C. The effluent depth in the channel shall be automatically maintained at a nominal 60 inches water depth (±1.5").

D. A total of two (2) channels shall be provided. The two (2) existing UV channels shall be retrofitted with new UV equipment. The UV system shall deliver a minimum UV dose of 30 mJ/cm^2 at peak flow of 6 MGD and minimum UV transmittance of 65% with one (1) module out of service per channel.

E. The system supplied shall, as a minimum, include:

Number of Channels:	2
Number of UV Modules/Channel :	1
Module Layout:	1 Across by 3 Banks in Series
UV Modules, Total:	6
Number of Lamps in Each Module :	40
UV Lamps, Total:	240
Number of Power Distribution And Data Centers (PDDC):	1
Number of UV Intensity Sensors :	6
Number of Low/High Level Switches :	2 sets
Number of air hose assemblies:	6
Level Controllers:	Flap Gate (if not already installed)

1.06 PERFORMANCE REQUIREMENTS:

A. System Performance

1. The end of lamp life third-party bioassay UV dose produced by the system shall not be less than 30.0 mJ/cm^2 with all UV modules in service, in an effluent with 65% UV transmission at 253.7 nm. Lamp output must be at least 90% of initial level after 13,000 hours of operation and with no fouling on the lamp sleeves.

2. The system design shall be based on third-party bioassay dose calculations taking into consideration the criteria listed below. Dose calculations based on the Point Source Summation model, or any UV intensity model, will not be accepted.

a. UV transmission (T_{10}) 65%.
b. UV lamp end of life derating factor (f_P) = 0.90.
c. Sleeve fouling derating factor (f_P) = 0.90 (in addition to 10% quartz sleeve loss).

3. Total head loss for each channel shall not exceed 0.93 inches, this being confirmed by measurements in the field after start-up.

B. Energy and Lamp Conservation (Automatic Flow Pacing)

1. The UV control system shall automatically turn on and off appropriate rows in relation to variations in plant flow and UV transmittance. The signals, provided by others, shall be 4-20 ma or numerical via Ethernet Modbus TCP/IP.

2. For this project, the UV system shall be capable of responding in minimum 7% increments within each channel for maximum flow pacing flexibility and economy.

3. The UV system design shall allow the operator an option to operate the UV system in either manual or automatic modes.

4. To reduce energy consumption the UV system shall be capable of automatically adjusting the number of lamps in service by eight lamp increments within each UV module.

C. Automatic Fault Compensation

1. Flow pacing shall be proactive and compensate for failed lamps by automatically turning on additional rows of lamps.

2. The UV system controls shall ignore the dose contribution of a row when 2 or more lamps out of 8 lamps are reported failed.

PART 2 - PRODUCTS

2.01 MATERIALS:

A. General:

1. All metal components in contact with effluent shall be Type 316L stainless steel.

2. All material exposed to UV light shall be Type 304L or Type 316L stainless steel, Type 214 quartz, Teflon, or other suitably UV resistant material.

B. Ultraviolet Lamps:

Lamps shall meet the following requirements:

1. Low pressure High Output UV lamps. Each lamp shall produce UV light with at least 90% of the UV emission at 253.7 nanometer wave length.

2. Low pressure mercury of the hot cathode instant start design in which the coiled filament cathodes are heated by the arc current.

3. The filament of the lamps shall be the clamped design, significantly rugged to withstand shock and vibration.

4. The electrical connections of the UV lamps at one end shall be through a non-proprietary pigtail with molded 2-wire connector.

5. The rated UVC lamp output shall be approximately 52.0 UVC watts.

6. The UV lamp intensity at a distance of 1 meter in air shall be 370 microwatts/square centimeter.

7. Minimum UV lamp arc length shall be 58 inches.

8. Lamps shall not produce any ozone.

9. The lamp bases shall be of a durable construction resistant to UV.

10. The lamp design shall prevent electrical arcing between electrical connections in moist conditions.

11. The power consumption of the system, on a per lamp basis, should not exceed 172 watts.

C. Ultraviolet Lamps Guarantees:

1. The UV supplier shall warrant that after 13,000 hours of operation the average UV lamp output will be no less than 90% of a new lamp (after 100 hours initial burn-in).

2. The number of UV lamps required shall be as determined sufficient by the UV manufacturer to meet the required disinfection standard and the minimum UV dosage specified.

3. The UV lamps will be warranted for 13,000 hours of useful life and the warranty is to be pro-rated against actual lamp use.

D. UV Lamp Sleeve.

1. The UV lamps are to be protected from contact with the effluent by a 99.9% silicon dioxide quartz sleeve with a minimum of 90% transmission of UV radiation at the 253.7 nanometer wave length and have OD of 24.5 mm and a nominal wall thickness of 1.25 mm.

2. One end of the quartz jacket shall be a closed test tube end and the other open with smooth radius edges.

E. Electronic Lamp Controllers (ELC)

1. Each module will include one high performance electronic lamp controller, or ballast for each pair of UV lamps such that the failure of one lamp does not impact operation of the peer lamp. The ELC shall be designed for use with the specified UV lamps. The ELC shall turn on and off lamps upon request and provide analog feedback to the UV system controls such as lamp current and internal ELC temperature. The ELC will automatically shut down lamps upon detection of a ground fault or ELC over-temperature.

2. The ELC shall comply with the following requirements:

   a. Specifically designed to power two (2) UV germicidal low pressure high output lamps, each lamp, with a UVC output of not less than 52 watts.
   b. Powers each UV lamp to produce lamp-output of 370 microwatts/cm^2 UV at a distance of one meter in air.
   c. With two (2) lamps in operation, the electrical power draw shall not 172 watts per lamp.
   d. Electronics shall be housed inside an aluminum casing.
   e. Housed inside the top enclosure of the UV module and attached to heat sinks for optimum cooling.

3. Separate enclosures for the ELCs, if used, must meet UL/NEMA 4X specifications. Force ventilated enclosures which permit introduction of outside air shall not be acceptable unless equipped with an active air filtration system or an automatic signal to advise operators when replacement of filter is required.

F. Data Control Assembly (DCA)

1. Each module shall include a Data Control Assembly (DCA), which will provide coordinated command, control and communications between all internal module systems and the UV system PLC via a dedicated Modbus TCP/IP communication link.

2. The DCA card will command:
   a. Rows of lamps to turn on and off.
   b. Cleaning plate to move up and down.
   c. UV module cooling fans to run, or not.

3. The DCA card will gather the following information for the UV system PLC:
   a. Lamp on/off status, current, hours and cycles.
   b. Cleaning plate end travel (bottom / top).
   c. Ballast temperature.
   d. UV sensor intensity readings (mW/cm^2).
   e. Various faults including the ELC GFI failure (ground fault) and ELC over-temperature shutdown (OTSD).

4. Each DCA must include rotary dip switch to customize the last three digits of the DCA card IP address for Modus communication link:

5. Each DCA must include a 10-position rotary dip switch to select a proper restart mode following loss of power or loss of communication with the PLC:

6. Each DCA must include on board LED indicators, which will simplify diagnosis and repairs:

G. UV Module:

1. Each vertical UV module shall be precision fabricated in type 316L stainless steel. The top enclosure meet the NEMA-4X standards. Six individual compression latches are used to clamp the module lid tight against a foam in place gasket. Four support legs shall connect the module enclosure to a bottom pan.

2. Each module shall be completely serviceable in the field while located in the channel and shall be fitted with water resistant UL & CE rated multi-pin connectors for power and an RJ-45 connection port for data.

3. All electrical connections shall be above maximum operating water elevations to protect against electrical hazard.

4. Ultraviolet lamps, electronic controls and individual ELCs shall be arranged so that they may be easily tested in place. When necessary, any malfunctioning device or unit shall be capable of being replaced without removal of the entire module from the channel.

5. To maintain proper operating temperatures each module shall be equipped with a stainless steel shroud and high efficiency-cooling fans. The fans and shroud will

automatically direct cooling air across the exterior surfaces of the module. In addition to the cooling fan, each module must be fitted with passive aluminum heat sink material to maintain proper operating temperatures inside the module with ambient air temperature from 32^0F to 130^0F.

6. Each module will be equipped with lifting lugs to allow for the attachment of a lifting spreader so that the modules or banks of modules can be easily lifted with a standard hoist or similar lifting device specified elsewhere.

7. Automatic interlock protection will be incorporated into each module enclosure such that with the opening of the module enclosure lid power to the lamps will be automatically shut off.

8. Each module shall be identified by the electronic serial number from its DCA card.

9. To minimize chemical cleaning frequency each module shall be equipped with a sleeve cleaning plate fitted with wipers. The wiper cleaning plate must be motor driven and can be operated in either manual or automatic mode from the UV system controls. In automatic, entire channel cleaning cycles are triggered at regular time intervals which are adjustable within the range of once per day to once per week. The wiping system shall be equipped with a current overload detection feature that stops the motor before a mechanical torque tender disengages.

10. Wipers

    a. Wipers are designed to clean the sleeve external surface by friction without the need to inject any chemical or detergent in-situ.
    b. Wipers shall be fabricated of UV resistant material and installed in a manner which accommodates any irregularities associated with the quartz sleeves and precludes any binding during operation.
    c. The wipers shall be replaceable without having to dismantle the wiper drive system, complete removal of the quartz sleeves, or disassembly of the module structure.
    d. To further extend the life of the wipers, the wipers shall be normally parked above the water level elevation when not in use. This will also prevent disturbance to the flow hydrodynamics of the module during normal disinfection operation.
    e. The wiper system shall be mechanically driven with a single drive assembly. The drive shall incorporate a centrally located means of supporting and aligning the wipers properly throughout the travel.
    f. The wipers shall travel the full length of the UV lamp sleeves. Designs with the wipers traveling only part way along the sleeves will not be considered acceptable.

11. Module cleaning systems which rely on a centralized method (such as a compressor or hydraulic pump) for driving the wiper where the failure of that component would result in a loss of wiping capability in the whole system, shall be equipped with a back-up compressor or pump and associated automated valves to insure adequate cleaning of the quartz sleeves.

12. Each UV module housing 40 low pressure high output UV lamps shall be equipped with protruding flow dispersion baffles to improve hydraulic mixing and to create a uniform UV intensity field within the reactor.

13. The baffles shall be an integral part of the UV module.

14. The baffle material shall be 316L stainless steel.

H. Electrical:

1. Power requirement of 400V, 3-phase, Wye, 3 wires + neutral + ground, 50/60 Hz, per channel shall be provided. If necessary, the UV system supplier shall be responsible in providing one (1) 480V Delta – 400V Wye + neutral + ground /3Phase/50/60Hz/63KVA stepdown transformer.

2. Maximum power consumption per UV module housing 40 low pressure high output lamps shall be 6.88 kW and shall not be greater than 20.64 kW per channel.

3. Each module shall be completely serviceable while located in the channel and shall be fitted with water resistant UL rated multi-pin connectors for power and data. Combined power and data shall not be acceptable.

4. Power interconnect cables and data cables provided in between the UV modules and PDDC shall be field terminated and interconnections be made by the Contractor.

5. Power cable interconnecting conduits between the wireways and the PDDC shall be provided by the Contractor.

2.02 INSTRUMENTATION AND CONTROLS

A. Power and Data Distribution Center (PDDC):

1. The wall/floor mounted PDDC shall be NEMA 4X rated for indoor/outdoor use and will be conveniently located as shown on the drawings. The minimum size of the PDDC shall be 48 inches in height, 36 inches width, and 12 inches depth. The maximum size of the PDDC shall be 60 inches in height, 36 inches width, and 12 inches depth. NEMA-3R with forced ventilated enclosures, which allow introduction of outside air shall not be acceptable unless equipped with an active air filtration system or automatic signal to advise operators when replacement of filter is required.

2. Mains power supply will enter the PDDC from below and terminate into an MCB. From the MCB power supply will be split between circuit breakers dedicated to provide power to each module and peripheral equipment.

3. Each UV module shall be protected by a panel mounted thermal magnetic circuit breaker device per NEC Code. These circuit breakers shall be mounted inside the PDDC. Each circuit breaker shall provide visual trip indication, be capable of

regular testing. To ensure safe operation, ground fault circuit detection systems, which permit remote reset, shall not be used.

4. The PDDC will include a Local Operator Interface (LOI) as described below. All equipment for the local control and monitoring of the UV system shall be mounted on or in the PDDC.

B. Local Operator Interface (LOI) Description

1. The LOI shall be PLC based. The Programmable Logic Controller (PLC) shall be an Allen Bradley CompactLogix. The Operator Interface Terminal (OIT) shall be a programmable NEMA 4X rated Panelview Plus 7 standard 10" color touch screen display which shall be mounted on the PDDC panel door. The PLC will communicate with each UV module DCA card using an Ethernet Modbus TCP/IP communication protocol.

2. System operating information will be displayed on the OIT in both color graphic and text format. The information must be continuously updated. As a minimum the following information shall be displayed in the main screen simultaneously: Number of channels/rows/banks/modules in service, channel actual vs. target dose, UV intensity, communication link status and UV lamp status.

3. System command, control and status shall be accomplished through the OIT. In the event of a fault the alarm blinks white on a red background until the alarm has been manually or automatically cleared.

4. Alarms shall, as a minimum, include:

    a. Channel low & high level switch.
    b. Channel UV dose low and low-low.
    c. Module (DCA) comms failure.
    d. Module DCA-Ballast com link failure.
    e. Module (DCA) over-temperature.
    f. Module (DCA) fault.
    g. Module lamp fault.
    h. Module multi-lamp failure.
    i. Module adjacent lamp failure.
    j. Module ELC over-temperature shutdown (OTSD).
    k. Module ELC GFI.
    l. UV intensity sensor out of range.
    m. UV intensity sensor low and low-low
    n. Cleaning fault
        i. Limit switches
        ii. Motor overload
        iii. Motor timeout

5. The alarm display will identify the affected module and then the actual component.

6. Information, such as individual lamp hours and cycles, normally stored in the DCA shall be accessed using the OIT. Lamp cycles and hours shall be reset via a password protected screen.

7. The Automatic Module Wiper Cleaning system shall be controlled and monitored by the DCA card. Automatic control of each module wiper plate shall be based on time and controlled from the UV system PLC whereby the operator shall be able to alter the interval between cleaning cycles. Manual control of the module wiper cleaning system shall be provided as well (up, down, cleaning cycle, stop).

2.03 AUTOMATIC LEVEL CONTROL

A. Flap gates, if not already in place, shall be placed at the discharge end of the UV disinfection channel(s) to ensure that the UV lamps are properly submerged regardless of the plant flows.

B. The level of the water shall be maintained between 57.5” and 62” inches at all design flow conditions.

2.04 MODULE CLEANING STATION:

A. The existing 304L stainless steel liner with drain stub and cover shall be reused. The module cleaning station accommodates one (1) module with 40 lamps immersed in citric or phosphoric acid (5-10% concentration with pH between 2.0-3.0).

2.05 SPARE PARTS AND SAFETY EQUIPMENT

A. The UV supplier shall furnish as part of the system the following spare parts and safety equipment:

1. 10% of Installed UV Lamps.
2. 10% of Installed Quartz Sleeves.
3. 10% of Installed Cleaning Wipers.
4. 5% of Installed ELCs.
5. One (1) DCA card
6. One (1) UV Intensity Sensor.
7. Two (2) pairs of personnel goggles for protection against UV energy between 200 - 400 nanometers wave length.
8. Two (2) UV area warning signs.
9. One (1) 50 lb. bag of citric acid.
10. One (1) Cleaning System Exerciser.

11. One (1) Lifting Frame

12. Gloves

B. All spare parts and safety equipment are to be separately packaged. All packages are to have with quantity, item description and part number.

PART 3 - EXECUTION

3.01 INSTALLATION

A. The Contractor shall construct the disinfection channels for the Ultraviolet Disinfection system as shown on the drawings and as recommended by the UV manufacturer.

B. Equipment shall be installed in accordance with the manufacturer's shop drawings and written installation instructions.

3.02 ELECTRICAL CONNECTIONS AND WIRING

A. The UV manufacturer shall furnish power and data cabling between the UV modules and the PDDC. The incoming power supply, conduit, and field terminations will be the responsibility of the contractor.

B. Equipment shall be delivered to site requiring minimal on-site labor for installation. Systems requiring extensive on-site wiring of the modules, and systems with more than one power and one data connection per module shall not be allowed.

3.03 MANUFACTURER'S FIELD SERVICES

A. Installation and Start-Up Services shall include a minimum of five (5) eight hour days in two (2) trips. Training for Plant Operators and maintenance staff will be coordinated between the Owner, Contractor and UV supplier to ensure maximum effectiveness.

B. Service personnel shall be fully qualified and full-time employees of the UV system manufacturer.

C. Performance testing of the UV system, if required, will be the Contractor's responsibility.

D. The UV supplier shall provide for engineer's approval a formal test protocol for use during performance tests.

- End -

SECTION 15001 - PIPE WORK GENERAL PROVISIONS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Work under this Section includes all material certificates; Shop Drawings; disinfection of potable water mains; and field testing of all pipe, pipe fittings, piping specials, and valves in all sections necessary to complete and make serviceable all piping systems.

B. The requirements of this Section apply to the work in the following Sections:

1. Section 15060 - Pipe and Pipe Fittings

2. Section 15079 - Pipe Accessories

3. Section 15100 - Valves

C. Related Work Specified Elsewhere

1. Section 02200 - Earthwork

2. Section 03310 - Concrete

1.2 QUALITY ASSURANCE

A. Codes and Standards: Comply with the provisions of the following codes and standards except as otherwise shown or specified.

1. AWWA: All applicable standards.

2. Arkansas Department on Environmental Quality: All rules and regulations.

1.3 SUBMITTALS

A. Material Certificates: Provide materials certificates signed by the material manufacturer and the Contractor for all pipe and pipe fittings. Certify that each material item complies with the specified requirements.

B. Shop Drawings: Submit Shop Drawings for all valves and special items, restrained joint systems for all systems, and laying schedules in accordance with Section 01340 of these Specifications.

PART 2 - PRODUCTS

(Not Applicable)

PART 3 - EXECUTION

3.1 TEST RESULTS

A. The Contractor shall conduct all tests in the presence of the Engineer. Test results shall be certified to the Owner in writing.

3.2 TESTING NEW WATER LINES AND FORCE MAIN PRESSURE SYSTEMS

A. Each section of piping shall be tested to a hydrostatic pressure of 150 psi (minimum) or 50 psi above the working pressure. The Contractor is required to furnish all pumps, gauges, instruments, test equipment, and personnel required for the tests, and make provisions for removal of test equipment and draining of pipes after tests have been made. All testing shall be made in the presence of the Engineer.

B. The pressure tests shall be sustained for not less than one (1) hour and as much longer as the Engineer may require to assure that:

1. No air pockets are in the line.

2. No broken pipe or defective materials are in the line.

3. No leaking joints have been made.

C. Before applying the specified test pressure, all air shall be expelled from the pipe. If outlets are not available at high places, the Contractor shall make the necessary taps at points of highest elevations before the test is made. After the test has been completed, corporation cocks shall be installed at these points and marked by the installation of a valve box.

D. Tests may be made of isolated portions of such piping as will facilitate general progress of the installation. Any revisions made in the piping systems will subsequently necessitate re-testing of such affected portions of the piping systems.

E. The contractor shall provide all water needed for flushing and testing at no additional cost to the owner.

F. Any defective material or defects in workmanship that become apparent during the tests shall be remedied and the subject piping shall be retested.

G. Prior to pressure testing of buried piping, backfill shall have been partially placed and tamped to provide adequate side support for all pipe and fittings, and reaction backing shall have been in place at least five (5) days. At joints, trenches shall be sufficiently open for joint inspection.

H. All piping systems shall be thoroughly flushed by providing a velocity of two and one-half (2-1/2) feet per second in the line being flushed.

I. Do not test against closed valves at pressures higher than the allowable seating pressures for individual valves. Contractor may test open valves at pressures up to that specified for the valve bodies. In sections of the line where the test pressures are greater than the allowable seating pressures for the valves, the Contractor shall provide temporary plugs to test against.

J. The leaking tests which may be performed at the same time as the pressure tests shall be sustained for not less than two (2) hours. The leakage shall be defined as the quantity of water that must be supplied into the newly laid pipe or any valved section thereof to maintain the specified leakage test pressure after the air in the pipe line has been expelled and the pipe has been filled with water.

K. No pipe line installation will be accepted if the leakage is greater than that determined by the following formula:

$$L = \frac{NPD^{0.5}}{7400}$$

L = allowable leakage in gallons per hour
N = number of joints in length of pipe line tested
D = nominal diameter of pipe in inches
P = average test pressure during leakage test in pounds per square inch

3.3 TEST PRESSURES FOR OTHER PRESSURE PIPING SYSTEMS

A. Either hydraulic or air tests may be used for piping systems listed below:

Non Pumped Process Piping (Under Tanks)	25 psi
	Non Pumped Process Piping (Buried/Exposed)
	2 times maximum static head
Drain Piping	5 psi

B. Tests shall be considered acceptable when pressures are maintained for two (2) hours without pressure drop or within other limits set for specific test procedures.

C. Tests for under-tank piping shall be conducted before concrete encasement is placed. Exposed piping systems shall be tested prior to being painted or insulated.

3.4 TESTING GRAVITY FLOW PIPING

A. General

1. The following procedures apply only to the storm drainage and plant drain systems.

2. Field testing of gravity flow pipes, including manholes, for joint integrity and water tightness shall be conducted by either an infiltration test or an exfiltration test. The Contractor shall furnish all plugs, pumps, piping, gauges, timers, instruments, required test apparatus, and all labor required for installing the testing equipment, conducting the test, and removing the testing apparatus after the tests have been completed. All testing shall be done in the presence of the Engineer.

3. The Engineer will determine the type of test required for each section after the ground water table has been measured by the Contractor. The following general criteria will govern the type of test to be conducted.

   a. Wherever the ground water table is measured to be not less than one (1) foot above the top of the pipe throughout the full length in the section being tested, an infiltration test shall be used.

   b. Wherever the ground water table is measured to be less than one (1) foot above the top of the pipe at the highest point in the section being tested, an exfiltration test shall be used.

B. Infiltration/Exfiltration

1. Maximum allowable leakage permitted under this Specification is 100 gpd/inch/mile for sanitary lines and 200 gpd/inch of pipe diameter/mile of pipe for storm water systems. The permissible leakage rate is established for either the infiltration or exfiltration test.

2. Equivalent leakage rates for various pipe diameters for one hundred (100) foot segments are:

Pipe Diameter		Permissible Leakage/100' at 100 gallons
gpm	gph	
8"	.010	0.62
10"	.013	0.79
12"	.016	0.95
15"	.020	1.18
18"	.024	1.42
24"	.032	1.90
30"	.040	2.40
36"	.048	2.88
42"	.055	3.31

3. Testing, whether for infiltration or exfiltration, is to be performed by standard methods and are to be approved by the Engineer prior to conducting the tests.

C. Testing Gravity Flow Lines by Visual Inspection: All gravity flow sewers eighteen (18) inches diameter and smaller shall be subject to testing by visual inspection for alignment and grade. A section of pipe between two manholes will have passed the test when a light held in a manhole will show a full circle when viewed from an adjoining manhole through the carrier pipe. Visual inspection is in addition to I/E tests.

D. Failures: If, for any reason, a section of pipe fails either of the tests previously outlined or any substitute test procedure approved by the Engineer, the Contractor shall locate the defective materials and/or installation and make any necessary repairs. After the corrective actions have been taken, the section of pipe shall be retested subject to the same provisions or requirements outlined above.

3.5 RELATIONSHIP OF SEWERS TO WATER MAINS

A. Sewer Parallel to Water Main: Sewers shall be located, during design, at least ten (10) feet horizontally from any existing or proposed water main. If, for absolutely essential reasons, it is not possible to achieve such separation, the sewer may be located not less than three (3) feet from a water main - horizontally,

provided there is at least eighteen (18) inches vertical separation between the bottom of the water main and the top of the sewer, with the sewer below the water main.

B. Vertical Separation: Whenever sewers must cross under water mains, the sewer shall be laid at such an elevation that the top of the sewer is at least eighteen (18) inches below the bottom of the water main. When the elevation of the sewer cannot be buried to meet the above requirement, the water main shall be relocated to provide this separation or reconstructed with slip-on or mechanical-joint ferrous pipe for a distance of ten (10) feet on each side of the sewer. One full length of water main should be centered over the sewer so that both joints will be as far from the sewer as possible.

C. Special Conditions: When it is impossible to obtain proper horizontal and vertical separation as stipulated above, the water main should be constructed of slip-on or mechanical-joint ferrous pipe and the sewer constructed of mechanical-joint ferrous pipe, pressure rated to at least 150 psi and both services should be pressure tested to assure watertightness.

3.6 DISINFECTION OF NEW POTABLE WATER SYSTEMS

A. Before being placed into service and before certification of completion by the Engineer, all new water systems, or extensions to existing systems or valved section of such extensions, or any replacement in the existing water system, or any exposed section of the existing system shall be disinfected according to the requirements of the ADEQ and AWWA as applicable.

".1001 DISINFECTION OF NEW SYSTEMS

(a) All interior surfaces of new potable water supply systems, including wells, filters, storage tanks and distribution lines shall be thoroughly disinfected by means of hypochlorite or chlorine solutions, after which bacteriological test samples shall be collected.

(b) After disinfection the water supply shall not be placed into service until bacteriological test results of representative water samples analyzed in an approved laboratory are found to be satisfactory."

".1003 DISINFECTION OF STORAGE TANKS AND DISTRIBUTION SYSTEMS

(a) Water distribution systems, including storage tanks and water mains, after flushing to remove sediment and other foreign matter, and after testing for leaks, shall be disinfected by the addition and thorough dispersion of a chlorine solution in concentrations sufficient to produce a chlorine residual of

at least 50 milligrams per liter (or ppm) in the water throughout the distribution system, including all water mains and storage tanks.

(b) The chlorine solution shall remain in contact with interior surfaces of the water system for a period of 24 hours. Then the water system shall be flushed with fresh water from an approved water source until the chlorine solution is dispelled.

(c) Representative samples of the water shall then be collected. If bacteriological tests of the samples indicate that the water quality is satisfactory, the water mains and storage tanks may be placed in service.

(d) In unusual situation s where large volume tanks are involved and where there is not sufficient water available to fill the tank or there is not available a suitable drainage area for the chlorinated water, or alternate disinfection procedure for tanks ma be proposed. Such proposal must be submitted in writing completely describing the proposed disinfection procedure and substantiating the need for an alternate procedure in the particular circumstances. Such alternate procedure must be approved before being implemented. The conclusion of the department shall be final.

B. The Contractor shall be required to make arrangements for having tests conducted. All expenses incurred in making tests shall be borne by the Contractor and should be included in his bid.

C. All chlorinated water used for disinfecting the potable water lines shall be dechlorinated per AWWA C652 (latest edition, Appendix B, prior to disposal to surface water. All expenses incurred for dechlorination shall be borne by the Contractor and shall be included in his bid.

END OF SECTION 15001

TECHNICAL SPECIFICATIONS

SECTION M1 – DESCRIPTION

M1.1 GENERAL:

This section of the specifications shall govern for all materials used in the construction of sanitary sewerage facilities. Projects that would necessarily involve materials other than those included in this specification shall be subject to the approval of the Engineer. Complete specifications covering all materials not included herein shall be submitted for approval.

TECHNICAL SPECIFICATIONS

SECTION M2 – SEWER / FORCE MAIN

PIPE & FITTINGS

M2.1. DESCRIPTION: The different kinds and strengths of sewer pipe outlined in this section shall be used in the construction of sanitary sewer lines unless otherwise specified in Section C - Construction Methods. For the appropriate sizes specified below, all pipe materials shown in this section shall be considered suitable for use at any location unless a specific material is specified on the drawings or in the Proposal. Only pipe materials listed in this section shall be used for sewer mains. Unless otherwise shown or specified, all pipe of the same diameter shall be of the same material.

M2.2. SDR 21 PVC HEAVY WALL PRESSURE PIPE (SEWER FORCE MAIN) (4" – 36"): All pipe shall be circular. The pipe shall be of the size and kinds shown on the plans or as required.

Pipe shall be heavy wall polyvinyl chloride (PVC) pipe with intergrall wall bell and spigot joints. Joints shall be gasketed unrestrained joints unless specified otherwise. Pipe shall conform to ASTM D2241 for pressure class 200 pipe. Pipe shall be minimum DR-21 rating.

M2.3. DUCTILE IRON PIPE (4" – 36"): All pipe shall be circular. The pipe shall be of the sizes and kinds shown on the plans or as required.

Pipe shall conform to ANSI 21.51 (AWWA C151) and shall have a cement mortar lining and seal coat conforming to ANSI 21.4 (AWWA C104). The minimum thickness class shall be Class 50 unless otherwise specified.

M2.4. SDR 26 PVC HEAVY WALL NON-PRESSURE-TYPE SEWER PIPE (4" - 24"):

A. Scope: This specification designates general requirements for SDR 26 heavy wall polyvinyl chloride (PVC) non-pressure type pipe with integral wall bell and spigot joints. This pipe may be used at depths up to 25 feet. Pipe shall conform to ASTM D2241.

B. Materials: All pipes must meet requirements as set forth in PS 22-70, with standard dimension ratio SDR 26, and bearing the National Sanitation Foundation seal for potable water pipe. Provisions must be made for contraction and expansion at each joint with a rubber ring, and integral thickened bell as part of each joint. Pipe and fitting must be assembled with a non-toxic lubricant.

Pipe shall be made from clean, virgin, NSF approved Class 12454-A PVC Compound conforming to ASTM resin specification D 1784. Clean reworked material generated from the manufacturer's own pipe production may be used.

C. Testing Requirements: All Physical and Chemical Tests should be conducted at 73 deg. F.

The pipe shall be designed to pass without failure a pressure of 640 psi applied to 60 to 70 seconds when tested in accordance with PS 22-70 as referenced in ASTM D 1599.

The pipe shall be designed to pass without failure for 1,000 hours a pressure of 400 psi when tested in accordance with PS 22-70 as referenced to ASTM D 1598.

After two hours immersion in a sealed container of anhydrous (99.5% pure) acetone a 1" long sample ring shall show no visible spalling or cracking. (Swelling or softening is not a failure.) In accordance with PS 22-70, as referenced to ASTM D 2152.

Place between 2 flat parallel plates a 2" long ring and compress in less than one minute to 100% flattening. There shall be no evidence of splitting or shattering.

A single impact load from a freely falling missile having a 1/2" diameter rounded 1" long nose shall be imparted on a 6" long horizontally placed specimen sample. No shattering or splitting (denting is not a failure) shall be evident when the following energy is imposed:

Nominal size	1½"	2"	2½"	3"	4"	5"	6"	8"
Ft.-lbs.	24	34	43	57	86	100	100	100

M2.5. PIPE JOINTS:

A. All PVC Pipe: Provision shall be made for expansion and contraction at each joint with a rubber ring and integral thickened

bell as a part of each joint. Pipe and fittings must be assembled with a nontoxic lubricant.

B. Cast Iron Pipe: All joints shall be slip-type or mechanical and shall conform to the requirements of ANSI Specification A 21.11 unless otherwise specified on the Plans.

C. Ductile Iron Pipe: All joints shall meet with the requirements for cast iron pipe, Paragraph M2.6 (B), ANSI-A 21.11 (AWWA C111).

M2.6. PIPE FITTINGS:

A. Standard Fittings: All bends, tees, plugs, adaptors, wyes, or other fittings shall meet with the requirements of the type and kind of pipe used and all joints shall meet with the requirements for the joints listed above.

B. Special Fittings: All special fittings shall be in accordance with the pipe manufacturer's recommendations and as approved. Connections between different kinds of pipe and for future connections shall be made with an adaptor designed for this purpose and detailed and submitted to the Engineer for approval.

M2.7. SEWER LOCATE TAPE: Sewer locate tape shall be placed 12" above the center of all sewer mains.

TECHNICAL SPECIFICATIONS

SECTION M3 - CONCRETE AND REINFORCING STEEL

M3.1 DESCRIPTION: This section covers materials for concrete and reinforcing steel used in sanitary sewer line construction.

M3.2 CEMENT:

A. Cement shall be Portland Cement conforming to AASHTO Designation M 85, Type I. Type III cement, high early strength, may be used if approved by the Engineer.

B. When concrete is mixed on the job site, cement shall be delivered in plainly marked paper sacks of not less than 94 pounds net weight.

M3.3 WATER: Water used in mixing concrete and mortar shall be free from injurious amounts of acids, alkalies, oils, sewage, and vegetable matter. It shall be fit for drinking.

M3.4 COMPOSITION AND STRENGTH:

A. Concrete shall be composed of Portland Cement, fine and course aggregate, and water proportioned in keeping with the following:

	Class "A" Concrete	Class "B" Concrete
Minimum Sacks of Cement - Per Cubic Yd.	5½	4½
Consistency Range in Slump - In.	2 - 4	2 - 4

B. Proportioning of concrete shall be by weight except that water may be measured by volume.

(1) A 1 cubic foot sack of Portland Cement will be considered as 94 pounds in weight.

(2) A gallon of water will be considered as weighing 8.33 pounds.

C. Class "A" concrete made with ordinary Portland Cement shall have a minimum compressive strength at 28 days of 3,000 psi. If made with high early strength cement, those strengths shall be attained at the age of 7 days.

M3.5 USE:

A. Class "A" concrete shall be used on all manholes and other structures and for Class "A" pipe bedding.

B. Class "B" concrete may be used for all concrete work except as specified in Paragraph M3.5.A and as shown on the standard details.

M3.6 REINFORCING STEEL:

A. Shop Drawings for all reinforcing shall be submitted in accordance with contract documents. Material shall not be fabricated or delivered to job site prior to return of approved shop drawings to Contractor. Shop drawings shall be sufficient in detail and dimensions that reinforcing steel and accessories may be placed without reference to drawings.

B. Reinforcing bars, including column ties and beam and joist stirrups shall conform to requirements of ASTM A615, Grade 40. The supplier shall provide 3 copies of certification as to type and grade at time of delivery.

C. Welded wire fabric shall conform to ASTM A185.

D. Galvanized Reinforcing Bars: Where specified or indicated on drawings, reinforcing shall be hot-dip galvanized after fabrication and bending in accordance with ASTM A153.

E. Smooth Dowel Bars for Wall and Floor Construction Joints shall be fabricated of round plain carbon steel bars complying with ASTM A306, Grade 40. Where indicated on drawings, a metal dowel cap shall be placed at one end of dowel to permit longitudinal movement of dowel within concrete section. The magnitude of movement shall equal joint width plus ½-inch.

M3.7 EXPANSION AND CONTRACTION JOINTS:

A. Asphalt mastic strips (preformed) shall be composed of approximately 75% asphalt, 15% fiber, and 10% mineral matter.

B. Mastic for poured joints shall be composed of refined asphaltic pyrobitumen and natural asphalt bitumens and show no tendency to separate.

C. Waterstops shall consist of a durable, elastic cured rubber compound, PVC, or vinyl capable of effectively sealing joints against the infiltration of moisture.

TECHNICAL SPECIFICATIONS

SECTION M4 - CONCRETE AND REINFORCING STEEL

M4.1. DESCRIPTION: This section covers materials for concrete and reinforcing steel used in sanitary sewer line construction.

M4.2. CEMENT:

A. Cement shall be Portland Cement conforming to AASHO Designation M 85, Type I. Type III cement, high early strength, may be used if approved by the Engineer.

B. When concrete is mixed on the job site, cement shall be delivered in plainly marked paper sacks of not less than 94 pounds net weight.

M4.3. WATER: Water used in mixing concrete and mortar shall be free from injurious amounts of acids, alkalies, oils, sewage, and vegetable matter. It shall be fit for drinking.

M4.4. COMPOSITION AND STRENGTH:

A. Concrete shall be composed of Portland Cement, fine and course aggregate, and water proportioned in keeping with the following:

	Class "A" Concrete	Class "B" Concrete
Minimum Sacks of Cement - Per Cubic Yd.	5½	4½
Consistency Range in Slump - In.	2 - 4	2 - 4

B. Proportioning of concrete shall be by weight except that water may be measured by volume.

(1) A 1 cubic foot sack of Portland Cement will be considered as 94 pounds in weight.

(2) A gallon of water will be considered as weighing 8.33 pounds.

C. Class "A" concrete made with ordinary Portland Cement shall have a minimum compressive strength at 28 days of 3,000 psi. If made with high early strength cement, those strengths shall be attained at the age of 7 days.

D. Admixtures: A cement reducing admixture conforming to ASTM C-618 will be used for all concrete at the Contractor's option. Concrete mix designs shall include the admixture, should this option be exercised.

Admixture shall be a cement dispersing agent used in conformance with manufacturer's directions. The dispersing agent used shall be subject to the approval of the Engineer. Contractor shall notify Engineer in writing that he is taking this option.

A retarding admixture, conforming to ASTM C-494, pretested with job materials under job conditions, shall be used, if approved, whenever necessary to prevent cold joints due to the quantity of concrete placed, to permit revibration of the concrete, to offset the effects of high concrete temperature, or to reduce the maximum temperature and rate of temperature rise.

M4.5. USE:

A. Class "A" concrete shall be used on all manholes and other structures and for Class "A" pipe bedding.

B. Class "B" concrete may be used for all concrete work except as specified in Paragraph M4.5.A and as shown on the standard details.

M4.6. REINFORCING STEEL:

A. Shop Drawings for all reinforcing shall be submitted in accordance with contract documents. Material shall not be fabricated or delivered to job site prior to return of approved shop drawings to Contractor. Shop drawings shall be sufficient in detail and dimensions that reinforcing steel and accessories may be placed without reference to drawings.

B. Reinforcing bars, including column ties and beam and joist stirrups shall conform to requirements of ASTM A615, Grade 40. The supplier shall provide 3 copies of certification as to type and grade at time of delivery.

C. Welded wire fabric shall conform to ASTM A185.

D. Galvanized Reinforcing Bars: Where specified or indicated on drawings, reinforcing shall be hot-dip galvanized after fabrication and bending in accordance with ASTM A153.

E. Smooth Dowel Bars for Wall and Floor Construction Joints shall be fabricated of round plain carbon steel bars complying with ASTM A663, Grade 40. Where indicated on drawings, a metal dowel cap shall be placed at one end of dowel to permit longitudinal movement of dowel within concrete section. The magnitude of movement shall equal joint width plus ½ inch.

M4.7. EXPANSION AND CONTRACTION JOINTS:

A. Asphalt mastic strips (preformed) shall be composed of approximately 75% asphalt, 15% fiber, and 10% mineral matter.

B. Mastic for poured joints shall be composed of refined asphaltic pyrobitumen and natural asphalt bitumens and show no tendency to separate.

C. Waterstops shall consist of a durable, elastic cured rubber compound, PVC, or vinyl capable of effectively sealing joints against the infiltration of moisture.

TECHNICAL SPECIFICATIONS

SECTION M5 – WATER MAIN

PIPE & FITTINGS

M5.1 WATER MAINS:

A. AWWA C-900 PVC Pipe: (6" - 12") The pipe shall be DR 18 (minimum) Class 150 psi (minimum), cast iron pipe o.d. base that meets all the requirements of AWWA C-900, ASTM D1784, ASTM D2241, and ANSI/NSF standard 61. All pipe shall be suitable for use as a pressure conduit at a maximum hydrostatic working pressure of 150 psi at 73 deg. F. Provisions must be made for expansion and contraction at each joint with an elastomeric ring and integral thickened bell as part of each joint. The dimensions of the gasket joint shall meet the requirements provided in ASTM D 3139 when measured in accordance with ASTM D2122.

All pipe shall bear the National Sanitation Foundation seal for potable water pipe.

The manufacturer shall furnish an affidavit that all delivered materials comply with requirements of the above specifications.

6" - 12" - DR 18, Class 150 PSI

B. AWWA Class 200 PVC Pipe: (1" – 8") The pipe shall be SDR 21 (minimum) Class 200 psi, cast iron pipe o.d. base that meets all the requirements of AWWA Class 200, ASTM D1784, and ASTM D2241. All pipe shall be suitable for use as a pressure conduit at a maximum hydrostatic working pressure of 200 psi at 73 deg. F. Provisions must be made for expansion and contraction at each joint with an elastrometric ring and integral thickened bell as part of each joint. The dimensions of the gasket joint shall meet the requirements provided in ASTM D3139 when measured in accordance with ASTM D2122.

All pipe shall bear the National Sanitation Foundation seal for potable water pipe.

The manufacturer shall furnish an affidavit that all delivered materials comply with requirements of the above specifications:

1" – 8" – SDR 21, Class 200 psi

C. Ductile Iron Pipe: (4" - 12") The pipe shall conform to ANSI A21.51 (AWWA C 151) and ANSI A21.50 (AWWA C150). The minimum tensile strength shall be 42,000 psi, and the modulus of rupture 60,000 psi. The pipe shall have a cement mortar lining and seal coat conforming to ANSI A21.4 (AWWA C 104). Joints shall conform to ANSI A21.11 (AWWA C 111) and may be mechanical joint or push-on joint unless otherwise specified.

The minimum thickness class shall be as follows or as specified:

4" - 12" - Metal Thickness Class 50.

The pipe shall be wrapped in polyethylene and taped in accordance with AWWA C105. Polyethylene material shall conform to ANSI/ASTM D1248. Min. Nominal Thickness = 9 mils.

C. Steel Pipe and Fittings:

D. Gray and Ductile Iron Fittings: Fittings shall be designed for working pressures of 350 psi in accordance with ANSI A21.10 (AWWA C153). Joints may be mechanical joint, push-on joint, or standard bell and spigot joint as specified. Mechanical joint fittings shall conform to ANSI A32.22 (AWWA C111) and shall be furnished with cast iron or ductile iron glands, bolts and nuts, and plain rubber gaskets. Fittings shall contain no more than 8.0% lead. The body thickness and radii of curvature of push-on joint fittings shall conform to ANSI A32.22 (AWWA C111). Standard bell and spigot fittings shall be Class D or equal. All fittings except sleeves and plugs shall have a cement mortar lining in accordance with ANSI A 32.4 (AWWA C104). Joint shall conform to ANSI A32.22 (AWWA C111) and may be mechanical joint or push-on joint unless otherwise specified. The minimum thickness class shall be Class 50 unless otherwise specified.

E. Mechanical Joint Restrainer Glands: Mechanical joint restrainer glands shall be made from cast iron or ductile iron and shall be designed for a working pressure of at least 200 psi, Megalug Series 1100 for Ductile Iron Pipe and Megalug Series 2000PV for PVC Pipe or approved equal. The set screws shall be extended through the outer most part of the gland. Glands shall be designed to fit standard mechanical joint fittings (AWWA C111). The minimum number and minimum size set screws shall be as follows:

Size Gland	Size Set Screws	No. Set Screws
4"	½"	4
6"	⅝"	6
8"	⅝"	9
10"	⅝"	16
12"	⅝"	16
16"	⅝"	24
20"	⅝"	28
24"	⅝"	32

F. JOINTS:

A. Plain End: Plain ends for use with mechanical couplings shall be square cut and the inside and outside edge burrs shall be removed. The pipe shall be sufficiently free from indentations, projections, or roll marks at each end to make a tight joint.

B. Rubber "O" Ring: Rubber "O" ring joints shall conform to AWWA C208 for bell and spigot ends with rubber gasket. The rubber "O" ring gasket materials shall comply with the requirements of AWWA C300.

G. GATE VALVES:

A. General: Gate valves, two (2) inches through twenty-four (24) inches shall be designed for a working pressure of 200 psi. Valves shall conform to AWWA C500 with iron bonnet (bronze mounted), nonrising stem double-disc (parallel seat type), o-ring stem seals and 2" x 2" square operating nut. Valves shall open when the operating nut is turned to the left (counterclockwise). Valve ends shall be mechanical joint complete with accessories or as specified. Tapping valves shall conform to above specifications except that the connections shall be ANSI B16.1, Class 125 flange on one side (inlet) and mechanical joint on the other (outlet) or as specified. Tapping Sleeves are to be Grade 304 Stainless Steel.

All gate valves shall be model A-2360-20 as manufactured by the Mueller Company or approved equal.

B. Valve Boxes: Valve boxes shall be the H-10346, 562-A, two-piece, screw type, 5½" shaft, 24-36" extension, with drop cover marked water as manufactured by the Mueller Co. or equal. Valve boxes shall be set vertical and concentric with the valve stem. Any valve box which is so

moved from its original position as to prevent the application of the valve key shall be satisfactorily reset by the contractor at his own expense. A concrete pad of the dimensions shown on the details of the plans shall be poured around all valve boxes.

C. Installation of Valves: Valves shall be jointed in accordance with the methods of jointing pipe as specified elsewhere herein. Valve stems shall be plumb and there shall not be any obstructions which will prohibit the installation of valve boxes directly over the stem.

Concrete anchor collars shall be provided around an adjoining length of pipe for all valves 16-inches in diameter or larger and for smaller valves when specified on the Plans. Mechanical joint retainer glands shall be installed on all valves with mechanical joint ends 12-inches in diameter or larger when cast iron or ductile iron pipe is specified and for smaller valves when specified on the Plans. All valves shall be cradled in concrete with an adequate bearing area to prevent differential settlement between the valve and pipe.

When the distance between the valve operating nut and the finished surface exceeds five (5) feet, a valve stem extension shall be provided. The stem shall be round steel bar stock at least 7/8 inch in diameter with a 2-inch square operating nut attached to the upper end and of length adequate to reach from the valve operating nut to a point within 18-inches to 12-inches of the finished surface. A box wrench made from steel ¼ inch shall be welded to the lower end of the stem extension which will fit over the valve operating nut. the stem extension shall be attached to the valve operating nut by a ¼ inch bolt which shall pass through the stem extension box and the valve operating nut. The hole for the ¼ inch nut shall be ⅜ inch in diameter. A round center guide made from 3/16 inch or ¼ inch steel plate shall be welded to the valve stem extension approximately 6 inches from the upper end. the diameter of the guide shall be slightly smaller in diameter than the inside diameter of the valve box. shop drawings shall be submitted to the Engineer for approval prior to installing stem extension pieces.

H. AIR RELEASE VALVE:

A. General: The air release valve shall have a combination of large and small orifice units for allowing air to enter or exit the transmission main. The valve shall have a cast iron body and the only moving part shall be a stainless steel ball. The valve shall be capable of fully automatic operation within the full range of pipeline operating conditions and shall not blow shut or collapse the ball during operation. The large orifice seat shall be replaceable.

Normal operating pressure shall be less than 150 psi. All valves shall have flanged inlets and outlets. The valve flange shall be 125 pound and conform to ANSI 16.1 for 150 psi working pressure.

The valve shall be in every way similar to a APCO Model 50C manufactured by APCO Valve Corp., Schaumburg, IL, or approved equal.

B. Connection: Each valve installation shall include a flanged butterfly valve installed below the air release valve between the release valve and the pipeline. The butterfly valve shall be a Pratt Model 2FII, or approved equal.

The butterfly valve shall have a handle operator, mechanical stops and position indicator.

All piping shall be ductile iron, Class 50.

C. Location: The valves shall be installed at locations shown on the plans or as directed by the Engineer.

I. BLOW-OFF VALVE INSTALLATION: Blow-off valves shall be installed at the locations shown on the plans. The unit price shall consist of furnishing and installing all required materials including gate valves, cast iron piping and fittings, and concrete required for blocking and performing all operations necessary for the installation of a blow-off valve in accordance with the details shown on the plans.

J. FREEZEPROOF YARD HYRANT: Yard Hydrants shall be Woodford Model Y34 (3/4" NPT) or approved equal and shall be installed at the locations shown on the plans. The unit price shall consist of furnishing and installing all required materials including fittings, risers, valves, gravel packing, and reinforcing pipes to install and fully secure the hydrant for use.

The Hydrant shall be labeled with a permanent sign as non-potable water use.

TECHNICAL SPECIFICATIONS

SECTION 1A - SITE WORK

1.1. DESCRIPTION: The work to be performed under this section shall consist of furnishing all labor, equipment, and materials, and in performing all operations necessary in connection with site clearing and restoration as shown in the plans and specifications herein.

It shall be the responsibility of each bidder to examine the site carefully and make his own calculations as to costs to be incurred by reason of the requirements of this section.

The construction right-of-way for water and sewer main construction will be provided by the Owner.

Site clearing and restoration shall include all of the following:

A. The cutting and removal of all trees, shrubs, underbrush, and the removal of any debris existing above natural ground surface and within the limits of right-of-way necessary to permit the construction of the improvements. Trees, shrubs, underbrush, and debris removed from the site shall be disposed of by the Contractor.

B. The removal, storage and reconstruction of fences where necessary to permit the construction of the improvements. As quickly as feasible after the work has been performed, fences shall be reconstructed to conditions at least as good as the original. The Contractor shall furnish new materials as necessary to permit proper restoration.

C. The repair of yards and lawns that are within the construction right-of-way. Disturbed lawns in the right-of-way shall be graded smoothly with topsoil to their original grade, and grass will be replaced. Likewise, shrubbery, trees, and other plants which must be removed by construction activities within the right-of-way will be replaced. The Contractor should, however, make every reasonable effort to avoid the unnecessary removal of trees, shrubbery and other plants in inhabited areas.

D. The reconstruction of dirt and gravel roads or drives. The alignment and grade shall be restored, as close as possible, to that existing prior to construction. Roads or drives that had a gravel

surface shall be replaced using native iron ore base course to a minimum compacted thickness of four inches.

E. The removal and subsequent replacement of sidewalks, curbs, patios, retaining walls, wooden decks, or other man-made structures which are displaced by the Contractor's operations. The Contractor shall furnish new materials necessary to permit replacement to a condition better than or equal to that existing prior to construction.

F. Where trees, plants, shrubbery, etc. are outside of the construction right-of-way and are not to be removed or removed and replaced, the Contractor shall protect such trees, plants, shrubbery, etc. by substantial wooden boxes and guards and shall not permit machinery or employees to scrape, tear the limbs from, or damage, or attach guy cables to them, and if, in the opinion of the Engineer, such trees, plants, shrubbery, etc. would be damaged by machinery, etc., hand excavation may be required. The Contractor shall be responsible for all damages to adjacent trees, plants, shrubbery, etc. outside of the construction right-of-way.

H. Where construction will occur within city or state owned right-of-ways, sitework shall conform to the governing authority. Refer to applicable ROW permits as necessary. The Contractor shall be responsible for notification of the City at least 48 hours prior to construction.

1.2. MEASUREMENT AND PAYMENT: Site work shall not be measured for separate payment but shall be considered subsidiary to the item of the contract to which the work applies.

TECHNICAL SPECIFICATIONS

SECTION 1B - EXCAVATION AND BACKFILL

2.1. DESCRIPTION: This section covers the excavation and backfill of sanitary sewer lines, manholes, or other structures.

2.2. EXCAVATION:

A. General Requirements: Excavation work shall be preformed in a safe and proper manner with suitable precautions being taken against all hazards. Excavations shall provide adequate working space and clearance for the work to be performed therein and for installation and removal of concrete forms when required.

Subgrade surfaces shall be clean and free of loose material of any kind when concrete is placed thereon. Backfilling and construction of fills and embankments during inclement weather shall not be done except by written permission of the Engineer. All open ditches shall be backfilled prior to the end of each working day in order to protect the pipe and to prevent a safety hazard.

B. Classification of Excavated Materials: No classification of excavation materials will be made. Excavation and trenching work shall include the removal and subsequent handling of all materials, excavated or otherwise removed in performance of the contract work regardless of the type, character, composition, or condition thereof.

C. Blasting: Blasting shall not be permitted on this project.

D. Limiting Trench Widths: Trenches shall be excavated to a width which will provide adequate working space and pipe clearances for proper pipe installation, jointing, and embedment. However, the limiting trench widths below an elevation 12-inches above the top of the installed pipe and each trench wall, expressed in inches, shall be as shown on the drawings.

Stipulated minimum clearances are not minimum average clearances, but are minimum clear distances which will be required.

Where necessary to prevent sliding and caving, banks may be cut back on slopes which shall not extend lower than one foot above the top of the pipe. Where for any reason, the width of the lower

portion of the trench as excavated at any point exceeds the maximum permitted in the foregoing tables, either pipe of adequate strength, special pipe embedment, or arch concrete encasement, as required by leading conditions and as determined by the Engineer, shall be furnished and installed by and at the expense of the Contractor.

E. Removal of Water: The Contractor shall provide and maintain adequate dewatering equipment to remove and dispose of all ground water entering excavations, trenches, or other parts of the work. Each excavation shall be kept dry during subgrade preparation and continuously thereafter until the structure is built or the pipe to be installed therein is completed to the extent that no damage from hydrostatic pressure, flotation, or to other cause will result.

F. Whenever so ordered by the Engineer, in writing, the Contractor shall excavate to such depth below grade as the Engineer may direct and the trench bottom shall be brought to grade with such material as the Engineer may order installed. All timber, concrete foundations, pipes, posts, stringers, stone, and/or gravel made necessary by unstable soil, shall be installed as directed by the Engineer. Compensation for extra excavation, timber, concrete, or other foundations, except where provided by contract unit prices, shall be made in accordance with the contract provisions for extra work.

G. Unstable Trench Walls: Where an unstable or running soil condition is encountered in the trench wall, such as may be found by excavation below ground water, stabilize this condition before laying the pipe. Depending upon the severity of the condition, tight sheeting, stay bracing, or a trench box may be used to control such trench conditions during the course of pipelaying operations. If the condition is too severe, it may be necessary to leave the sheeting in place to prevent lateral migration of both the material used beneath and around the pipe and trench wall material. Well points or under-drain may also be used to control excessive ground water conditions.

H. Over-Excavation: During the course of construction, should the trench be inadvertently over-excavated below a point greater than 6-inches below the bottom of the pipe, but not beyond a point 12-inches below the bottom of the pipe, fill that area of over-excavation with an acceptable class of embedment material and compact to a minimum of 90 percent Standard Proctor Density, regardless of soil type. Fill any area of over-excavation beyond a point 12-inches

below the bottom of the pipe with processed stone or processed gravel. Any such over-excavation shall be replaced by, and at the expense of the Contractor.

I. Disposal of Excavated Materials: Excavated material shall be piled adjacent to the work to be used for backfilling as required. Excavated material which is unsuitable for backfilling and excess material shall be disposed of in a manner approved by the Engineer.

J. Excavation Below Pipe Subgrade: Except as otherwise required, pipe trenches shall be excavated approximately 6-inches below the finished pipe subgrade to allow for the installation of pipe bedding materials.

2.3. PIPE EMBEDMENT FOR PVC PIPE: Pipe embedment shall consist of bedding, haunching, and initial backfill materials as shown on the standard detail sheets of the plans. The class of material to be used below and above the pipe and placement and compaction of embedment material shall conform to the requirements shown on the plans and to the following specifications:

A. Embedment Materials: The following are descriptions of the classifications of embedment materials which may be used for pipe embedment as shown on the standard detail sheets of the plans:

Class I: Angular, (3/4 to 1½) graded stone, including a number of fill materials that have regional significance such as coral, slag, cinders, crushed stone, and crushed shells.

Class II: Suitable native material including fine sands, sandy clay mixture, and gravel/clay mixtures. This also includes excavated trench material if suitable.

B. Bedding Placement and Composition: Prior to pipe installation, carefully bring the bedding material to grade along the entire length of pipe to be installed. To ensure that adequate and uniform support is provided under the pipe and to avoid differential settlement of the pipe, certain procedures should be adhered to and precautions taken as outlined herein. Blocking shall not be used to bring the pipe to grade.

(1) Class I Material: When Class I material is used for bedding, little or no compaction is necessary due to the nature of the angular particles. A depth of 6-inches of Class I material is sufficient to provide uniform bedding. However, in the initial

stage of placing this type of material, take care to ensure that sufficient Class I material has been worked under the haunch of the pipe to provide adequate side support. Take precautions to prevent movement of the pipe during placing of the material under the pipe haunch. Except for the protection of the pipe from large particles of backfill material, little care need be taken and no compaction is necessary in placing initial backfill to a distance of 6-inches above the top of the pipe.

2.4. TRENCH BACKFILL: Backfilling from a point 6" above the pipe to the top of the trench shall be done with good earth and shall be free of large rocks. No material of a perishable, spongy or otherwise unsuitable nature shall be used in backfilling.

Where trenches are not under existing or proposed paved areas, backfill need not be mechanically tamped. Before reaching the top of the trench, the trench shall be flooded with water to achieve some degree of consolidation. Consolidation with heavy equipment shall not be allowed.

Where trenches are under existing or proposed paved areas, the entire trench up to a point 6" below existing or proposed subgrade shall be backfilled with select materials and compacted to a density of 90% AASHO T-180 modified or better. The remaining 6" shall be similarly backfilled, but the minimum compaction shall be 95% AASHO T-180 modified.

The backfill of materials in trenches under existing or proposed paved areas shall be compacted with mechanical devices manufactured for that purpose from the top of the pipe to the top of the existing or proposed subgrade.

2.5. TESTING: In place moisture-density test may be ordered by the Engineer to insure that all trench backfill complies with the requirements of the specification. Tests will be performed by a recognized testing laboratory, and all costs will be paid for by the Owner. Copies of all test results will be furnished to the Contractor.

2.6. COMPACTION: All trench backfill in areas under paved or unpaved roads, parking areas, sidewalks and other structures, as determined by the Engineer shall be compacted to a density of at least 90% of the maximum dry density as determined by the AASHO Method T99 to a point 6 inches below the top of the backfill. The top 6 inches shall be compacted to a density of 95% of the maximum dry density as determined by AASHO Method T99. In all other locations, compaction of backfill from the bottom of the trench to a distance of one foot above the top of the

pipe. From a point one foot above the top of the pipe to the top of the trench, the backfill need not be mechanically tamped. Before reaching the top of the trench, the trench shall be flooded with water or rolled by passing the wheel or track of a piece of equipment along the trench line to achieve some degree of consolidation.

In place moisture-density test may be ordered by Engineer to ensure that all trench backfill complies with the requirements of the specification. Tests will be performed by a recognized testing laboratory, and all costs will be paid for by the Owner. Copies of all test results will be furnished to the Contractor.

2.7. SPECIAL PROBLEMS:

A. Bell Holes: When the pipe being installed is provided with elastomeric seal joints, bell holes shall be excavated in the bedding material to allow for unobstructed assembly of the joint. Care should be taken that the bell hole is no larger than necessary to accomplish proper joint assembly. When the joint has been made, the bell hole should be carefully filled with bedding or haunching material to provide for adequate support of the pipe throughout its entire length.

B. Minimum Cover for Load Application: Provide at least 36 inches of cover over the top of the pipe before the trench is wheel-loaded. Where pipelines are less than 36" deep, avoid the use of heavy equipment across these lines.

C. Use of Compaction Equipment: Take care to avoid contact between the pipe and compaction equipment. Compaction of haunching, initial backfill, and backfill material should generally be done in such a way so that compaction equipment is not used directly above the pipe until sufficient backfill has been placed to ensure that such compaction equipment will not have a damaging effect on the pipe.

D. Removal of Trench Protection: If sheeting or other trench protection is removed, take care so as not to disturb previously constructed foundation bedding, haunching, and initial backfill. If it has been necessary to place or drive sheeting or other trench protection below the top of the pipe, consideration should be given to leaving in place this portion of the sheeting or trench protection, since its removal could jeopardize the side support necessary for the pipe.

TECHNICAL SPECIFICATIONS

SECTION C3 - DEWATERING OF TRENCHES

C3.1. DESCRIPTION:

This section covers the dewatering of trenches to the extent that bedding material and sanitary sewer pipe can be placed on dry, firm trench bottom.

C3.2. WELLPOINTING:

Wellpointing where required to keep the excavation dry and the subgrade stable, shall be installed when the excavation is beneath the water table, except as hereinafter provided, and shall be in continuous operation until backfill is completed to this level. When construction equipment is to be operated in an area that has been excavated and wellpointing is required to keep trench excavation dry and the subgrade stable, the wellpointing shall be installed when the excavation is within two (2) feet of the water table. There shall be sufficient pumping equipment, in good working order, available at all times, to remove any water that accumulates in excavations to the extent that a stable subgrade is obtained. Where the pipe line crosses natural drainage channels, the work shall be conducted in such a manner that unnecessary damage or delays in the prosecution of the work shall be prevented. Provision shall be made for the satisfactory disposal of surface water pumped so as to prevent damage to public or private property.

C3.3. TRENCH DEWATERING:

Dewatering of trenches other than by wellpointing shall be accomplished by whatever means elected by the contractor; however, bedding material or pipe may not be placed in wet or unstable trenches. Soil that can not be properly dewatered shall be excavated and dry material tamped in place to such a depth as may be required to provide a firm trench bottom.

C3.4. SURFACE RUNOFF: Surface runoff water shall be diverted away from the trenches. Such diversion shall be into existing drainage structures, such as storm sewers, ditches or streams. Diversion of surface runoff shall be in such a manner to prevent flooding of streets or private property. Sitework and grading shall include work to maintain positive drainage during construction.

C3.5. DISPOSITION OF WATER FROM DEWATERING:

All water removed from the trenches by wellpointing or any other means shall be pumped, piped or drained into existing drainage structures, such as storm sewers, ditches or streams. The disposition of water from dewatering operations shall be accomplished in a manner that will prevent the flooding of public or private property.

C3.6. MEASUREMENT & PAYMENT:

Dewatering of trenches shall not be measured for separate payment but shall be considered subsidiary to the item of the contract to which the work applies.

TECHNICAL SPECIFICATIONS

SECTION 1C – TRENCH SAFETY SYSTEMS

4.1. DESCRIPTION:

This section covers excavation and supporting systems for trenches to protect the safety of workers, provide suitable means for constructing utility lines, and to protect public or private property, including existing utilities.

The Contractor's attention is directed to Bid Item "Trench Safety Systems" under which full compensation will be made for the design, materials, equipment, fabrication and labor required to furnish, install, and remove trench excavation, shoring, bracing and protective systems.

Trench safety shall fully comply with the Contractor's "Trench Safety System and Construction Plan".

4.2. EXISTING STRUCTURES:

Where existing buildings, other utilities, streets, highways, or other structures are in close proximity to the trench, adequate protection shall be provided by the use of sheeting and shoring to protect the structure, street, or highway from possible damage. In the case of utilities, the Contractor may elect to remove the utility provided that the removal and subsequent replacement meets with the approval of the Engineer, the utility owner, or whoever has jurisdiction of the structure. In all cases, it shall be the responsibility of the Contractor to protect public and private property and any person or persons who might, as a result of the Contractor's work, be injured.

4.3. EXCAVATIONS, TRENCHING, AND SHORING:

The Contractor shall include in his bid price and be solely responsible for trench safety provisions meeting the requirements of the United States Department of Labor Occupational Safety and Health Administration. The following regulations, as contained in Subpart P, Part 1926 of the Code of Federal Regulations, shall be complied with along with all other applicable Subparts and Regulations not herein contained:

TECHNICAL SPECIFICATIONS

SECTION C5 - PIPE LAYING

C5.1. DESCRIPTION:

This section covers the laying of pipe for sanitary sewers and force mains. All material shall be in accordance with PART M - MATERIALS of these specifications.

C5.2. GRAVITY SEWER and FORCE MAINS:

A. Each joint of pipe shall be inspected carefully before being placed in the trench. Any joint found to be cracked, or otherwise so damaged as to impair its usefulness, shall be plainly marked in such a manner that the marking will not rub or wash off. Damaged joints shall be removed from the site as soon as feasible.

B. All sewer pipe shall be laid with the bell up-stream. Each pipe shall be laid to plan line and grade, or to line and grade directed by the Engineer, using batter boards and top line, or laser beam grade light. Where batter board and top line is used, each pipe shall be plumbed for line with a plumb bob, and graded for elevation with a grade stick. Care shall be taken that each spigot is centered properly in the bell of the preceeding pipe and properly seated, and that each pipe is solidly bedded. As the work progresses, the pipes shall be cleaned of all dirt and other foreign matter. They shall be maintained clean until accepted or put in service.

C. At the end of each day's work, and when for any reason the laying of pipe will be discontinued for an appreciable period, the open ends of pipe line shall be closed temporarily.

D. The cutting of pipe for any reason shall be done in a neat and workmanlike manner without damage to pipe or pipe lining.

E. Pipe shall be lowered carefully into the trench in such manner that spigot and bell will not become contaminated. Spigot and bell shall be checked for cleanliness immediately before insertion of spigot into bell.

F. Proper facilities shall be provided for lowering sections of pipe into trenches. Under no circumstances shall pipe be laid in water and no pipe shall be laid when trench conditions or weather are unsuitable for

such work. Full responsibility for the diversion of drainage and for dewatering of trenches during construction shall be borne by the Contractor.

G. Spigot and bells shall be cleaned thoroughly before the application of lubricant and attachment of the preformed joint gasket. Application of lubricant and attachment of the gasket shall be in strict accord with the joint.

H. Pipe shall not be placed in the trench without excavating for bells so that the entire barrel of the pipe is uniformly supported on the pipe bedding.

I. Pipe shall be supported to proper line and grade, and secured against upheaval or floating during the placement of concrete bedding or encasement.

C5.3. STEEP GRADES:

A. Concrete Pipe Anchors: Where sanitary sewer lines are constructed on grades of fifteen percent (15%) or greater, concrete anchors shall be provided as shown on the plans. The first anchor will be placed just below the first pipe joint above the downstream manhole. Anchors will be placed at intervals not greater than one hundred fifty (150) feet above the first anchor.

B. Type of Pipe: Cast Iron or Ductile Iron Pipe, meeting the requirements of SECTION M2 – SANITARY SEWER PIPE, shall be used on all sewer lines when the grade is fifteen percent (15%) or greater.

C5.4. CONNECTIONS TO EXISTING SEWERS:

A. Connections to existing sewers shall not be made until all of the proposed sewer lines and manholes have been constructed, cleaned and approval granted by the Engineer for making connection. No connection to existing sewers shall be made until new sewers have passed specified leakage tests.

B. All work shall be completed in a workmanlike manner using materials specified or as approved by the Engineer. Watertight connections shall meet with the requirements concerning tests of these specifications.

TECHNICAL SPECIFICATIONS

SECTION C6 - PIPE JOINTS

C6.1 DESCRIPTION:

This section covers the installation of pipe joints. Joint materials shall be as specified in SECTION M2 – SANITARY SEWER PIPE.

C6.2 PIPE JOINT INSTALLATION:

All pipe joints other than those specified herein shall be made in strict accordance with the manufacturer's recommendation and as approved. All joints shall be made watertight in accordance with the latest ASTM Standards. Excavation for bells or other joint protrusions shall be made to insure that the bottom of the pipe firmly rests against the bedding for entire length of the pipe.

C6.3 INSTALLATION OF SLIP-TYPE JOINTS:

A. Prior to jointing, the bell and spigot end of the pipes shall be cleaned thoroughly by whatever means as are necessary to remove all foreign matter and attain the required cleanliness. A wire brush shall be used as necessary. Particular care shall be exercised to clean the gasket seat.

B. Joints shall be made in strict accord with the recommendations of the pipe manufacturer. The rubber gasket shall be cleaned and inserted in the gasket seat within the bell. The spigot end of the pipe shall be inserted in the bell of the pipe to which connection is being made, and forced to a firm contact with the shoulder of the bell. Pipe alignment may then be deviated from true alignment according to the pipe manufacturer's recommendation.

C6.4 INSTALLATION OF MECHANICAL JOINTS:

A. The spigot end of pipe and the bell of fitting and the rubber gasket shall be cleaned thoroughly as specified for pipe joints in paragraph C6.3 above. The gland shall also be cleaned in like manner.

B. After the gland and gasket are placed on the spigot end of the pipe a sufficient distance from the end to avoid fouling the bell, the spigot

end shall be inserted in the fitting bell to firm contact with the bell shoulder. The rubber gasket then shall be advanced into the bell and seated in the gasket seat. Care shall be exercised to center the spigot end within the bell.

C. The gland shall be brought into contact with the gasket, all bolts entered, and all nuts made hand tight. Continued care shall be exercised to keep the spigot centered in the bell. The joints shall be made tight by turning the nuts with a wrench, first partially tightening a nut, then partially tightening the nut 180 deg. therefrom and working thus around the pipe with uniformly applied tension until the required torque is applied to all nuts. Required torque ranges and indicated wrench lengths for standard cast iron bolts are as follows:

Diameter	Range of Torque		Length of Wrench
Inches	Foot	Pounds	Inches
5/8	40	60	8
¾	60	90	10
1	70	100	12
1¼	90	120	14

TECHNICAL SPECIFICATIONS

SECTION C7 - PIPE FITTINGS

C7.1 DESCRIPTION:

This section covers the installation of pipe fittings for sanitary sewer lines.

C7.2 PIPE FITTINGS INSTALLATION:

All pipe fittings shall be installed in strict accordance with the manufacturer's recommendations. Joints caused by the installation of fittings shall meet with the requirements of SECTION C6 - PIPE JOINTS. Pipe fittings shall meet with the requirements of SECTION M2 – SANITARY SEWER PIPE.

TECHNICAL SPECIFICATIONS

SECTION C8 - MANHOLES

C8.1. DESCRIPTION:

This section covers the construction methods for manholes, drop manholes, and watertight manholes.

C8.2. EXCAVATION AND BACKFILL:

A. Excavation: Excavation for manholes shall be completed in a workmanlike manner. The area of excavation for the base shall be only that necessary to provide an adequate base with its sides poured against undisplaced earth. All excavations shall be dewatered in accordance with SECTION C3 - DEWATERING OF TRENCHES before any permanent construction is started. Sheeting and shoring shall meet with the requirements of SECTION C4 - TRENCH SAFETY.

Where excavation is carried below plan grade because of unsuitable soil or for any other reason, the space below plan grade shall be filled with bedding material thoroughly tamped or the space may be filled with concrete poured monolithically with the base.

B. Backfill: Backfill of manholes shall be compacted to a density of not less than 90% of the density obtained in the laboratory. Moisture density relations of soils shall be determined in accordance with AASHO Designation T 180 modified. 90% density shall be obtained the entire depth of excavation except in public streets or roads where a density of 95% shall be obtained for the top 6 inches.

Backfill around manholes shall not be completed until adequate strength has been obtained to support the backfill without damage to the manhole. In no case will backfill be allowed on brick manholes, precast manholes, or poured-in-place manholes until the concrete is at least 48 hours old except as approved by the Engineer.

C8.3. INVERTS:

A. All pipe lines shall extend entirely through the manhole to a joint approximately 6" outside the manhole except where change in

direction or in sizes of pipes makes such construction unfeasible. Pipe in a manhole at the upper end of the line or discharging into an existing manhole shall not extend entirely through the manhole. In all cases, the pipe or pipes shall extend entirely through the manhole wall so that a joint occurs approximately 6" outside the manhole wall. Depth of the invert along the line of flow shall be approximately ½ the diameter of the abutting pipe. Curves in inverts shall have as long radius as feasible to facilitate flow. Shape of the invert shall be that approximating the bottom half of the pipe and inverts shall be brushed smooth.

B. The surface of the concrete slab shaped to form the invert shall be sloped upward from the edge of the invert to the manhole wall. The upper half of any pipe extending inside the manhole wall shall be cut substantially flush with the wall. Any rough edge shall be smoothed with mortar.

C. Mortar used in manholes shall be mixed in the proportions by volume of one part cement to four parts sand. If carefully done, mortar may be mixed in a mortar box. Mortar shall have a workable consistency, but shall be as dry as feasible.

D. Before constructing the invert of precast section manholes, the groove of the bottom riser shall be cleaned thoroughly. Care shall be exercised that the groove is entirely filled with mortar.

E. Inverts shall be formed directly in the manhole's concrete base in accordance with details shown on the standard manhole details.

C8.4. PRECAST MANHOLES:

A. Manholes of precast sections shall be positioned carefully upon the concrete base and be raised in a truly vertical plane. Space between pipe and periphery of cut-out shall be entirely filled with mortar or concrete as is appropriate for space to be filled. A collar approximately 8" wide shall be formed around the pipe against the outside of the manhole.

B. Minimum wall thickness for manhole risers shall be as listed under wall "B" of the "Class Tables" of ASTM C76.

C. All precast manholes shall be constructed with a 1' section of pipe immediately below the cone or top section in order to lower the manhole for any future change in grade.

D. The base concrete shall be Class "A", and deposited on an undisturbed bearing surface. The base shall have a minimum diameter 6" greater than the outside diameter of the manhole and the minimum thickness of the slab (as measured from the bottom of the sewer mains) shall be as follows:

0-8' manholes	-	8"
8-12' manholes	-	10"
12' and above	-	12"

C8.5. POURED-IN-PLACE MANHOLES:

A. Forms for poured-in-place manholes shall have cut-outs to fit around the sewer pipe entering the manhole so that the form rests upon the concrete base. The space around cut-outs shall be filled in accordance with the requirements for pre-cast manholes.

B. Poured-in-place manholes shall meet with the requirements and details as shown on the standard details. The top section or cone shall be concentric.

C. Construction of poured-in-place manholes shall be in accordance with all applicable parts of these specifications.

D. The base shall be cast monolithically with the rest of the manhole. The invert and flow channel shall be formed during or immediately after the placing of the concrete and brush-finished as soon as concrete has sufficiently set. The concrete must set for 24 hours before any pipe inside of the manhole is trimmed.

The base concrete shall be 3,000 psi, maximum slump 4", vibrated or tamped on undisturbed bearing. The base shall have a minimum diameter 6" greater than the outside diameter of the manhole, and a minimum thickness including the area under the pipe as follows:

0-8' manhole	-	8"
8-12' manhole	-	10"
12 and above	-	12"

E. All invert channels shall be smooth and accurately shaped to a semi-circular bottom conforming to the inside of the adjacent sewer section. Inverts shall be formed directly in the concrete of the manhole base or may be constructed by laying full section sewer pipe straight through the manhole and breaking out the top half after the base is constructed. Inverts shall extend up at least half of the diameter of the pipe. Changes in the direction of the sewer and

entering branches shall have a true curve of as large a radius as the size of the manhole will permit. Where the pipe is laid through the manhole, the invert shall be finished to 1/4" below the center of the pipe. The pipe shall be trimmed down to 1/4" below the surface of the invert, and the edges of the pipe along the invert and at the walls of the manhole shall be plastered and brush-finished. Plaster shall be 2 parts of masonry sand to 1 part of Portland cement.

F. The vertical forms, wall spacers, and placing cone must be carefully positioned and firmly clamped in place before any placement is made. The wall spacers must be located 90 deg. from each other. The manhole shall be cast of 3,000 psi concrete with a maximum slump of 4". The first placement shall consist of approximately ½ yard of concrete deposited evenly around the walls and vibrated until there is a minimum slope of 60 deg. from the bottom of the forms to the bearing surface both inside and outside of the manhole. When this is complete and before additional concrete is added, the concrete must be carefully vibrated on each side of each pipe. Additional concrete must be deposited in evenly distributed layers of about 18" with each layer vibrated to bond it to the preceding layer. The wall spacers must be raised as the placements are made with the area from which the space is withdrawn being carefully vibrated. Excessive vibration is to be avoided.

Form marks and offsets up to 1" will be permitted on the outside surface of the manhole. Form marks and offsets up to 1/2" will be permitted inside of the manhole. All offsets on the inside surface of the manhole will be smoothed and plastered so there is no projection or irregularity capable of scratching a worker or catching and holding water or solid materials. Honeycomb will be plastered with a mortar consisting of 3 parts of masonry sand to 1 part Portland cement immediately upon removal of the forms.

The specific ring and cover and the method of installing it will be designated by the Owner or Engineer.

Backfilling will be performed evenly and carefully around the manhole 24 hours or more after the placement of concrete is completed.

Should circumstances make a cold joint necessary, a formed groove or reinforcing dowels will be required in the top of the first placement for shear protection. Immediately before the second placement is made, the surface of the cold joint shall be thoroughly

cleaned and wetted with a layer of mortar being deposited on the surface.

C8.6. MANHOLE DETAILS:

All manholes shall be constructed in accordance with the standard manhole details or as approved by the Engineer. Manholes 4'0" or less in height shall have a 24" minimum, 30" maximum high cone section and a maximum 8" high throat section.

C8.7. CONNECTION TO EXISTING MANHOLES:

A. Connection to existing manholes shall not be made until all other manholes and sewer lines have been completed, cleaned, tested, and inspected in accordance with these specifications.

B. Connections to existing manholes shall be made by cutting a hole in the wall of the manhole, shaping the bottom of the manhole to fit the invert of the connections, inserting a length of sewer through the opening and filling around the pipe with a 1 part Partland cement to 2 parts masonry sand cement mortar and troweling the cement mortar inside and outside the manhole to a neat finish. When necessary to satisfactorily perform the work the flow of sewage shall be blocked at a time of minimum flow. If necessary to prevent flow back up in the line to the extent that damage would occur the contractor shall maintain the flow level lowered with a trench pump section inserted in the line or in the next manhole up the line. Discharge shall be made into an appropriate manhole downstream of the construction. Connections to manholes, mains, and house services shall be made in a thoroughly workmanlike manner to the satisfaction of the Engineer.

C8.8. MANHOLE RINGS AND COVERS:

Manhole ring settings shall be as shown on the standard details. Tops of the manhole rings and covers shall be level except in public rights-of-way where the top shall be set flush with pavements, sidewalks, or other surface areas.

C8.9. MANHOLE CONNECTIONS FOR PVC SEWER PIPE:

PVC Sewer Pipe shall be connected to all manholes by using a waterstop gasket conforming to ASTM F477 Specifications for "Elastomeric Seals for Joining Plastic Pipe" and by a stainless steel, worm drive, 3/8" Hex Head, Slotted Screw, 9/16" wide, clamp equal to or exceeding Ideal, 64 or 68

Series, 0.024" thick, or equal. An equal connection shall be recommended by the respective pipe manufacturer.

TECHNICAL SPECIFICATIONS

SECTION C9 - RESTORATION OF SPECIAL SURFACES

C9.1. DESCRIPTION:

This section covers replacement of special services including private drives, parking areas and paved street surfaces.

Restoration of other surfaces is covered under Section C-1 SITE WORK.

C9.2. BACKFILL UNDER SPECIAL SURFACES:

Backfill under special surfaces shall be specified in Section C2 - Excavation and Backfill of these specifications as modified herein.

Backfill from 6-inches above the pipe shall be made of suitable materials from the spoil bank brought up in compacted layers not exceeding 6-inches in depth of loose material. Compaction of backfill shall be carefully and thoroughly done so as not to displace utility lines from their original positions. All the backfill materials shall be at optimum moisture and shall be thoroughly compacted to 90% of the maximum density as determined by the Modified Proctor Compaction Test. However, the top 6-inches of the backfill shall be compacted to 95% maximum density as determined by the Modified Proctor Compaction Test.

C9.3. STREET REPLACEMENT:

City streets shall be replaced as specified herein for "paved street open-cut repair". The type of street replacement used in specific locations shall be as directed by the Engineer.

A. Paved Street Open-Cut Repair: After the backfill material has been brought within 7½" of the finish surface, the material on either side of the trench shall be removed for a horizontal distance of 12" from the widest point of the trench to a depth of 8". This will provide a shoulder of undisturbed bearing along each side of the trench 12" wide. The cut shall have a uniform width as nearly as is practicable, and shall be made perpendicular to the surface of the pavement in order that the repair shall result in a uniform, neat appearance. If the street is asphalt, 6" of Class "B" concrete will be poured to within 1½" of the surface. As soon as the concrete has obtained its final set, the surface will be tack coated and surfaced with 1½" hot mix asphaltic concrete meeting the Arkansas Highway

Department specifications. The above requirements shall apply for all pavement thicknesses up to and including the thickness outlined above, but in no case shall the total thickness of repairs to streets be less than the total thickness of the pavement in each individual case.

B. Oiled Street Open-Cut Repair: Backfill on streets which are oil streets and as described by the Engineer shall be done in the following manner:

(1) Compaction requirements will be the same as outlined in Section C9.2.

(2) The backfill will top within 12" of the finished surface. Compacted native iron ore gravel will be used to within 4" of the finished surface. The final 4" will be composed of a road oil and sand mixture. The oil and sand mixture shall be of the portion one gallon of road oil per one cubic foot of sand.

TECHNICAL SPECIFICATIONS

SECTION C10 - CAST-IN-PLACE CONCRETE

C10.1. GENERAL:

A. Standards: Concrete work shall conform to all requirements of ACI-30l "Specifications for Structural Concrete for Buildings" ACI-318 "Building Code Requirements for Reinforced Concrete" ACI-350 "Concrete Sanitary Engineering Structures", and ACI 305 and 306 "Recommended Practice for Hot (Cold) Weather Concreting", and the provisions of these specifications.

B. Scope: Work consists of furnishing all plant, labor, materials, equipment, and appliances, and performing all operations in connection with installation of the concrete work, complete, in strict accordance with the Specifications and Drawings.

C. Inspection: Embedded items must be inspected and tests for concrete and other materials shall have been completed and approved by the Engineer before concrete is placed.

C10.2. MATERIALS: All concrete materials shall conform to the latest revised ASTM Designations listed below:

A. Coarse Aggregate shall consist of gravel, crushed gravel, crushed stone, air-cooled blast furnace slag, or a combination thereof, conforming to ASTM C-33 with a maximum size of 1½".

B. Fine Aggregate shall conform to ASTM C-33 and shall be washed river sand composed of clean, uncoated grains of strong materials.

C. Cement shall be Portland cement conforming to ASTM Specification C-150, Type I, Type IA, Type III, or Type IIIA. Only one brand of cement shall be used for exposed concrete.

D. Water: Clean, fresh and free from oil, acids, alkali, vegetable, sewage, organic or other deleterious matter.

E. Admixtures: A retarding admixture, conforming to ASTM C-494, pretested with job materials under job conditions, shall be used, if approved, whenever necessary to prevent cold joints due to the quantity of concrete placed, to permit revibration of the concrete, to

offset the effects of high concrete temperature, or to reduce the maximum temperature and rate of temperature rise.

F. Premolded Expansion Joint Filler Strips shall be non-extruding type conforming to the current AASHTO Designation M153.

G. Abrasive Aggregate shall be equal to fine (c.f.) "Alundum" aggregate as manufactured by Norton Company, Worcester, Mass. or "Frictex NS" as manufactured by Sonneborn-Contech.

H. Curing Compound: Concrete curing compound shall be of a nature and composition not deleterious to concrete and shall be of a standard and uniform quality ready for use as shipped by the manufacturer. At the time of use, the curing compound shall be in a thoroughly stirred condition. Curing compounds shall not be diluted by the addition of solvent or thinners, or be altered in any manner without the specific approval of and in a manner prescribed by the manufacturer. Curing compound shall conform to the requirements of ASTM C309 Type 1.

The curing compound shall be sufficiently transparent and free from color that there will be no permanent change in the color of the concrete. The compound shall contain, however, a temporary dye of sufficient color to make the membrane clearly visible for a period of at least four hours after application.

I. Cement Grout: Cement based grout shall be used for grouting work except as otherwise specified.

(1) Quality: Grout shall be composed of cement, sand, admixtures and water proportioned and mixed as herein-after specified.

(2) Cement: Cement for grout shall be Type I normal Portland cement conforming to the specifications for cement in concrete. Type III high early strength Portland cement may be used only when approved by the Engineer.

(3) Sand: Sand shall conform to ASTM C33 and shall be graded so that 100% by weight will pass a standard No. 8 mesh sieve, and at least 45% by weight will pass a standard No. 40 mesh sieve.

(4) Design Mix: Grout shall be a mixture of one part cement to two parts sand with a water cement ratio of 0.55. Drypack grout shall be a mixture of one part cement, two parts sand

and the minimum amount of water required for mixing and placing. When shrinkage control of standard grout is required, aluminum powder shall be added as herein specified.

(5) Mixing: Mixing and placing apparatus shall be similar to that specified for concrete. Grout shall be mixed for a period of at least one minute. Diluted grout shall be agitated from time to time as considered necessary to keep the ingredients well mixed and in suspension. Sand and cement shall be free from lumps when placed in the mixer. Grout shall be screened to remove coarse particles.

J. Nonshrink Cement-Based Grout: Grout for setting equipment, column and other bases and anchor bolts shall be nonshrink cement-based grout. Nonshrink cement-based grout shall consist of pre-measured, prepackaged materials supplied by the manufacturer, requiring only the addition of potable water. The manufacturer's instructions shall be printed on the outside of each bag.

The manufacturer shall submit information verifying the cement-based grout exhibits the following properties:

(1) Nonshrink - No shrinkage (0.0%) and a maximum 4.0% expansion when tested in accordance with ASTM C-827. No shrinkage (0.0%) and a maximum of 0.2% expansion in the hardened state when tested in accordance with CRD-C 621.

(2) Compressive Strength - A minimum 28-day compressive strength of 5,000 psi when tested in accordance with ASTM C-109.

(3) Setting Time - A minimum initial set time of 60 minutes when tested in accordance with ASTM C-191.

(4) Composition - No metallic particles (aluminum powders, iron fillings) or expansive cement.

The contractor shall perform all grouting in accordance with the manufacturer's recommendations. Technical service shall be supplied upon request.

Grout shall be Five Star Grout, as manufactured by U.S. Grout Corporation, Fairfield, CT or equal.

K. Nonshrink Epoxy-Based Grout: Nonshrink Epoxy-based Grout shall be a pourable, 100% solids epoxy system consisting of three, pre-measured, prepackaged components: resin, hardener, and specially-blended aggregate. Resin component shall not contain any non-reactive diluents. Variation of component ratios is not permitted unless specifically recommended by the manufacturer.

The manufacturer shall submit information verifying the epoxy grout exhibits the following properties:

(1) Grout for bonding new cement to old, setting reinforced dowels into pre-drilled holes and or pressure grouting shall be an epoxy grout mixed in accordance with the manufacturer's instructions.

(2) Nonshrink - No shrinkage (0.0%) and a maximum 4.0% expansion when tested in accordance with ASTM C-827.

(3) Compressive Strength - A minimum compressive strength of 10,000 psi in 7 days when tested according to ASTM C-579, Method B.

(4) Heat Development - A maximum 100 degrees F peak exotherm in a 2" diameter x 4" high sample when tested at 75 degrees F material and laboratory temperatures.

(5) Thermal Coefficient - A maximum 30 x 10^{6} in./in./degree F thermal coefficient when tested according to ASTM C-531.

The contractor shall perform all grouting in accordance with the manufacturer`s recommendations. Technical service shall be supplied upon request.

Grout shall be Five Star Epoxy Grout, as manufactured by U.S. Grout Corporation, Fairfield, CT or approved equal.

L. Drypack Mortar: Drypack mortar shall be composed of approximately one part Type II Portland cement, 1½ to 2 parts sand, 2 to 3 fluid ounces water reducing densifier per sack of cement, aluminum powder as required for shrinkage control, and sufficient water to make a stiff workable mix. Sand, cement, water, and water reducing densifier shall be as specified for concrete.

C10.3. QUALITY AND CONTROL

A. Design: Concrete shall be composed of Portland cement, fine aggregate, coarse aggregate and water. All concrete shall be designed by an approved testing laboratory in accordance with the ACI Standard Recommended Practice for Selecting Proportions for Concrete (ACI-211) to produce the strength for each class of concrete specified, and with slumps and maximum sizes of coarse aggregate in accordance with the requirements outlined below. The concrete shall be so designed that the concrete materials will not segregate and excessive bleeding will not occur. Any costs to the testing laboratory for designing concrete mixes shall be borne by the Contractor.

Prior to placing any concrete, the Contractor shall submit for review mix designs for each specified concrete and grout type. Design data shall include the name of the concrete supplier; manufacturer/supplier and type of cement used; size and type of aggregate; proportional weights of cement, aggregate, and water per cubic yard of concrete; name and quantity of admixture used. Trial batches shall be made and the following data shall be submitted: 1-seven day, 1-14 day, and 1-28 day compressive strength test for each mix at various slumps; and percent of air content for each mix. No deviation for accepted mix designs will be permitted without prior written approval by the Engineer.

Concrete strengths shall be as follows:

Class A Concrete	-	4000 psi @ 28 days; minimum 6 sack mix (To be used for all work unless otherwise specified)
Air Content	-	4 ± 1%
Maximum Water Cement Ratio	-	0.45
Class B Concrete	-	2000 psi @ 28 days; minimum 4 sack mix (To be used only as concrete fill)

MAXIMUM SLUMPS FOR VARIOUS
TYPES OF CONSTRUCTION

Types of Construction	Hand Placed Maximum	High Frequency Vibrator Used Maximum
Reinforced Foundation Walls and Footings	4"	2"
Slabs, Beams, and Reinforced Walls	4"	3"
Building Columns	4"	3"
Pavements	3"	2"

The slump shall not exceed the maximum specified above for the type of construction for which it is to be used. The 28-day compressive strength determined in accordance with current ASTM Specifications C-39 and C-31 and with specimens cured in accordance with C-31 shall not be less than that shown above for the specified class of concrete. No water will be added after the amount specified by the mix design.

B. Production of Concrete: All ready-mixed concrete shall be batched, mixed and transported in accordance with "Specifications for Ready-Mixed Concrete (ASTM C-94)". Plant equipment and facilities shall conform to the "Check List for Certification of Ready-Mixed Concrete Production Facilities" of the National Ready-Mixed Concrete Association. Site mixed concrete shall conform to the requirements of "Specifications for Structural Concrete" (ACI-301). The Contractor may elect to use either ready-mixed or site mixed concrete for this project provided he informs the Engineer of his choice.

C. Laboratory Testing: The Owner shall engage an independent testing laboratory to conduct concrete tests. Unless otherwise informed, the Contractor will be responsible for sampling concrete for test cylinders, recording, and delivering them to the laboratory, providing all materials required, and for making all slump tests in the field directed by the Engineer. All costs in connection with work performed by the laboratory will be paid by the Owner. The Contractor shall be responsible for the costs of work performed by the laboratory required for redesign of concrete proportions and retesting of in place concrete when cylinders indicate low strength concrete has occurred.

At least one test shall be made on fresh concrete for each sixty (60) cu. yds. of each class of concrete (or fraction thereof) placed on any one day and in any event, not less than one test for each class of concrete each day it is used. Testing shall be done in accordance with the following ASTM Specifications, latest edition:

C172, Standard Method of Sampling Fresh Concrete
C31, Standard Method of Making and Curing Concrete Compression & Flexure Test Specimens in the Field
C39, Standard Method of Test of Compressive Strength of Molded Concrete Cylinders
C143, Standard Method of Slump Test for Consistency of Portland Cement Concrete

Before any concrete is poured, the Contractor shall construct a storage box in accordance with ASTM Specification C31. Each set of tests shall consist of one slump test and three compression test cylinders. All cylinders shall be kept in the storage box for the first 24 hours. The three cylinders shall be laboratory cured and tested for adequacy of the design for strength of the concrete in accordance with ASTM Specification C31. One cylinder shall be tested at 7 days and two at 28 days.

D. Failure of Concrete to Meet Strength Requirements: The concrete shall be considered acceptable if, for any one class of concrete, the average of all tests or any five consecutive tests is equal to or greater than the specified strength, provided that no more than one test of the five falls between 90% and 100% of the specified strength. The only cylinders to be used for determination of concrete acceptability will be those laboratory cured and tested at 28 days. When it appears the tests of laboratory-cured cylinders will fail to meet these requirements, the Engineer may require changes in the proportions of concrete for the remainder of the work in order to meet the strength requirements. In addition, the Engineer may also require additional curing not to exceed a total of 21 days on portions of the concrete already poured.

The Engineer may also require tests in accordance with Methods of Securing, Preparing and Testing Specimen from Hardened Concrete for Compressive and Flexural Strengths (ASTM Specifications C42) when the concrete cylinder tests fail to meet strength requirements. In the event there still is questions as to the quality of the concrete in the structure, the Engineer may require load tests for that portion where the questionable concrete has been placed. Such load tests will be made as outlined in Chapter

20 of American Concrete Institute Building Code. (ACI 318-71), and shall be at the expense of the Contractor.

E. Removal of Under Strength Concrete: If the above tests indicate that a particular batch of previously placed concrete is under strength, the Engineer may direct that the under strength batch be removed and replaced. The removal of the under strength concrete shall also include the removal of concrete that has obtained the required strength if the Engineer deems this necessary to obtain structural or visible continuity when the concrete is replaced.

The removal, and replacement of any under strength concrete, shall be made at no additional cost to the Owner. This shall include any new formwork required or any reinforcing steel that may be required. The Owner shall not be charged any additional costs for any extra work that is required because of the failure of any concrete to meet the minimum test requirements.

C10.4. INSTALLATION:

A. Preparation Before Placing: Water shall be removed from excavations before concrete is deposited. Hardened concrete, wood chips, shavings, and other debris shall be removed from interior of forms and inner surfaces of mixing and conveying equipment. Wood forms shall be oiled or, except in freezing weather, wetted with water in advance of pouring. Reinforcement shall be secured in position, inspected and approved by the Engineer before starting pouring of concrete.

B. Conveying: Concrete shall be conveyed from mixer to forms as rapidly as practicable and by methods which will prevent segregation or loss of ingredients. It shall be deposited as nearly as practicable in its final position. Chutes used shall be such that concrete slides in them and does not flow. Chutes, if permitted, shall have a slope of less than 1 on 2. Where a vertical drop greater than five (5) feet is necessary, placement shall be through elephant trunks or similar devices to prevent segregation.

C. Placing: Concrete shall be placed before initial set has occurred and in no event after it has contained its water content for more than 30 minutes. Unless otherwise specified, all concrete shall be placed upon clean, damp surfaces free from running water, or upon properly consolidated fills, but never upon soft mud or dry, porous earth. The concrete shall be compacted and worked in an approved manner into all corners and angles of the forms and around reinforcement and embedded fixtures as to prevent

segregation of the coarse aggregate. Construction of forms for the lifts of vertical walls shall be such as to make all parts of the walls easily accessible for the placement, spading, and consolidation of the concrete as specified herein.

D. Vibration: All concrete shall be placed with the aid of mechanical vibration equipment as approved by the Engineer. Vibration shall be transmitted directly to the concrete; in no case shall it be transmitted through forms. The duration of vibration at any location in the forms shall be held to the minimum necessary to produce thorough compaction. Vibrations shall be supplemented by forking or spading by hand, and adjacent to the forms on exposed faces in order to secure smooth, dense and even surfaces, with particular care being taken to prevent coarse aggregate from becoming set too near any surfaces that are to receive rubbed finish.

E. Construction Joints: Construction joints shall be formed as indicated on the Drawings or as approved or directed by the Engineer. Where indicated or required, dowel rods shall be used. All concrete at the joints shall have been in place not less than 12 hours, and longer if so directed by the Engineer, before concrete resting thereon is placed. Before placing is resumed, or commenced, excess water and laitance shall be removed, and concrete shall be cut away, where necessary, to insure a strong dense concrete at the joint. In order to secure adequate bond, the surface of concrete already in place shall be cleaned, roughened, and then spread with a one-half (½) inch layer of mortar of the same cement-sand ratio as is used in the concrete, immediately before the new concrete is deposited. The unit of operation is not to exceed 100 feet in any horizontal direction, unless otherwise required by the Drawings. Construction joints, if required, shall be located near the mid-point spans for slabs, beams or griders. Joints in columns or piers shall be made at the underside of the deepest beam or girder at least five (5) hours before any overhead work is placed thereon. Joints not shown or specified shall be so located as to least impair strength and appearance of work. Vertical joints in wall footings shall be reduced to a minimum. Placement of concrete shall be at such a rate that surfaces of concrete not carried to joint levels will not have attained initial set before additional concrete is placed thereon. Girders, beams and slabs shall be placed in one operation. To insure a level straight joint in exposed vertical surfaces, a strip of dressed lumber may be tacked to the inside of the forms at the construction joint. the concrete shall be poured to a point one (1) inch above the underside of the strip. The strip shall be removed one (1) hour after concrete has been placed and any irregularities in the joint line

leveled off with a wood float and all laitance removed. Waterstops shall be installed in all construction joints below grade or in liquid containing structures as noted on the Plans. Install as per SECTION C13 - CONSTRUCTION JOINTS & WATERSTOPS.

F. Patching: Any concrete which is not formed as shown on the Plans, or for any reason is out of alignment or level or shows a defective surface shall be considered as not conforming with the intent of these Specifications and shall be removed from job by Contractor at his expense, unless the Engineer grants permission to patch defective area, which shall be done in accordance with the following procedure. Permission to patch any such area shall not be considered a waiver of the Engineer's right to require complete removal of defective work if patching does not, in his opinion, satisfactorily restore quality and appearance of surface. Suitable non-shrink, latex or epoxy mortar shall be used for patching and repairing defective surface if directed by the Engineer.

After removing forms, all concrete surfaces shall be inspected and any poor joints, voids, stone pockets, all tie holes, or other defective areas shall be patched, if permitted by the Engineer. Where necessary, defective areas shall be chipped away to a depth of not less than one (1) inch with edges perpendicular to the surface. Area to be patched and a space at least six (6) inches wide entirely surrounding it shall be wetted to prevent absorption of water from the patching mortar. A grout of equal parts Portland cement and sand, with sufficient water to produce a brushing consistency, shall then be well brushed into the surface followed immediately by the patching mortar. The patch shall be made of the same material and of approximately the same proportions and shall not be richer than 1 part cement to 3 parts sand. White Portland cement shall be substituted for a part of the gray Portland cement to match color of the surrounding concrete. The proportion of white and gray cements shall be determined by making a trail patch. The amount of mixing water shall be as little as consistent with the requirements of handling and placing. The mortar shall be retempered without the addition of water by allowing it to stand for a period of one (1) hour during which time it shall be mixed occasionally with a trowel to prevent setting.

The mortar shall be thoroughly compacted into place and screeded off so as to leave patch slightly higher than surrounding surface. It shall then be left undisturbed for a period of 1 to 2 hours to permit initial shrinkage before being finally finished. the patch shall be finished in such a manner as to match the adjoining surface. On exposed surfaces where unlined forms have been used, the final

finish shall be obtained by striking off the surface with a straightedge spanning the patch and held parallel to the direction of the form marks.

Tie holes left by withdrawal of rods or the holes left by removal of ends of ties shall be filled solid with mortar after first being thoroughly wetted.

G. Slabs on Grade: The Contractor shall insure that subgrade has been thoroughly compacted and leveled prior to concrete placement. Sprinkle all subgrades with water no more than ½ hour prior to placing concrete.

Place vapor barrier below interior slabs unless noted otherwise. Sprinkling of fill is not necessary when using vapor barrier. Lap vapor barrier 6" in direction of pour, and seal laps with specified mastic. Repair all ruptures of the vapor barrier that might occur before or during concrete pour.

The Contractor shall insure that all reinforcing steel is located properly prior to pour, and that steel will not be vertically displaced during the pour.

H. Edging: Edges exposed to view on the outside of structures, footings, pads and slabs, and all those in the inside of structures shall be chamfered, beveled or neatly edged with a radius tool as approved by the Engineer. Bevel shall be at an angle of 45 degrees, such bevel being ¾ inch on a side. If so required by the Engineer, however, the Contractor shall provide square edges for any portion of the work.

C10.5. SLAB FINISHES:

A. Exterior Walks & Paving: The top surface shall be "slip-resistant" as follows:

Steel troweled as noted in SECTION C10.5B and have a final finish applied in brushing lightly with a soft bristle brush to form a slightly roughed surface.

B. Interior slabs that are to receive a finish floor covering (this does not include ceramic tile covering) shall be finished by tamping the concrete with special tools to force the coarse aggregate below the surface, then screeding and floating with straightedges to bring the surface to the required finish level. While the concrete is still green but sufficiently hardened to bear a man's weight without deep

imprint, it shall be wood floated to a true and even plane with no coarse aggregate visible. Sufficient pressure shall be used on the wood floats to bring moisture to the surface. After surface moisture has disappeared, surfaces shall be steel-trowelled to a smooth, even, impervious finish, free from trowel marks. After cement has set enough to ring the trowel, surface of all slabs shall be given a second steel trowelling to a burnished finish.

C. Interior slabs to receive fill or mortar setting bed shall be finished by tamping concrete with special tools to force coarse aggregate below the surface, and screeded with straightedges to bring surface to required finish plane. Surface shall be left roughened sufficiently to produce good bond with topping material.

D. Top and bottom slabs of all structures and water carrying conduits except as noted otherwise on the Plans shall be finished as follows: The top of the slab shall be screeded to grade and cross section; lightly tamped as required to bring up a good bed of mortar for finishing and re-screeded as necessary. The surface shall then be finished with a wood float and leveling darby. No further finish will be required on top slabs of structures or conduits which are to be buried. In the case of all exposed top slabs of structures and conduits, they shall be given a final wood float and a light broomed, slip resistant finish to a uniform surface which conforms with accuracy to required shape, slope and grade. Slabs shall be edged as appropriate.

E. Interior floor slabs that are not to receive any finish floor covering shall be "slip resistant finish" as follows: The top surface shall be steel trowelled as noted in C3.5B above and have a final finish applied by brushing lightly with a soft bristle brush to form a slightly roughed surface.

F. The floor surfaces of basins in which raking mechanisms are to be installed shall be finished, as indicated on the Drawings, by sweeping in cement grout with the mechanism. The cement grout to be used shall be composed of one part Portland cement and two parts sand by weight.

The sweeping-in process shall be performed under the supervision of the Engineer or, if necessary, under the supervision of a factory representative of the equipment manufacturer.

The slab upon which the grout is to be applied shall be finished in accordance with the provisions of paragraph C10.5D above except that after leveling and floating, it shall be raked in such a manner as

to provide a good bond for the grout. Before grout is deposited on the slab, it shall be thoroughly cleaned, wet down with clean water, and lightly dusted with neat cement immediately prior to placement of the grout.

G. Concrete Hardener shall be applied to the floors where scheduled to be exposed concrete. Concrete surfaces to be treated must be thoroughly set and dry, clean and free of dust. Three applications of "lapidolith", "saniseal", "hornolith","vitrox", or approved equal liquid are required, using one gallon per 100 square feet for the complete treatment. Apply hardener strictly according to the manufacturer's printed instructions. Any substitution for the specified hardeners must be of the magnesium fluosilicate or zinc fluosilicate types.

C10.6. FINISH OTHER THAN FLOORS:

A. All top surfaces, other than slabs, not covered by forms, and which are not to be covered by additional concrete or fill shall receive a wood float finish without additional mortar. Care shall be taken that no excess water is present when the finish is made. Other surfaces shall be brought to finished elevations and left true and regular. All exposed interior concrete shall be grouted smooth and give a cement wash of one part light colored Portland cement and two parts fine aggregate mixed with water to consistency of thick paint. Grout shall be cork or wood floated to fill all pits, air bubbles, and surface holes. Excess grout shall be scraped off with a trowel and rubbed with burlap to remove any visible grout film. Surface shall be kept damp during setting period. The finish for any area shall be completed in same day and the limits of a finished area shall be made at natural breaks in finished surface.

B. Rubbed Finish Unless otherwise indicated, all faces (except top surfaces of slabs) exposed to view, such as walls, grade beams, columns, beams, canopy soffits and fascias, etc. shall be finished as follows:

Forms shall be removed, as specified in SECTION C12 - CONCRETE FORMWORK, and all fins removed, offsets leveled, damaged places and depressions resulting from the removal of metal ties or other causes shall be carefully pointed with a mortar of sand and cement in the proportion which has been employed for the particular class of concrete treated. The surface film of all such pointed places shall be carefully removed before setting occurs. After the point has set sufficiently to permit it, all exposed surfaces shall be dampened and rubbed with a No. 16 carborundum stone,

to a smooth even plane. Final rubbing shall be done with a No. 30 carborundum stone, or an abrasive of equal quality, to obtain an entire surface of a smooth texture and uniformity in color. Mortar or grout worked up during rubbing shall be promptly removed by sacking with burlap or other suitable means so that no visible grout film or paste will remain. A cement wash or plaster coat shall not be used. All surfaces shall be finished uniformly smooth and washed clean. The rubbed finish for any area shall be completed in the same day and the limits of a finished area shall be made at natural breaks in the finished surface. If the Contractor does not provide suitable surface finish using carborundum stones specified above, the Engineer, without additional cost to the Owner, may require the use of a power operated grinding machine to produce the desired finish.

C10.7. CURING:

A. Unformed concrete surfaces shall be water cured to prevent check of the fresh concrete surface. Where drying conditions are severe, as determined by the Engineer, fog sprays shall be employed to prevent checking of the fresh concrete surface. Fog spraying shall be continued as specified until the finished surface has attained sufficient strength to permit flooding or covering with burlap mats. Where drying conditions are not severe, as determined by the Engineer, unformed concrete surfaces shall be covered with wet burlap mats as soon as the concrete has sufficiently set, and shall thereafter be kept under wet burlap.

Formed surfaces, both interior and exterior, shall be water cured by water sprays or under burlap mats beginning as soon as the forms are stripped. Prior to stripping of forms, the concrete and forms shall be kept moist by the water sprays.

Unless otherwise specified, surfaces shall be water cured for 7 days after the concrete is placed.

After 48 hours of water cure, and with the acceptance of the Engineer, the curing of concrete surfaces may be completed by the curing compound method. Curing compounds shall be applied in strict conformance with the manufacturer's instructions. If the compound is applied to a surface which is later to be painted, the Contractor shall thoroughly sandblast the surface to remove all vestiges of the compound prior to concrete finishing. Curing compound shall not be used on any surfaces against which additional concrete or other finishing materials are to be bonded.

B. In all concrete structures, Class A concrete made with normal Portland cement shall be prevented from drying for at least the first seven (7) days after placing. Whenever the temperature of the surrounding air is between 40 deg. and 60 deg. F., adequate provision shall be made for maintaining the temperature of concrete above 60 deg. F. or the moist curing period shall be extended to insure a compressive strength corresponding to that which would be secured under provisions of the previous part of this paragraph.

C. Whenever the temperature of surrounding air is below 40 deg. F., all Class A concrete shall be maintained at a temperature of not less than 50 deg. F. for at least 72 hours for normal concrete or for as much more time as is necessary to insure proper rate of curing of the concrete. The housing, covering or other protection used in connection with curing shall remain in place and intact at least 24 hours after the artificial heating is discontinued. No salt or other chlorides shall be used for prevention of freezing.

D. Protection from the Sun: All concrete shall be adequately protected from injurious action of sun in a manner satisfactory to the Engineer.

E. Temperature Control: During and at the conclusion of the specified curing period, means shall be provided to insure that the temperature of the air immediately adjacent to the concrete does not fall more than 3 deg. F in any 1 hour nor more than 30 deg. F in any 24 hours.

C10.8. CONCRETING IN COLD WEATHER: When the atmospheric temperature may be expected to drop below 40 deg. F at the time concrete is delivered to the work site, during placement, or at any time during the curing period, the following provisions also shall apply:

A. The temperature of the concrete at the time of placing shall not be less than 50 deg. F nor more than 90 deg. F. The temperature of neither aggregates nor mixing water shall be more than 100 deg. F just prior to mixing with the cement.

B. When the daily minimum temperature is less than 40 deg. F, concrete structures shall be insulated or housed and heated after placement. The temperature of the concrete and air adjacent to the concrete shall be maintained at not less than 50 deg. F nor more than 90 deg. F for the duration of the curing period.

C. Methods of insulating, housing, and heating the structure shall conform to "Recommended Practice for Cold Weather Concreting," ACI Standard 306.

D. When dry heat is used to protect concrete, means of maintaining an ambient humidity of at least 40% shall be provided unless the concrete has been coated with curing compound or is covered tightly with an approved impervious material.

C10.9. CONCRETING IN HOT WEATHER: When climatic or other conditions are such that the temperature of the concrete may reasonably be expected to exceed 90 deg. F at the time of delivery at the work site, during placement, or during the first 24 hours after placement, the following provisions also shall apply:

A. The Contractor shall maintain the temperature of the concrete below 90 deg. F during mixing, conveying, and placing. Methods used shall conform to "Recommended Practice for Hot Weather Concreting," ACI Standard 305.

B. The concrete shall be placed in the work immediately after mixing. Truck mixing shall be delayed until only time enough remains to accomplish it before the concrete is placed.

C. Exposed concrete surfaces which tend to dry or set too rapidly shall be continuously moistened by means of fog sprays or otherwise protected from drying during the time between placement and finishing, and after finishing.

D. Finishing of slabs and other exposed surfaces shall be started as soon as the condition of the concrete allows and shall be completed without delay.

E. Concrete surfaces exposed to the air shall be covered as soon as the concrete has hardened sufficiently and shall be kept continuously wet for at least the first 48 hours of the curing period, and for the entire curing period unless curing compound is applied as specified.

F. Formed surfaces shall be kept completely and continuously wet for the duration of curing period (prior to, during, and after form removal) or until curing compound is applied as specified.

C.10.10. INSERTS AND EMBEDDING:

A. Inserts: Where pipes, castings or conduits are to pass through the walls, the Contractor shall place such pipes or castings in the forms before pouring the concrete, or in special cases, with the express consent of the Engineer or as specified, he shall build accepted boxes in the forms to make openings for subsequent insertion of such pipes, castings or conduits as required by the Engineer. To withstand water pressure and to insure watertightness around the openings so formed, the boxes shall be provided with continuous keyways and waterstops all the way around, and they shall have a slight flare to facilitate grouting and the escape of entrained air during grouting. Before placing the grout, the concrete surfaces and the surfaces of the insert shall be coated with an epoxy bonding compound. Mixing and application of the bonding agent and time of placement of the grout shall be in accordance with the manufacturer's directions.

Additional reinforcement shall be provided around large openings, as shown on the drawings. The pipes, castings or conduits as specified shall be grouted in place by pouring in grout under a head of at least 4 inches. The grout shall be poured or rammed or joggled into place to fill completely the space between pipes, castings or conduits, and the sides of the openings so as to obtain the same watertightness as the wall itself. The grouted castings shall then be water cured as specified herein. The grouting material so placed shall be surfaced when the forms are removed to give a uniform appearance to the wall if such wall be exposed to view.

B. Embedding: The Contractor shall set accurately and hold in exact position in the forms until the concrete is poured and set, all gate frames, gate thimbles, special castings, channels or other metal parts that are to be embedded in the concrete; and he shall set accurately all inserts and anchor or other bolts necessary for the attaching of piping, valves, metal sash and equipment. All nailing blocks, plugs, strips and the like, necessary for the attachment of trim, finish and similar work shall be furnished and placed by the Contractor.

Blockouts may be used for embedded items, with the prior written consent of the Engineer. Where blockouts are allowed, non-shrink cement based grout shall be used to set the embedded items.

In lieu of embedding anchor bolts and other items to be anchored in the concrete, the Contractor will be permitted with prior written

acceptance of the Engineer, to drill holes in hardened concrete and install the anchor bolts and other items with non-shrink epoxy based grout. Drilling or coring holes shall be done by rotary drill with diamond boring or coring bits. Bonding mortar or grout shall be epoxy bonding adhesive grout or epoxy bonding adhesive mortar. Holes shall be blown clean and dry before installation of embedded items. Before insertion, both the hole and the item to be embedded shall be coated with bonding compound. Studs of equal size and length may be substituted for anchor bolts if nut fasteners are used. When accepted by the Engineer, three-part compounded expansion shields may be used for anchorage of minor miscellaneous metal.

C10.11. DRYPACK MORTAR: Where surfaces are required to be built up with mortar, such surfaces shall be thoroughly roughened by brushing, completely cleaned, and coated with appropriate bonding compound before the application of the required mortar. The mortar shall be applied immediately following the application of the bonding compound in bands or strips to form a compact durable covering of the required thickness and shall be free from lumps and depression. Construction joints in the mortar shall be sloped to thin edges and, before application is resumed, the joint shall be thoroughly cleaned. Drypack mortar shall be used for built-up surfaces, setting miscellaneous metal items, and correcting minor repairs and imperfections.

No mortar shall be applied during freezing weather unless adequate protection is provided.

The mortar shall be cured as specified for concrete.

C10.12. MODIFICATION OF EXISTING CONCRETE: Where the work indicated on the drawings required modification of existing concrete structures or concrete poured over six months previously to be removed or modified, the existing concrete shall be cut accurately to the lines required under the supervision of the Engineer. Concrete faces exposed to view shall be cut with a concrete saw. The cutting shall be accomplished in a manner that preserves, free from cracks or other injuries, those parts of the existing structure that are to remain. Where the cut surface is to be left exposed, it shall be cleaned and faced with non-shrink grout and finished to match adjacent surface. Where new concrete or mortar is to be placed against existing concrete surfaces or surfaces that have been cut, such surfaces shall be thoroughly cleaned by sandblasting, if required by the Engineer, and coated with the bonding compound just prior to the placement of the new concrete. Bonding compounds shall be as specified herein. Depth of saw cut should be ¾" minimum. Unless otherwise indicated on the drawings or specified, continuity of reinforcing steel shall be obtained by

either exposing bars to provide sufficient laps with new bars or by welding existing bars with new bars as specified. Where indicated, existing bars shall be exposed and fully developed by; embedding in new concrete.

C10.13. PROTECTION AND REPAIR OF CONCRETE CONSTRUCTION: All surfaces shall be protected against injury. During the first 72 hours after placing the concrete, any wheeling, working or walking on the concrete shall not be permitted. All slabs subject to wear shall be covered with a layer of sand or other suitable material as soon as the concrete has set. Sisalcraft paper or other similar tough waterproof paper may also be used, provided all joints between adjacent strips of paper are carefully sealed. This does not alter the requirements for proper curing as specified herein.

No concrete slabs or top surfaces or walls shall be placed during rain unless acceptable protective shelter is provided, and during such weather, all concrete placed within the preceding 12 hours shall be protected with waterproof canvas or other suitable coverings. These shall be provided and kept ready at hand.

Immediately after the removal of forms, all concrete shall be inspected, and all pour joints, rough sections or rock pockets containing loose materials such size and shape as will form a 1" key for cement mortar fill. Before the mortar is applied, the surface of the existing concrete shall be coated with epoxy bonding compound. All form tie holes and small imperfections shall be filled. The fill for small imperfections and form ties shall consist of cement mortar composed of one part cement well mixed with three parts of the fine aggregate by volume and just enough water so that the mortar will stick together on being molded into a ball by slight pressure of the hands; and is shall be thoroughly compacted into place. Where the area or volume of defective concrete is large, it may be repaired by; reforming the surface and filling the opening with concrete. For such major repairs, the filling shall be reinforced and doweled securely to the old concrete, neatly finished to match the surface and texture of the adjacent concrete. All patches shall be cured as accepted by the Engineer.

TECHNICAL SPECIFICATIONS

SECTION C11 - STEEL REINFORCEMENT

C11.1. MATERIAL: Steel reinforcement shall conform to the "Specification for Deformed Billet Steel Bars for Concrete Reinforcement" ASTM A615, Grade 40.

Wire fabric reinforcement shall conform to the current "Specifications for Welded Steel Wire Fabric for Concrete Reinforcement", ASTM A-185, or "Specifications for Welded Deformed Steel Wire Fabric for Concrete Reinforcement", ASTM A-497.

C11.2. STORAGE: Reinforcement shall be stored above the ground surface upon skids, platforms or other supports and shall be protected from mechanical injury and surface deterioration by exposure to the weather.

C11.3. SPLICES: No splices of bars, except when shown on the Plans, will be permitted without the approval of the Engineer. Bars shall be rigidly clamped or wired at all spices in a manner approved by the Engineer. Welding may not be used except with the specific approval of the Engineer. Welding, when approved, shall conform to the American Welding Society's "Recommended Practices for Welding Reinforcing Steel, Metal Inserts and Connections in Reinforced Concrete Construction" (AWS D12.1). Welded wire fabric shall be lap spliced a minimum of 2 inches plus the bar spacing. Splices in reinforcing bars shall conform to the general requirements of the ACI Code, except ring tension reinforcement splices, which should be a minimum of 40 bar diameters. Splices should be staggered where possible or increased by 30%.

C11.4. DETAILING & FABRICATION: Furnish Shop Detail and Field Placing Drawings for all reinforcing steel for approval of the Engineer. Shop Drawings shall include reinforcing, placing plans and details indicating size, location, arrangement, splice locations, bending diagrams, placing sequence, etc. Placing Drawings shall be insufficient detail to allow field personnel to accurately place reinforcing. Shop and Placing Drawings shall be prepared in accordance with "Manual of Standard Practice for Detailing Reinforced Concrete Structures" ACI 315-65, current edition.

Reinforcement bars shall be bent cold to the shapes indicated on the Plans. Fabrication tolerances, fabrication, and detailing of steel

reinforcement shall conform to the "Manual of Standard Practice for Detailing Reinforced Concrete Structures" (ACI-315).

Steel reinforcement shall be of the type and size, cut to lengths and bent to shapes as indicated on the Plans. Unless otherwise indicate, hooks, laps, splices, embedment lengths, and other details of reinforcement shall be provided as set forth in the

ACI Building Code (ACI-318) to develop the full tensile strength of the bar.

C11.5. PLACING REINFORCEMENT: Metal reinforcement at the time concrete is placed shall be free from mud, oil, paint, excessive rust and excessive mill scale or any other coating that would destroy or reduce its bond with the concrete.

Metal reinforcement shall be accurately positioned and dimensioned in accordance with the Plans and Specifications. The bars and mesh shall be tightly secured against displacement by ties of annealed wire, or suitable clips at intersections. Wall reinforcement shall be supported and held securely against displacement in its proper position clear of the forms as indicated on the Plans. Placing tolerances shall conform to ACI-318.

Nails shall not be driven into the wall forms to support reinforcement nor shall any other device used for this purpose come in contact with the form on the waterside of any water containing structure. Metal devices used to provide the required clear distances from reinforcing steel to waterside of concrete surfaces shall be galvanized, or shall be as approved by the Engineer.

The main reinforcement of slabs in contact with the ground shall be supported in its proper position, as indicated on the Plans, by means of precast cement mortar blocks, of approved dimensions, resting on the slabs' subbase. Such precast blocks shall be made of mortar composed of 1 part cement to 2 parts sand. Blocks shall be spaced at the intervals required to maintain the reinforcement in its required position in the slab during the placing of the concrete. The slab reinforcement shall not be used to support planking or runways used in placing concrete.

Bending of bars embedded in hardened concrete will not be permitted except when specifically approved by the Engineer for the field condition encountered.

In the case of floor slabs, galleries, deck slabs, and beams, metal chairs, spacers and other metal accessories necessary to provide the required clear distances and proper alignment and spacing between bars shall be

galvanized or shall have plastic protective covering over portions in contact with forms.

C11.6. CONCRETE PROTECTION FOR REINFORCEMENT: Steel reinforcement shall be placed and held in position so that the concrete cover, as measured from the surface of the bar shall be the following, except as otherwise shown, specified, or directed:

Slabs:

1½ inches, in general, top and bottom.
1½ inches at surfaces troweled as floor finish, walkway, or driveway.
2 inches on bottom for slabs over water and where exposed to the weather.

Footings:

2 inches at top of footings.
3 inches at bottom, sides, and end of footings.

Walls:

2 inches on surfaces against earth.
1 inch on interior surfaces.
2 inches on interior surfaces contacting water.

Beams and Girders in Contact with Water:

2 inch minimum to stirrup steel.
2½ inch minimum to main longitudinal steel.

Columns:

2 inches, in general, to main vertical reinforcement.
2½ inches, to main reinforcement on surfaces in contact with water.

Beams and Girders:

1½ inch minimum to stirrup steel.
2 inches minimum to longitudinal Steel.

TECHNICAL SPECIFICATIONS

SECTION C12 - CONCRETE FORMWORK

C12.1. SCOPE: Work in this section includes all labor, plant and material necessary to furnish and install all concrete formwork required by the project. Concrete formwork shall conform to all requirements of ACI 301 "Specifications for Structural Concrete for Buildings" and ACI 318 "Building Code Requirements for Reinforced Concrete" and ACI 347 "Recommended Practice for Concrete Formwork" except as modified herein.

C12.2. MATERIALS:

A. Forms shall be of wood, metal, highly water resistant plywood, or other material approved by the Engineer. Forms for sections greater than 18" thick shall be of wood. Form surfaces shall be smooth and free from irregularities, dents, sags, or holes when used for permanently exposed surfaces. Bolts and rods used for internal ties shall be so arranged that, when the forms are removed, all metal will not be less than two (2) inches from any concrete surface. Wire ties will not be permitted where concrete surface will be exposed to weathering, and discoloration would be objectionable. Exposed concrete shall have approved form liners of masonite or plywood, or shall be constructed of smooth surfaced plywood.

B. Corner forms forming ½ inch chamfers or as otherwise specified on plans, shall be used on all outside corners that are to be exposed in the finished structure. Chamfer forms shall be molded plastic or polyvinyl chloride radius of chamfer strips. Use one style of form throughout the project.

C. Rustication and Score Line Strips shall be a non-absorbent material such as extruded polyvinyl chloride, plastic, fiberglass or metal or they may be milled from good quality lumber and well sealed to prevent moisture absorption, wood strips may not have protruding splinters which may become embedded in the concrete. Sealing wood shall be accomplished by immersion or brushing on two coats of form coating.

D. Form ties for concrete shall have an approved waterstop barrier to prevent seepage of moisture along the ties. The ends of the tie

metal after breaking off shall be minimum of 1½ inches from the finished wall face. Submit samples to the Engineer for review.

C12.3. EXECUTION: Forms shall be built true to line and grade, and be mortartight and sufficiently rigid to prevent displacement or sagging between supports. All formwork and shoring shall be designed for the construction loads to be placed on them, and the design and construction of said forms shall be in accordance with ACI Standard "Recommended Practice for Concrete Formwork (ACI 347). The structural adequacy of the formwork shall rest with the Contractor. All forms shall be so constructed that they can be removed without hammering or prying against the concrete. Forms shall not be removed without approval of the Engineer. Forms shall not be removed before the minimum times given below, or longer if job control tests indicate the concrete has not attained strength specified below, except when specifically authorized by the Engineer.

Beams and Slabs	14 days
Walls up to 12" Thick and Vertical Surfaces	3 days
Columns	5 days
Walls greater than 12" Thick	7 days

In general, forms or shores for supported slabs and beams shall not be removed until the concrete, so supported, has acquired 70% of its design strength; except where loads other than the dead weight of the concrete are added, the shores shall not be removed until 24 hours after the concrete has obtained 90% of its design strength. Forms shall be removed immediately after expiration of the lapsed time specified above or sooner, if required by the Engineer, where concrete is to receive a rubbed finish.

TECHNICAL SPECIFICATIONS

SECTION C13 - CONSTRUCTION JOINTS AND WATERSTOPS

C13.1. GENERAL: This section covers construction joints, expansion joints, and the placing of waterstops where such are indicated on the Plans.

C13.2. POLYVINYL PLASTIC WATERSTOP: Waterstops shall be installed in all construction joints with water or other liquid on one side of joint and at other locations as required by the Plans. All waterstops shall be continuous throughout their length.

The waterstops shall be heavy duty polyvinyl waterstop conforming to Corps of Engineers Specification CRD-C-572, latest edition, as manufactured by Servicised Products Division of W.R. Grace and Company; Vinylstops by Sonneborn-Contech; W.R. Meadows, Inc.; Vinylex Corporation; or an approved equal of the same type and material and approximately equal in dimensions and weight but not necessarily of exactly the same shape. Waterstops shall be "Rib Type" with a center bulb, 4" wide, capable of resisting a maximum pressure load of 65 feet of water, unless otherwise shown on Plans.

"Expansion Type" waterstops shall be of ribbed construction, 6" wide, with a capacity for 1" of movement.

All waterstops shall be installed so that one-half its width will be embedded on one side of the joint and one-half on the other. The Contractor shall employ a method of holding the waterstop in position for the first pour that is satisfactory to the Engineer. The method selected must insure that the waterstop will be held securely in true vertical or horizontal position and in straight alignment in the joint.

Care shall be exercised to insure that the waterstop is completely encompassed in good mortar.

C13.3. JOINTS IN WATERSTOPS: All waterstops shall be continuous and so joined at all points of contact in the same plane, or at intersections with waterstops in different planes, as to form a complete barrier to the passage of water through any construction, contraction, or expansion joint.

Joints in the waterstops, whether made for the purpose of continuity in a straight strip or for the purpose of securing a watertight junction between

strips in different planes, shall be made by heat welding as hereinafter specified.

Joints in PVC waterstops shall be made by heating the two surfaces to be jointed until the material has softened to the point where it is just short of being fluid and then bringing the two softened surfaces together with a slight rubbing motion followed by firmly pressing them together so that a solid and tight bond is made.

The joints in strips of waterstop made in the above manner shall be such that the entire cross section of the joint shall be dense, homogeneous and free of all porosity. All finished joints shall have a tensile strength of not less than 75 percent of the material of the strip as extruded.

The heating of the surfaces to be joined shall be done by means of an electric splicing iron designed for the specified purpose and controlled by means of a voltage regulator.

In use, the heat of the hot plate shall be so regulated as to prevent too rapid melting and accompanying charring of the waterstop material.

The use of makeshift hot plates will not be permitted nor will other means of heating the strips to be joined be allowed except in a case of emergency, as determined by the Engineer.

The Contractor shall provide such jigs as will assist in making the joints in a proper and workmanlike manner and in holding the strips so that the alignment of jointed strips is correct and angles are true to those required.

Prior to embedment, all joints in the waterstop strips will be inspected by the Engineer and any found defective shall be remedied without delay.

C13.4. PROTECTION OF WATERSTOP BETWEEN POURS: The Contractor shall take such steps as are necessary to protect exposed waterstops in the interim period between concrete pours.

C13.5. EXPANSION JOINTS: Expansion joints of the size and type shown on the Plans, or specified herein, shall be placed in concrete pavement or structure as shown on the Plans.

A. Preformed Asphalt Fiber Joint Material: Asphalt fiber sheet filler shall consist of preformed strips of inert material impregnated with asphalt. It shall be of the thickness shown on the Plans or indicated in these Specifications.

The sheet filler shall conform to the requirements of AASHTO Specification M-59 with the following additional provisions.

The sheet filler shall be of such character that it will not be deformed by ordinary handling during hot weather nor become hard and brittle in cold weather. It shall be of a tough, resilient, durable material not affected by weathering.

B. Hot Poured Rubberized Tar Joint Sealer: Hot poured rubberized mastic sealer shall consist of a mixture of durable, elastic rubber, coal tar pitch, and other materials which will form a resilient and adhesive compound capable of effectively sealing concrete joint surfaces against repeated expansion and contraction. The material shall be installed in accordance with the manufacturer's directions.

C13.6. CONSTRUCTION JOINTS: Location of all construction joints shall be approved by the Engineer. Maximum length of wall pours shall be 40 ft. maximum height of wall pours shall be 18 ft. provided in the construction joints or as shown on the plans. Bottom slabs and wall footings for concrete structures that will hold water shall be poured monolithically without cold joints or other discontinuities or weakened areas. Radial control joints consisting of ½" to ¾" wide troweled grooves shall be required at 60 deg. increments in circular slabs. Such joints shall be caulked with epoxy joint sealer after the concrete is cured and prior to placement of grout topping if required. All cracks greater than 0.05" wide not located in control joints shall be sealed by cutting a bevel groove on the water side of the crack ½" to ¾" wide and caulking with epoxy sealant. Crack widths shall be measured at the concrete surface.

C13.7. ADHESIVE WATERSTOP: Preformed plastic waterstop shall meet or exceed all requirements of Federal Specification SS-S-00210 Type I or Type II. Such plastic waterstop shall be equal to SYNKO-FLEX as manufactured by SYNKO-FLEX Products, Inc. Houston, TX or approved equal and shall meet the following requirements.

The plastic waterstop shall be produced from blends of refined hydrocarbon resins and plasticizing compounds reinforced with inert mineral filler, and shall contain no solvents, irritating fumes or obnoxious odors. The plastic waterstop shall not depend on oxidizing, evaporating or chemical action for its adhesive or cohesive strength. It shall be supplied in extruded form of suitable cross-section and of a size to seal the joint areas of concrete sections. the plastic waterstop shall be protected by a suitable removable two-piece wrapper. The two-piece wrapper shall be so designed that ½ may be removed longitudinally without disturbing the other half, to facilitate application of the sealing compound. The flexible

plastic waterstop shall also meet the requirements as stated in the following table:

Composition	Test Method	Min	Max
Bitumen (petroleum plastic content)	ASTM D 4	50	70
Ash-Inert Mineral Matter	AASHO T 111	30	50
Volatile Matter	ASTM D 6	--	2.0

Property	Test Method	Min	Max
Specific Gravity @ 77 deg. F.	ASTM D 71	1.20	1.30
Softening Point	ASTM D 36	320 deg. F.	--
Penetration 77 deg. F. (150 gms) 5 sec.	ASTM D 217	50	120

TECHNICAL SPECIFICATIONS

SECTION C14 – CONCRETE TREATMENT PLANT INSTALLATION

C14.1. SCOPE:

This Contractor shall be responsible for working with the manufacturer or supplier of the plant and equipment and shall perform all necessary excavation, backfill, concrete base, slabs, dewatering, sewer connections, service roads, crane equipment and electrical service connection and wiring. This Contractor shall also furnish and install the related fencing and buildings as noted on the plans as well as all seeding and finish grading noted.

C14.2. GENERAL:

The excavation for all structures shall be made to the lines and grades as shown on the plans. The sides of the excavaton shall be properly sloped or shoring and bracing must be erected to comply with appropriate safety standards. Sufficient room must be allowed for setting of concrete structures while allowing adequate work space for installation.

Information about soil conditions shall be taken from the test boring or drawings and descriptions herein. In case unforeseen soft, unstable or unsatisfactory fill ground is encountered at the elevation required, the condition shall be brought to the attention of the Architect/Engineer immediately. The excavation shall extend down to stable ground or as directed and be backfilled with clean sand and tamped to provide a firm support as approved by the Architect/Engineer. When unforeseen rock is encountered, it shall be removed and bedded with sand or screenings.

The Contractor shall provide and operate all pumping equipment including well points necessary to keep the excavation free of water and shall dispose of water in a manner satisfactory to the Architect/Engineer.

C14.3. PRECAST UNITS

Machine excavation shall be carried 1” to 4” below bottom of the precast unit and filled with a bed of sand or screenings to permit leveling of bottoms to correct final grades. Furthermore, should the Contractor excavate below the grade set by the Engineers or disturb the soil by the use of power shovels or other heavy suitable material and compacted at the Contractor’s expense.

C14.4 BACKFILL

Backfill material shall be deposited in layers on all sides of the structure for the full length of the excavation. Each layer shall be thoroughly compacted until the backfill has reached at least one foot below the finish grade.

Use only clean sand, screenings and soil for backfill with soil only for the upper-most foot. Coarse sand or screenings shall carry to surface in traffic areas.

Slope finish grade to provide proper surface drainage away from plant. Surplus material shall be hauled from the site and disposed of by the Contractor at his own expense. The Contractor shall consult the Architect/Engineer in this regard before disposing of excess material.

C14.5 CRANE

The Contractor shall furnish a crane of adequate size to safely handle the heaviest section at any angle of boom. The Contractor shall verify the maximum weight with manufacturer prior to selecting his equipment. The crane shall be used to unload and set in place all precast concrete sections as well as heavy mechanical equipment. A concrete pumper shall be furnished by the Contractor to assist in the placement of grout and concrete as required to seal all joints and pour all concrete fillets.

TECHNICAL SPECIFICATIONS

SECTION T1 - DESCRIPTION

T1.1. GENERAL: This part of the specifications stipulates test requirements for materials, construction methods, leakage tests of the sewer lines, and testing of the water mains.

TECHNICAL SPECIFICATIONS

SECTION T2 - SEWER LINE TESTING

T2.1. DESCRIPTION: This section covers the testing of pipe materials, joints, or other materials incorporated into the sanitary sewer line and leakage tests to determine watertightness.

T2.2. SANITARY SEWER PIPE: All pipe and pipe materials will be accepted on the manufacturer's certificate that the pipe meets with the specification requirements and has been tested in accordance with the latest ASTM standard procedure for testing pipe, pipe joints, or other material unless specific tests are requested by the Engineer. All pipe and pipe materials shall be subject to permeability and hydrostatic tests.

T2.3. LEAKAGE TESTS OF SEWERS MAINS: All sewers shall pass leakage tests as specified herein. The leakage test must be performed in the presence of a representative of the Engineer. The Contractor is requested to provide 24 hours notice before beginning testing procedures. Tests shall be completed in accordance with the following procedure:

GRAVITY SEWER MAINS

A. Infiltration-Exfiltration Test: The pipeline shall not leak under exterior ground water pressures in excess of 50 gallons per inch of nominal pipe diameter per mile of pipeline per 24 hours. If, in the opinion of the Engineer, the ground water table at the time of testing is too low to produce dependable results, exfiltration tests shall be run. Allowable limits of exfiltration shall be 50 gallons per inch of nominal pipe diameter per mile of pipeline per 24 hours. This test shall be performed in the following manner:

The lower end of the section to be tested shall be plugged with a suitable watertight plug. The manhole at the upper end of the section shall be filled with water to an average depth of four (4) feet above the lower end, taking steps to ensure that all air has been removed from the line at the lower end. Depth measurements shall then be taken by the Engineer to establish the variance in the water level. An allowance of an additional ten (10) percent of gallonage lost shall be permitted for each additional two feet of head over a basic two (2) feet minimum internal head.

SEWER FORCE MAINS

B. The test shall be the same as listed for water mains in Section T3 and shall consist of raising and holding the hydrostatic pressure in the test section to 150 psi. Such pressure shall be maintained for a period of not less than four (4) hours, during which time the water pumped into the line to maintain the test pressure shall be accurately measured in a satisfactory manner.

Water Mains shall be Hydrostatic Tested per AWWA C605-13 leak test for PVC. No pipe installation will be accepted if the leakage is greater than that determined by the following formula:

$$Q = \frac{LD\sqrt{P}}{148000}$$

in which Q is allowable leakage, in gallons per hour; L is the length of pipe tested in feet; D is the nominal diameter of the pipe, in inches; and P is the average test pressure during the hydraulic test, in pounds per square inch gage. In the event any section of the line tested fails to meet the above specified requirements for water tightness, the cause of the excessive leakage shall be determined and remedied to the satisfaction of the Engineer, at the expense of the Contractor, including retesting. It shall be the responsibility of the Contractor to provide the necessary outlets for testing the pipeline.

$$Q=LD(P)^{0.5} / 148{,}000$$

Where Q = quantity of makeup water in gallons per hour
L = Length of pipe section being tested, in feet
D = nominal diameter of the pipe, in inches
P = average test pressure during the hydraulic test in PSI (gauge pressure)

B. Air Testing: N/A

T2.4. MANHOLE VACUUM LEAKAGE TESTS: Refer to leakage testing for gravity sewer mains.

T2.5. LEAKS ENCOUNTERED IN FINAL INSPECTION: In addition to passing the above described leakage tests, all obvious running leaks which may be observed in the final inspection shall be satisfactorily repaired.

T2.6. DEFLECTION TESTING: Deflection testing shall be performed on the total footage of the project. The deflection test shall occur after a thirty day consolidation of the backfill in the trench section. A maximum of five

percent deflection is allowable. A contractor shall use a mandrell deflection testing as follows:

A. Completely flush the line making sure the pipe is clean of any mud or trash that would hinder the passage of the mandrell.

B. During the final flushing of the line, attach a floating block or ball to the end of the mandrell. Pull rope and float the rope through the line.

C. After the rope is threaded through the line, connect the pull rope to the mandrell and place the mandrell in the entrance of the pipe.

D. Connect a second rope to the back of the mandrell. This will enable you to retrieve the mandrell if a blockage is encountered.

E. Remove all the slack in the pull rope by gently pulling the rope at the far manhole. After the slack has been removed, place a tape marker on the rope close to the pipe where the mandrell will exit. If the mandrell encounters blockage, the marker will provide a means of measuring the traveled distance of the mandrell so that the restricted area can be located.

F. Draw the mandrell through the sewer.

G. An increasing resistance to pull is an indication of excessive deflection. If this occurs, measure beginning marker on rope the distance to manhole. Locate section and replace bedding or pipe if visual examination reveals damage.

H. Retest.

Resistance to pull may be caused by not properly flushing or cleaning the line prior to testing. Actions to take prior to digging are as follows:

(1) Remove mandrell and reflush with water, or

(2) Preferably remove mandrell and pull a rubber sewer cleaning ball through the line with water to clear any mud or debris that did not flush during initial cleaning.

The mandrell O.D. shall be equal to the minimum pipe I.D. less the allowance for the maximum five percent deflection.

The test equipment used shall be certified as satisfactory by the Engineer at the beginning of the project. The Engineer or his representative may at any time require a calibration check of the instrumentation used.

T2.7. CLEANING UP: As the construction work progresses, the Contractor shall backfill the trenches, remove excess excavated materials and other debris and do sufficient clean-up and blading of the trench surfaces to make the streets and alleys suitable for safe use of traffic.

After the construction work is completed and before final acceptance by the Owner, the Contractor shall remove all rubbish, excess materials, excess materials from excavations and other debris from the site of the work, and all trench surfaces shall be bladed as heretofore specified. Adjacent road ditches and slopes which have been disturbed by this construction shall be restored to original shape density and condition. The cost of clean-up shall be included in the bid prices for the various units of work.

TECHNICAL SPECIFICATIONS

SECTION T3 - TESTING AND STERILIZATION

T3.1 DESCRIPTION OF WORK: The work to be performed under this section of the specifications shall consist of furnishing all labor, materials, and equipment necessary to test and sterilize the water main as specified herein.

T3.2 HYDROSTATIC TEST: After the pipe has been laid for at least seven (7) days, the line shall be tested in such sections approved by the Engineer. The Contractor shall furnish all labor, materials, tools, and equipment required to bulkhead and seal off the line for testing, fill it with water, raise the filled line to test pressure and measure both pressure and leakage over the test period.

The entire length of the installed line shall be field tested for water tightness in the following manner:

The section of the line to be tested shall be filled with water and allowed to stand for such time as is required for the cement lining of the pipe to absorb such water as it will and for escape of all air from the line. During the filling of the line, care shall be exercised to see that all air vents are open and all bulkheads, valves, manholes, connections, etc. in the section undergoing test shall be carefully examined for leakage. All known leaks shall be stopped, regardless of these test requirements. If permanent air vents are not located at all high points, the contractor shall install corporation cocks at such points so that the air can be expelled as the line is filled with water. After all the air has been expelled, the corporation cocks shall be closed and the test pressure applied. At the conclusion of the pressure test, the corporation cocks shall be removed and plugged or left in place at the discretion of the owner.

The test shall consist of raising and holding the hydrostatic pressure in the test section to 150 psi. Such pressure shall be maintained for a period of not less than four (4) hours, during which time the water pumped into the line to maintain the test pressure shall be accurately measured in a satisfactory manner.

No pipe installation will be accepted if the leakage is greater than that determined by the following formula:

$$L = \frac{SD\sqrt{P}}{7400}$$

in which L is allowable leakage, in gallons per hour; S is the length of the pipe tested in feet; D is the nominal diameter of the pipe, in inches; and P is the average test pressure during the leakage test, in pounds per square inch gage.

In the event any section of the line tested fails to meet the above specified requirements for water tightness, the cause of the excessive leakage shall be determined and remedied to the satisfaction of the Engineer, at the expense of the Contractor, including retesting.

T3.3 STERILIZATION: Prior to sterilizing, each valved section of the new pipeline shall be pressure tested and flushed with clean water from the existing system to remove all apparent evidence of dust, soil and fine debris which may have entered the line during construction and testing.

Chlorine shall be used to sterilize the pipeline by the following method: The amount of chlorine applied shall be such as to provide a dosage of not less than fifty (50) parts per million. The chlorinating material shall be introduced to the water lines and distribution system in a manner approved by the Engineer. After a contact time of not less than twenty-four (24) hours, the system shall be flushed with clean water until the residual chlorine content is not greater than 0.2 parts per million. All valves in the lines being sterilized shall be opened and closed several times during the contact period.

A minimum of three (3) samples shall be collected and submitted for analysis to the State Board of Health for each segment of water line installed. No water main shall be placed into service until satisfactory test reports have been received.

Unless otherwise provided for in the Bid Schedule and Proposal, the cost of furnishing the chlorine, labor, tools, equipment, and test of chlorine content and bacteriological tests shall be at the expense of the Contractor.

TECHNICAL SPECIFICATIONS

SECTION MP - MEASUREMENT AND PAYMENT

MP.1. GENERAL:

The contractor shall review the scope of work and site conditions to become familiar with all aspects of construction necessary to complete the proposed scope of work. The payment for work items shall be measured and paid in accordance with the units or items of measured as defined in the bid form for each item.

Where items are referred to as being paid by the Lump Sum, the contractor will be allowed to request a progress payment reflective of the percentage completed as agreed to by the Engineer and Contractor.

SECTION G

GENERAL REQUIREMENTS

SECTION MP

MEASURMENT AND PAYMENT

SECTION C

CONSTRUCTION METHODS

SECTION T

TESTING

SECTION M

MATERIALS

SECTION ME

MECHANICAL EQUIPMENT

TEXARKANA - NORTH WWTP EXPANSION

	Current	Proposed
Design Process Flow (MGD)	0.95	1.95
Peak Hydraulic Flow (MGD)	3	6
Influent Parameters		
BOD5 (mg/L)	200	200
TSS (mg/L)	200	200
NH3N (mg/L)	30	30

Effluent Limits

Parameter	Water Quality-Based		Technology-Based/BPJ		Previous Permit		Permit Limit	
	Monthly Avg. mg/l	7-day Avg. mg/l	Monthly Avg. mg/l	7-day Avg. mg/l	Monthly Avg. mg/l	7-day Avg. mg/l	Monthly Avg. mg/l	7-day Avg. mg/l
$CBOD_5$	10	15	25	40	10.0	15.0	10	15
TSS	15.0	22.5	30	45	15.0	22.5	15.0	22.5
NH_3-N								
(April)	6.0	6.1	N/A	N/A	6.0	6.1	6.0	6.1
(May – October)	4.0	6.0	N/A	N/A	4.0	6.0	4.0	6.0
(November – April)	6.0	9.0	N/A	N/A	6.0	9.0	6.0	9.0
DO								
(May – October)	5.0 (Inst. Min.)		N/A		5.0 (Inst. Min.)		5.0 (Inst. Min.)	
(November – April)	7.0 (Inst. Min.)		N/A		7.0 (Inst. Min.)		7.0 (Inst. Min.)	
FCB (col/100 ml)								
(April)	1000	2000	N/A	N/A	200	400	1000	2000
(May – September)	200	400	N/A	N/A	200	400	200	400
(October – March)	1000	2000	N/A	N/A	1000	2000	1000	2000
TDS	3,800 lbs/day		N/A	N/A	N/A	N/A	3,800 lbs/day	
	N/A	N/A	Report	Report	Report	Report	Report	Report
Sulfates	480 lbs/day		N/A	N/A	N/A	N/A	480 lbs/day	
	N/A	N/A	Report	Report	Report	Report	Report	Report
pH	6.0-9.0 s.u.		6.0-9.0 s.u.		6.0-9.0 s.u.		6.0-9.0 s.u.	

PRIMARY SCREEN

Ex. Concrete Channel		
Channel Width, ft	1.666	
Flow Depth		
Flow Velocity		
Estimated Vol. of Screenings, ft^3/MG	3	3
Estimated Weekly Vol. of Screening, cy	0.74	1.52
See equipment manufacturer's design basis		
Freeze protection?		

AERATION BASIN

	Each Basin	Total Plant (4 basins)
Design Flow Rate, MGD	0.49	1.95
Design incoming BOD5, mg/L	200	
BOD Mass Loading, lbs	813	3253
Basin Length, ft	100	
Basin Width, ft	30	
Basin Depth, ft	17.85	
Basin Volume, cf	53550	214200
Design Detention Time, hrs	29.21	29.21
Design Organic Loading Rate, lbBOD5/day/1000cf (per 10 States 92.31)	15.00	
Actual Organic Loading Rate, lbBOD5/day/1000cf	15.18	15.18
Design F:M Ratio (per 10 States 92.31)	0.05-0.1	
Design MLVSS, mg/L	4000.00	4000.00
F:M Ratio	0.061	0.061
Design Dissolved Oxygen	2.00	
	see manufacturer's air requirement	
Blower Capacity (2 existing, 3 total @ 1270 CFM Ea.)		
LBS BOD/Day	1584.60	3252.60
OTE/Basin	0.37	0.37
Air Required (FT^3/Day)	3628040.40	3723515.15
Air Required (CFM)	2519.47	2585.77
Air Required per Blower (CFM)	1259.74	861.92
Air requirement less than blower capacity		

CLARIFIER

	Each Clarifier	Total Plant (3 Clarifiers)
Design Flow Rate, MGD	0.975	1.95
Design loading rate, gpd/sf (per 10 States 72.232)	800	
Surface Area-required, sf	1219	2437.5
Clarifer Diameter, ft	65	
Surface Area Provided, sf	3317	9950
Design Weir Loading Rate, gpd/lf (per 10 States 72.43)	30000	
Total Weir Length Required, ft	32.5	65.0
Weir 1 Radius, ft	24.5	
Weir 2 Radius, ft	25.5	
Total Weir Length Provided, lf	157	471

POST AERATION

Basin Length, ft	20	
Basin Width, ft	20	
Basin Depth, ft	12	
Basin Volume, cf	4800	
	Current	Proposed
Detention Time, min	17.2	8.6

STATE OF ARKANSAS
LICENSED PROFESSIONAL ENGINEER
No.17723
CALEB J. MUDFORD
8-10-26

INFLUENT PUMP STATION

Wet Well (Existing)	Current	Future
Length (ft)	19.0	
Width (ft)	13.7	
Depth (ft)	4.5	
Volume (gallons)	8736.1	
Inflow Rate-Peak (gpm)	2085	4170
Design Pump Rate	4000	5500
Cycle Time per minute	8.8	8.7

*Cycle time is greater than 6 cycles/min. Design is good.

Existing Forcemain

SYSTEM CURVE

Condition	Existing Ductile Iron	
HW C-value	100	
Diameter	18	in
Length	360	ft
Flow Increment	1000	gpm

Flow	Friction Loss /100ft, ft	Total Friction Loss, ft	Static Head, ft	Total Dynamic Head, ft	Velocity
0	0.0	0.0	40.5	40.5	0.0
1000	0.1	0.2	40.5	40.7	1.3
2000	0.2	0.8	40.5	41.3	2.5
3000	0.4	1.6	40.5	42.1	3.8
4000	0.8	2.7	40.5	43.2	5.1
5500	1.4	5.0	40.5	45.5	7.0
6500	1.9	6.7	40.5	47.2	8.2

Project proposed to install a 3rd pump matching the existing, Flygt Model C321-636 with 35hP variable speed motor, with design point of 2140 gpm @ 46' TDH. See multi pump performance curve below.

RAS PUMP STATION

Wet Well (Existing)	Current	Future	
Length (ft)	10.0		
Width (ft)	10.0		
Depth (ft)	3.25		
Volume (gallons)	2431.0		
Design RAS Rate as % of daily design flow	150%	150%	Per 10 States 92.41 for extended aeration
RAS Rate (gpm)	990.375	2032.875	
Design Pump Rate	1100	2200	
Cycle Time per minute	24.6	15.7	

*Cycle time is greater than 6 cycles/min. Design is good.

Existing Forcemain

SYSTEM CURVE

Condition	Existing Ductile Iron	
HW C-value	100	
Diameter	10	in
Length	360	ft
Flow Increment	550	gpm

Flow	Friction Loss /100ft, ft	Total Friction Loss, ft	Static Head, ft	Total Dynamic Head, ft	Velocity
0	0.0	0.0	20.3	20.3	0.0
550	0.3	1.2	20.3	21.5	0.7
1100	1.2	4.4	20.3	24.6	1.4
1650	2.6	9.3	20.3	29.5	2.1
2200	4.4	15.8	20.3	36.1	2.8
2750	6.7	23.9	20.3	44.2	3.5
3300	9.3	33.6	20.3	53.8	4.2

Project proposed to install a 3rd pump matching the existing, Flygt Model CP3152.181 with 20hP variable speed motor, with design point of 1100 gpm @ 36' TDH. See multi pump performance curve below.

WAS PUMP STATION

Progressive Cavity positive displacement pumps directly connected to clarifier drawoff, no wet well.
Current successful operation of the plant has shown to require a wasting rate of XXX% of the average daily flow

Design peak wasting rate as % of daily desig	25%	25%	Per 10 States 92.44
Design WAS Rate (gpm)	165.1	338.8	
Design Pump Rate	240	360	

Existing Forcemain

SYSTEM CURVE

Condition	Existing Ductile Iron	
HW C-value	100	
Diameter	4	in
Length	5000	ft
Flow Increment	75	gpm

Flow	Friction Loss /100ft, ft	Total Friction Loss, ft	Static Head, ft	Total Dynamic Head, ft	Velocity
0	0.0	0.0	20.3	20.3	0.0
75	0.7	36.4	20.3	56.6	1.9
150	2.6	131.4	20.3	151.6	3.8
225	5.6	278.3	20.3	298.6	5.8
300	9.5	474.2	20.3	494.5	7.7
330	11.3	565.7	20.3	586.0	8.4
405	16.5	826.7	20.3	846.9	10.4

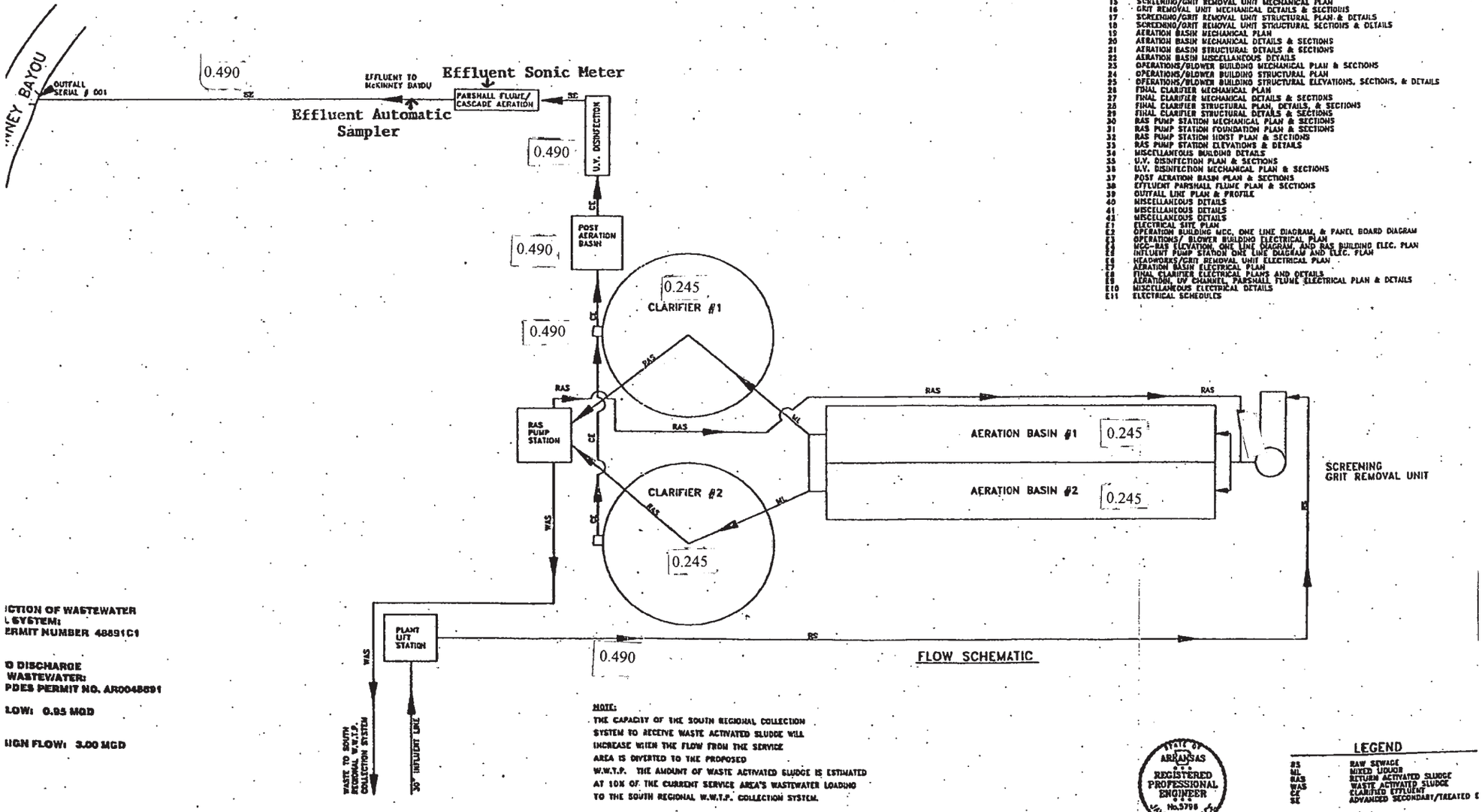
Partially Full Pipe Flow

Clarifier #3 RAS Drain			
Q=1.49/n*A*Rh^2/3*S^1/2			
Pipe Size		0.83	ft
Mannings n=		0.013	
Flow Depth		0.75	ft, 90% max flow
Slope		1.00%	
Flow Area	A= r^2*(0-sin0)/2	0.52	ft^2
Pipe Radius	r=D/2	0.42	ft
Theta Ang	0=2acos((r-y)/r))	5.00	
Wetted perimeter	P=r*0	2.08	
Hydraulic radius	Rh=A/P	0.25	
		2.34	cfs
		1044.28	gpm

*Pipe capacity exceeds design RAS rate of 150% design flow of 0.95MGD, or 660gpm, per clarifier.

Clarifier #3 Drain-To-Influent			
Q=1.49/n*A*Rh^2/3*S^1/2			
Pipe Size		1.00	ft
Mannings n=		0.013	
Flow Depth		0.90	ft, 90% max flow
Slope		1.00%	
Flow Area	A= r^2*(0-sin0)/2	0.74	ft^2
Pipe Radius	r=D/2	0.50	ft
Theta Ang	0=2acos((r-y)/r))	5.00	
Wetted perimeter	P=r*0	2.50	
Hydraulic radius	Rh=A/P	0.30	
	Q=	3.81	cfs
	Q=	1698.12	gpm

EPA Basic, Part B, #B3, page 7
Process Flow Diagram



ICTION OF WASTEWATER
L SYSTEM:
ERMIT NUMBER 48891C1

O DISCHARGE
WASTEWATER:
PDES PERMIT NO. AR0048691

LOW: 0.95 MGD

IGN FLOW: 3.00 MGD

NOTE:
THE CAPACITY OF THE SOUTH REGIONAL COLLECTION SYSTEM TO RECEIVE WASTE ACTIVATED SLUDGE WILL INCREASE WHEN THE FLOW FROM THE SERVICE AREA IS DIVERTED TO THE PROPOSED W.W.T.P. THE AMOUNT OF WASTE ACTIVATED SLUDGE IS ESTIMATED AT 10% OF THE CURRENT SERVICE AREA'S WASTEWATER LOADING TO THE SOUTH REGIONAL W.W.T.P. COLLECTION SYSTEM.

STATE OF ARKANSAS
REGISTERED PROFESSIONAL ENGINEER
No.5798
JAMES E. RICE

LEGEND

RS	RAW SEWAGE
ML	MIXED LIQUOR
RAS	RETURN ACTIVATED SLUDGE
WAS	WASTE ACTIVATED SLUDGE
CE	CLARIFIED EFFLUENT
SE	ADVANCED SECONDARY/TREATED E

FLOW SCHEMATIC

FIGURE I-3

Designed JER
Checked JCT
Drawn KRY

NRS CONSULTING ENGINEERS
4415 JEFFERSON AVE.
TEXARKANA, AR 71854
(501) 773-9867

CITY OF TEXARKANA, ARKANSAS
PROPOSED WASTEWATER TREATMENT PLANT

FLOW SCHEMATIC & SHEET INDEX

Scale N.T.S.

Job No. TX-98-01

TEXARKANA, ARKANSAS
NORTH WWTP - EXPANSION
TX-01-24

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6.	HYDRAULIC PROFILE
7.	DEMOLITION PLAN
8.	SITE & GRADING PLAN
9.	YARD PIPING
10.	EROSION & SEDIMENT CONTROL PLAN
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29.	MISCELLANEOUS DETAILS
30.	MISCELLANEOUS DETAILS
31.	EROSION & SEDIMENT CONTROL DETAILS



TEXARKANA WATER UTILITIES
801 WOOD STREET
TEXARKANA, TX 75501
PH: 903-798-3800

CALL BEFORE YOU DIG
1-800-482-8998
ARKANSAS ONE-CALL SYSTEM

BEFORE CONSTRUCTION BEGINS
GIVE 48 HOURS NOTICE
FOR UNDERGROUND UTILITY LOCATIONS
CALL: THE ARKANSAS ONE-CALL SYSTEM 1-800-482-8998

SUBMITTED BY:

A.L. FRANKS ENGINEERING

CERTIFICATE OF AUTHORIZATION
A.L. FRANKS ENGINEERING, INC.
NO. 1681
ARKANSAS ENGINEER

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STATE OF ARKANSAS
LICENSED PROFESSIONAL ENGINEER
No.17723
CALEB J. MUDFORD

5-18-26
CALEB J. MUDFORD, P.E. PROJECT ENGINEER DATE

5/18/2026
ANTHONY L. FRANKS, P.E. PROJECT REVIEWER DATE

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ARKANSAS HEALTH DEPARTMENT NOTES

1. THIS PROJECT SHALL CONFORM TO THE FOLLOWING:

A) "RECOMMENDED STANDARDS FOR WASTEWATER FACILITIES" (TEN STATES STANDARDS).

B) ARKANSAS STATE LICENSING LAW FOR COMMERCIAL CONTRACTORS ACT 150 OF 1965 AND ACT 162 OF 1987 (AS AMENDED) REQUIRES THE INSTALLATION CONTRACTOR TO HAVE A CONTRACTORS LICENSES CLASSIFICATION OF MUNICIPAL AND UTILITY CONSTRUCTION.

C) ARKANSAS BOARD OF HEALTH "RULES AND REGULATIONS PERTAINING TO PUBLIC WATER SYSTEMS"

D) ALL APPLICABLE AWWA (AMERICAN WATER WORKS ASSOCIATION) SPECIFICATIONS INCLUDING:

1) AWWA C600–23 STANDARDS FOR INSTALLATION OF DUCTILE WATER MAIN AND THEIR APPURTENANCES.

2) AWWA C605–21 STANDARD FOR UNDERGROUND INSTALLATION OF POLYVINYL CHLORIDE (PVC) PRESSURE PIPE AND FITTINGS FOR WATER.

3) AWWA C651–23 STANDARDS FOR DISINFECTING WATER MAINS.

4) AWWA C900–22 & C907–23 STANDARD FOR PVC PRESSURE PIPE FOR WATER DISTRIBUTION.

5) AWWA C651–23 STANDARDS FOR DISINFECTING WATER MAINS REQUIRE BACTI SAMPLING ON DISTRIBUTION SYSTEM EVERY 1200 FEET. HOWEVER, THE ARKANSAS DEPT. OF HEALTH, DIVISION OF ENGINEERING WILL ALLOW BACTI SAMPLING EVERY 2600 FEET ON MAINS AND BRANCH LINES AT THE END OF EVERY BRANCH LINE.

2. AWWA C651–23, APPENDIX C (CHLORINE NEUTRALIZATION) WILL BE COMPLIED WITH. " DRAINAGE OF MAINS AND DISPOSAL OF CHLORINATED WATER SHALL BE IN ACCORDANCE WITH ALL FEDERAL, STATE AND LOCAL LAWS, ORDINANCES AND REGULATIONS. MAINS SHALL BE DRAINED TO SANITARY SEWERS, WHERE AVAILABLE. DRAINAGE DIRECTLY TO SURFACE WATERS (CREEKS, RIVERS, STREAMS, LAKES, PONDS, ECT.) WILL NOT BE ALLOWED. DRAINAGE BRANCHES, BLOW–OFF'S, AIR VENTS AND APPURTENANCES SHALL BE PROVIDED WITH VALVES AND SHALL BE LOCATED AND INSTALLED AS SHOWN ON THE PLANS AND STANDARD DETAILS. DRAINAGE OF MAINS WILL BE ACCOMPLISHED IN SUCH A MANNER AS TO MINIMIZE EROSION AND SILTATION TO ADJOINING PROPERTIES. WATER VELOCITY FROM DRAINAGE AND OR BLOW–OFF WILL BE DISSIPATED AS NECESSARY TO PREVENT EROSION. DRAINAGE BRANCHES OR BLOW–OFFS SHALL BE NOT BE CONNECTED TO ANY SEWER, SUBMERGED IN ANY STREAMS, OR INSTALLED IN ANY OTHER MANNER THAT WILL PERMIT BACK SIPHONAGE INTO THE DISTRIBUTION SYSTEM.

3. THE OPERATING ROUTINE SHALL INCLUDE NECESSARY PROTECTIVE MEASURES TO DETECT AND REMOVE OR DESTROY ANY CONTAMINANT OF CONCERN OR REGULATION THAT MIGHT ENTER THE DISTRIBUTION SYSTEM. EVERY PRECAUTION MUST BE TAKEN AGAINST THE POSSIBILITY OF SEWAGE CONTAMINATION OF THE WATER IN THE DISTRIBUTION SYSTEM.WATER MAINS AND SANITARY SEWERS SHALL BE CONSTRUCTED AS FAR APART AS PRACTICABLE, AND SHALL BE SEPARATED BY UNDISTURBED AND COMPACTED EARTH. A MINIMUM HORIZONTAL DISTANCE OF TEN FEET SHOULD BE MAINTAINED BETWEEN WATER LINES AND SEWER LINES OR OTHER SOURCES OF CONTAMINATION. WATER LINES AND SEWERS SHALL NOT BE LAID IN THE SAME TRENCH EXCEPT ON THE WRITTEN APPROVAL OF THE ARKANSAS DEPARTMENT OF HEALTH. WATER MAINS NECESSARILY IN CLOSE PROXIMITY TO SEWERS MUST BE PLACED SO THAT THE BOTTOM OF THE WATER LINE WILL BE AT LEAST 18 INCHES ABOVE THE TOP OF THE SEWER LINE AT ITS HIGHEST POINT. IF THIS DISTANCE MUST BE UNAVOIDABLY BE REDUCED, THE WATER LINE OR THE SEWER LINE MUST BE ENCASED IN WATERTIGHT PIPE WITH THE SEALED ENDS EXTENDING AT LEAST TEN FEET EITHER SIDE OF THE CROSSING. ANY JOINT IN THE ENCASEMENT PIPE IS TO BE MECHANICALLY RESTRAINED. THE ENCASEMENT PIPE MAY BE VENTED TO THE SURFACE IF CARRYING WATER OR SEWER UNDER PRESSURE. WHERE A WATER LINE MUST UNAVOIDABLY PASS BENEATH THE SEWER LINE, AT LEAST 18 INCHES OF SEPARATION MUST MAINTAINED BETWEEN THE OF THE TWO PIPES IN ADDITION TO THE PRECEDING ENCASEMENT REQUIREMENT. EXCEPTIONS TO THIS MUST BE APPROVED IN WRITING BY THE ARKANSAS DEPARTMENT OF HEALTH. A MINIMUM HORIZONTAL DISTANCE OF THREE FEET SHALL BE MAINTAINED BETWEEN WATER LINES AND OTHER UNDERGROUND UTILITIES OF A NONSANITARY NATURE (GAS, ELECTRIC, ETC.). EXCEPTIONS TO THIS MUST BE APPROVED IN WRITING BY THE ARKANSAS DEPARTMENT OH HEALTH

GENERAL NOTES

1. A 3'–0" MIN. BURY SHALL BE MAINTAINED ON WATER MAIN.
2. CONTRACTOR SHALL BE RESPONSIBLE FOR DAMAGE TO EXISTING STRUCTURES, PIPING, CONDUIT, ETC. RESULTING FROM CONSTRUCTION WHETHER SHOWN ON THESE DRAWINGS OR NOT.
3. CONTRACTOR SHALL PERFORM FINISH GRADING, TOP SOILING, SODDING AND ESTABLISHMENT OF GRASS COVER IN ALL DISTURBED AREAS PER PLANS AND SPECIFICATIONS, OR AS DIRECTED BY THE ENGINEER.
4. ALL WATER MAINS TO BE TESTED PER PLANS AND SPECIFICATIONS.
5. CONTRACTOR SHALL HAVE UTILITIES LOCATED AND SHALL BE RESPONSIBLE FOR DAMAGE TO ALL UTILITIES ARISING FROM CONTRACTORS WORK, REGARDLESS OF BEING SHOWN OR OMITTED FROM THESE DRAWINGS. SHOWN UTILITIES ARE INDICATED IN APPROX. LOCATIONS ONLY.
6. ALL DEBRIS SHALL BE DISPOSED OF PER SPECIFICATIONS OR AS DIRECTED BY THE ENGINEER.
7. CONTRACTOR SHALL BE RESPONSIBLE FOR MAINTAINING THE MINIMUM REQUIRED 10 FEET HORIZONTAL SEPARATION BETWEEN WATER AND SEWER MAINS.
8. CONTRACTOR SHALL ABIDE BY ALL ADH SEPARATION DISTANCES AND CONTAMINATION REQUIREMENTS.
9. CONTRACTOR SHALL RESTRICT ALL OPERATIONS INSIDE OF STREET/HWY R.O.W. ACCESS PERMISSION ACROSS ADJACENT PROPERTIES SHALL BE OBTAINED BY CONTRACTOR. ANY DAMAGE TO ANYTHING ON THE PROPERTY SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR.
10. CONTRACTOR SHALL EXPOSE EXISTING UTILITIES IN ADVANCE OF CONSTRUCTION. GRADE ADJUSTMENTS SHALL BE APPROVED BY THE ENGINEER. COSTS ASSOCIATED w/ NOT EXPOSING EXISTING UTILITIES TO ALLOW GRADE ADJUSTMENT SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR.
11. CONTRACTOR SHALL INSTALL 12 GAUGE COATED COPPER TRACER WIRE ON ALL WATER MAINS. TRACER WIRE SHALL LOOP SERVICES AND VALVE BOXES AS SHOWN ON DETAIL. CONTINUOUSLY THROUGH GEL–PAKS SHALL BE USED FOR ALL SPLICES.
12. ALL WATER MAIN VALVES AND FITTINGS SHALL BE DUCTILE IRON w/ MECHANICAL JOINTS.
13. ALL DIRECTIONAL BORES 3" TO BE CERTA–LOK SDR–17 CLASS 250 ALL DIRECTIONAL BORES 4" – 8" TO BE CERTA–LOK C900, D.I. OR FUSIBLE C–900.
14. CONSTRUCTION STAKING FOR CENTER LINE OF WATER MAIN ALONG U.S. HIGHWAYS AND COUNTY ROADS WILL BE CONTRACTORS RESPONSIBILITY.
15. OWNER AND IT'S REPRESENTATIVES WILL PROVIDE GENERAL LOCATION OF EXISTING WATER MAINS. CONTRACTOR IS RESPONSIBLE FOR DAMAGE AND SUBSEQUENT REPAIRS OF EXISTING MAINS, SERVICE LINES AND APPURTENANCES.
15. ALL BENDS, FITTINGS, VALVES & FIRE HYDRANTS SHALL BE BLOCKED PER DETAILS.
16. M.J. BENDS SHALL BE UTILIZED WHERE ALLOWABLE DEFLECTION WOULD BE EXCEEDED.
17. ALL WATER MAIN VALVES TO BE INSTALLED w/ ADJ. VALVE BOXES & CONCRETE STABILIZATION PADS.
18. FIRE HYDRANTS TO BE LOCATED ON PROPERTY CORNERS PLUMB & AT HEIGHT DIRECTED BY ENGINEER.
19. ALL BENDS NECESSARY TO MEET DEFLECTION REQUIREMENTS AND ASSOCIATED BLOCKING SHALL BE INCLUDED IN BID.
20. ALL SALVAGE MATERIAL TO BE DELIVERED TO THE CITY.
21. PRIOR TO CONNECTING PROPOSED MAINS TO EXISTING MAINS THE CONTRACTOR IS TO TEMPORARILY BLOCK, PRESSURE TEST AND BAC–TI SAMPLE PER ENGINEER AND ADH SPECIFICATIONS.
22. REFER TO WATER MAIN INSTALLATION DETAILS ON SHEET 17 & 18.
23. PLUGGING AND ABANDONING EXISTING WATER MAINS SHALL BE ACCOMPLISHED UPON ACCEPTANCE TESTING COMPLETION. ABANDONING EXISTING WATER MAINS IS SUBSIDIARY TO THE PROJECT.
24. DRIVEWAYS WITH ASPHALT OR CONCRETE PAVEMENT SHALL BE CROSSED BY DIRECTIONAL BORE. GRAVEL DRIVEWAYS SHALL BE TRENCHED AND REPAIR IS SUBSIDIARY TO WATER MAIN INSTALLATION.
25. CONTRACTOR SHALL VERIFY LOCATION OF EXISTING WATER METERS PRIOR TO SERVICE INSTALLATION.
26. EXISTING HYDRANTS TO BE ABANDONED SHALL BE REMOVED AND DELIVERED TO THE CITY.
27. DISINFECTION AND TESTING OF WATER MAINS SHALL BE ACCOMPLISHED AS WORK IS COMPLETED AND WILL BE PAID SEPARATELY. FLUSHING OF WATER MAINS SHALL BE ACCOMPLISHED AT FIRE HYDRANTS OR FLUSH HYDRANTS AT THE EXTREMITY OF NEWLY INSTALLED MAINS.
28. DIRECTIONAL BORES UNDER DITCHES AND CREEKS SHALL BE CERTA–LOK C–900 PVC PIPE
29. REMOVE EXISTING FIRE HYDRANTS IS NOT A PAY ITEM AND SHALL BE INCIDENTAL TO NEW FIRE HYDRANT INSTALLATION.
30. INSTALL 1" TAP WITH SERVICE TERMINATING WITH CORP STOP IN METER BOX FOR BACTI SAMPLING AT LOCATIONS DESIGNATED BY THE ENGINEER. COST SHALL BE INCIDENTAL TO TESTING & STERILIZATION.
31. CONTRACTOR SHALL VERIFY DEPTHS OF EXISTING SEWER MAINS PRIOR TO CROSSING AND/OR DIRECTIONAL BORING PROPOSED WATER MAINS. IN THE EVENT THAT 2–FT VERTICAL SEPARATION CANNOT BE ACHIEVED THE WATER MAIN SHALL BE CASED WITH A 20–FT JOINT OF C900 PVC PIPE BEING CENTERED OVER THE SEWER MAIN. EACH END OF THE CASING SHALL BE SEALED.
32. SOME PROPOSED LINES ARE SHOWN OUTSIDE THE STREET R.O.W. FOR CLARITY. ALL CONSTRUCTION SHALL BE WITHIN STREET AND HIGHWAY R.O.W.
33. ABANDONED MAINS SHALL BE PLUGGED WITH A PROPERLY SIZED MJ PLUG AT THE TIME TIE–INS ARE MADE. PRE–BID SITE VERIFICATION : 34. FIELD VERIFY ALL EXIST CONDITIONS. PRIOR TO BIDDING & CONSTRUCTION REPORT ANY . DISCREPANCIES TO ENGINEER IN WRITING PRIOR TO BIDDING. NO EXTRA PAYMENTS WILL BE MADE TO CONTRACTOR AFTER BIDDING TO ACCOMMODATE SITE DISCREPANCIES NOT REPORTED PRIOR TO BIDDING.
34. IT IS RECOMMENDED THAT THE CONTRACTOR VISIT THE SITE, PRIOR TO BIDDING.

STATE OF ARKANSAS
LICENSED PROFESSIONAL ENGINEER
No.17723
CALEB J. MUDFORD
5-18-26

Date	Revision	By

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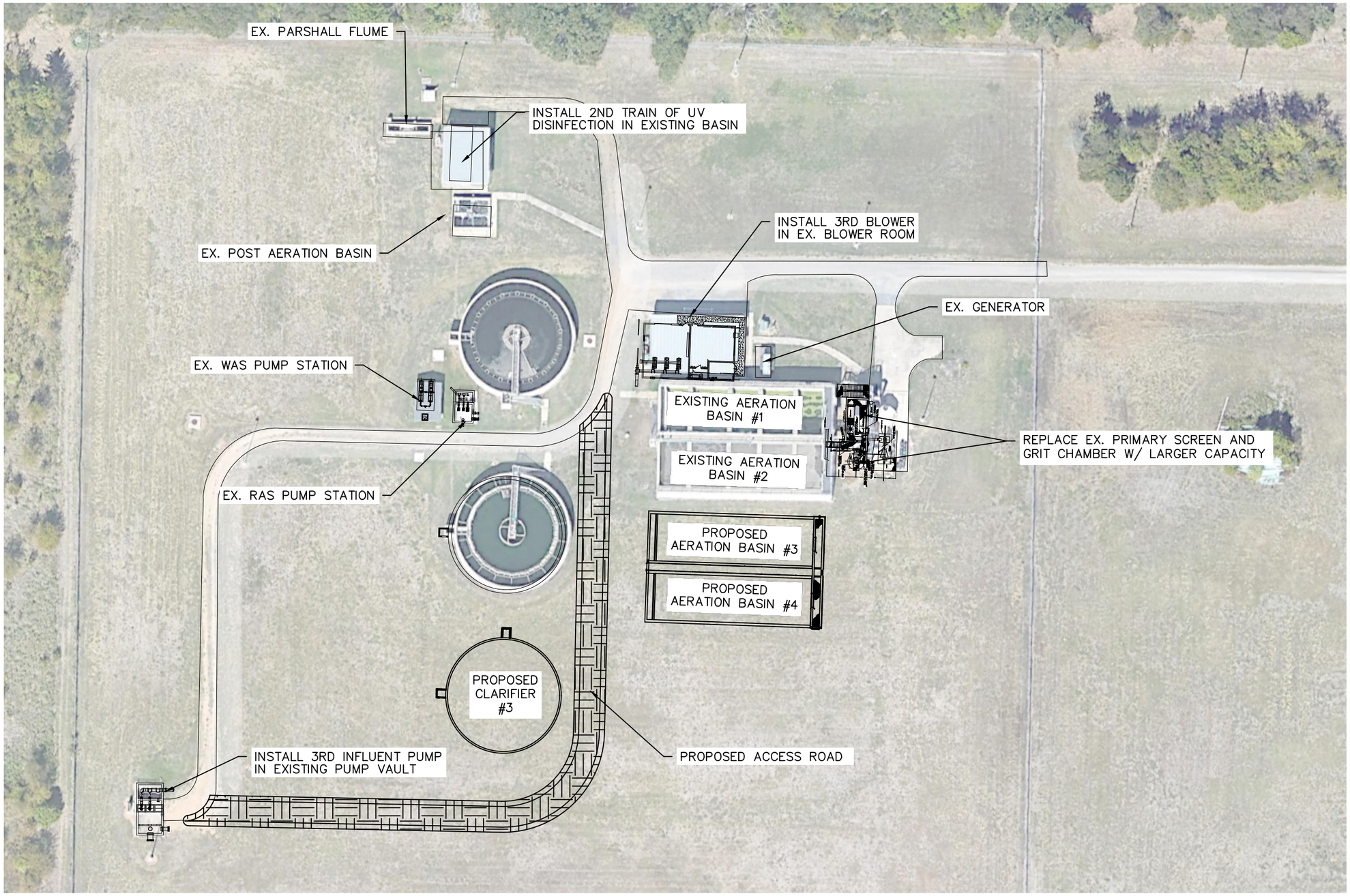
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TEXARKANA WATER UTILITIES
NORTH WWTP
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GENERAL NOTES

Job No.:TWU–02–23
Scale: N/A
Date: 5/2026
Sheet 2

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SCALE: 1"=60'-0"

60

NOTES

NO WORK IS ASSOCIATED WITHIN THE PROJECT SCOPE FOR THE EXISTING WAS PUMP STATION, POST AERATION BASIN AND PARSHALL FLUME AND AS SUCH THOSE EXISTING COMPONENTS ARE NOT INCLUDED WITHIN THIS PLAN SET. CONTRACTOR MAY REQUEST ASBUILT PLANS FOR THESE COMPONENTS AS NEEDED.

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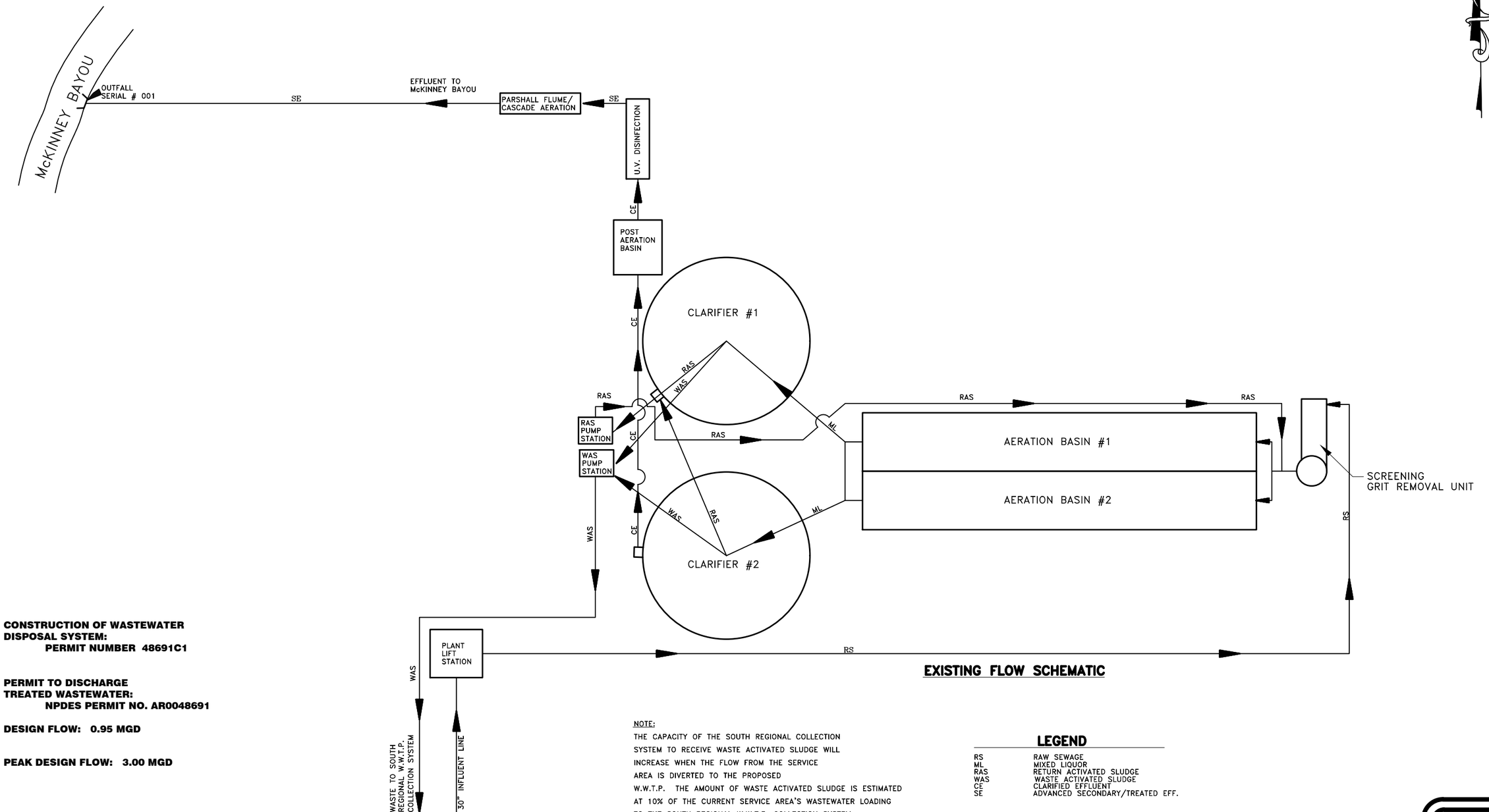
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TEXARKANA WATER UTILITIES
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SITE OVERVIEW

Job No.:TWU-02-23
Scale: 1"=60'
Date: 5/2026
Sheet 3

STATE OF ARKANSAS
LICENSED PROFESSIONAL ENGINEER
No.17723
CALEB J. MUDFORD
5-18-26



EXISTING FLOW SCHEMATIC

CONSTRUCTION OF WASTEWATER DISPOSAL SYSTEM:
PERMIT NUMBER 48691C1

PERMIT TO DISCHARGE TREATED WASTEWATER:
NPDES PERMIT NO. AR0048691

DESIGN FLOW: 0.95 MGD

PEAK DESIGN FLOW: 3.00 MGD

NOTE:
THE CAPACITY OF THE SOUTH REGIONAL COLLECTION SYSTEM TO RECEIVE WASTE ACTIVATED SLUDGE WILL INCREASE WHEN THE FLOW FROM THE SERVICE AREA IS DIVERTED TO THE PROPOSED W.W.T.P. THE AMOUNT OF WASTE ACTIVATED SLUDGE IS ESTIMATED AT 10% OF THE CURRENT SERVICE AREA'S WASTEWATER LOADING TO THE SOUTH REGIONAL W.W.T.P. COLLECTION SYSTEM.

LEGEND

RS	RAW SEWAGE
ML	MIXED LIQUOR
RAS	RETURN ACTIVATED SLUDGE
WAS	WASTE ACTIVATED SLUDGE
CE	CLARIFIED EFFLUENT
SE	ADVANCED SECONDARY/TREATED EFF.

Date	Revision	By

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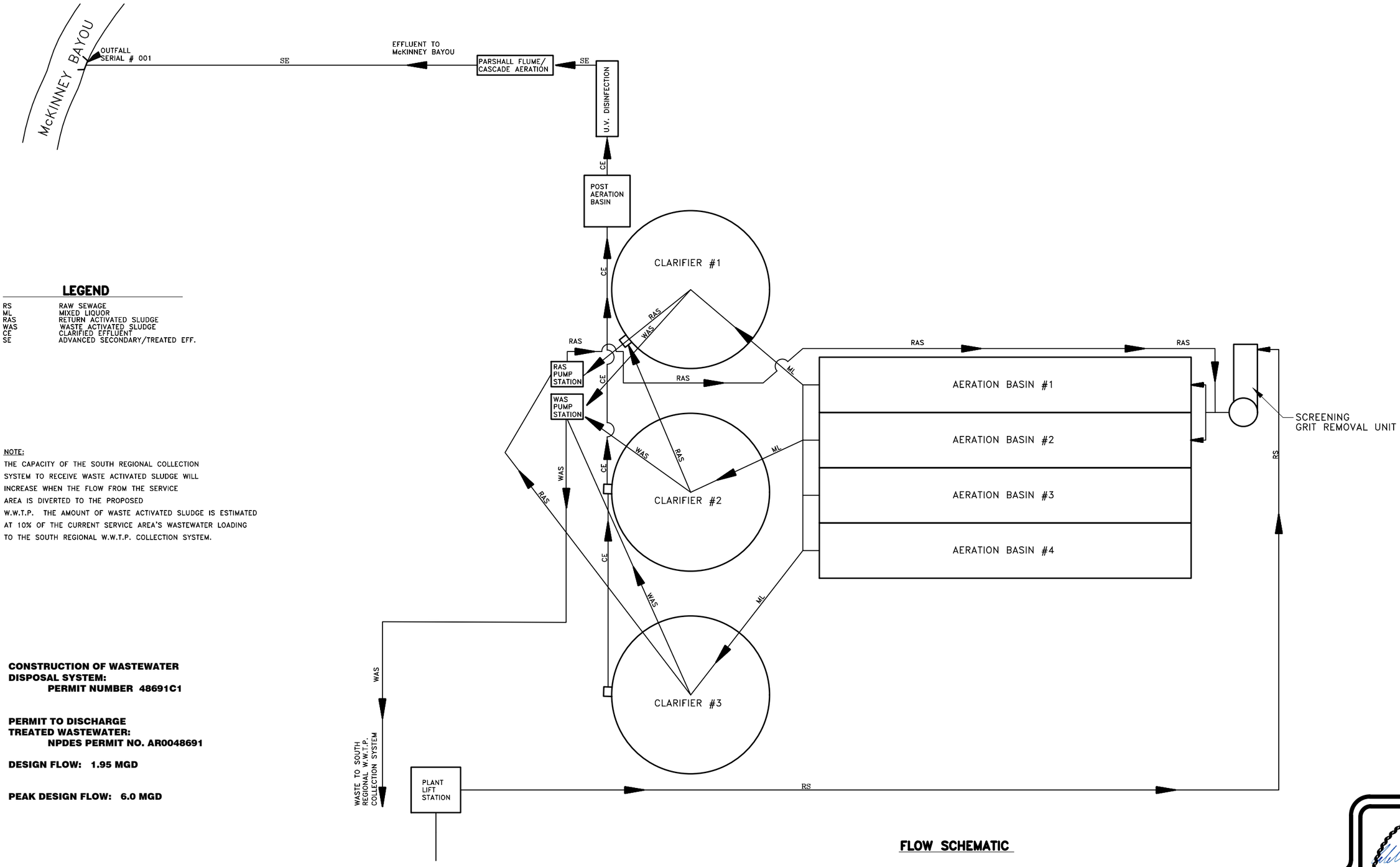
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EXISTING FLOW SCHEMATIC

Job No.:TWU-02-23
Scale: N.T.S.
Date: 5/2026
Sheet 4

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LICENSED PROFESSIONAL ENGINEER
No.17723
CALEB J. MUDFORD
5-18-26

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LEGEND

RS	RAW SEWAGE
ML	MIXED LIQUOR
RAS	RETURN ACTIVATED SLUDGE
WAS	WASTE ACTIVATED SLUDGE
CE	CLARIFIED EFFLUENT
SE	ADVANCED SECONDARY/TREATED EFF.

NOTE:
THE CAPACITY OF THE SOUTH REGIONAL COLLECTION SYSTEM TO RECEIVE WASTE ACTIVATED SLUDGE WILL INCREASE WHEN THE FLOW FROM THE SERVICE AREA IS DIVERTED TO THE PROPOSED W.W.T.P. THE AMOUNT OF WASTE ACTIVATED SLUDGE IS ESTIMATED AT 10% OF THE CURRENT SERVICE AREA'S WASTEWATER LOADING TO THE SOUTH REGIONAL W.W.T.P. COLLECTION SYSTEM.

CONSTRUCTION OF WASTEWATER DISPOSAL SYSTEM:
PERMIT NUMBER 48691C1

PERMIT TO DISCHARGE TREATED WASTEWATER:
NPDES PERMIT NO. AR0048691

DESIGN FLOW: 1.95 MGD

PEAK DESIGN FLOW: 6.0 MGD

FLOW SCHEMATIC

Date	Revision	By

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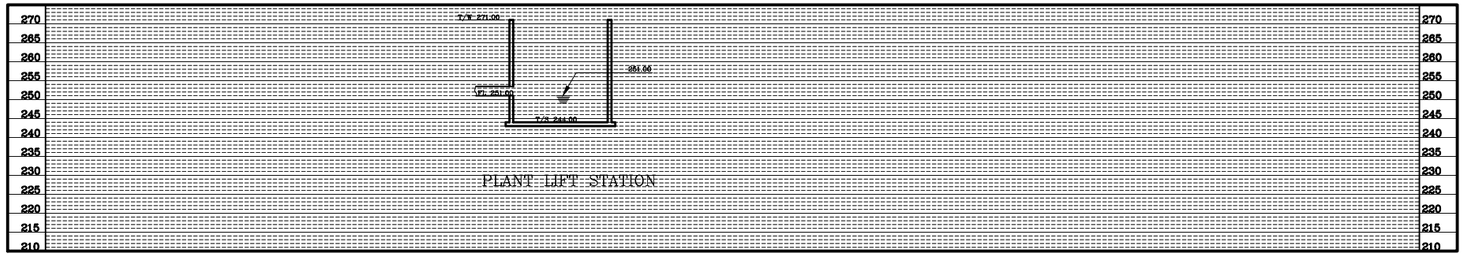
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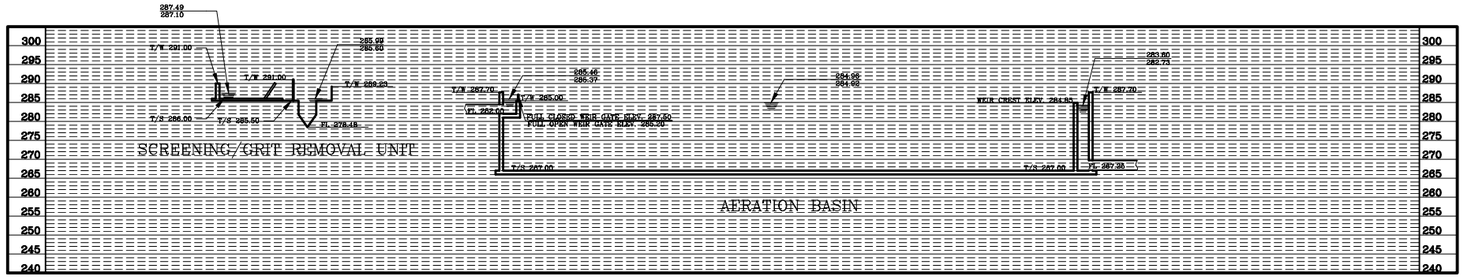
PROPOSED FLOW SCHEMATIC

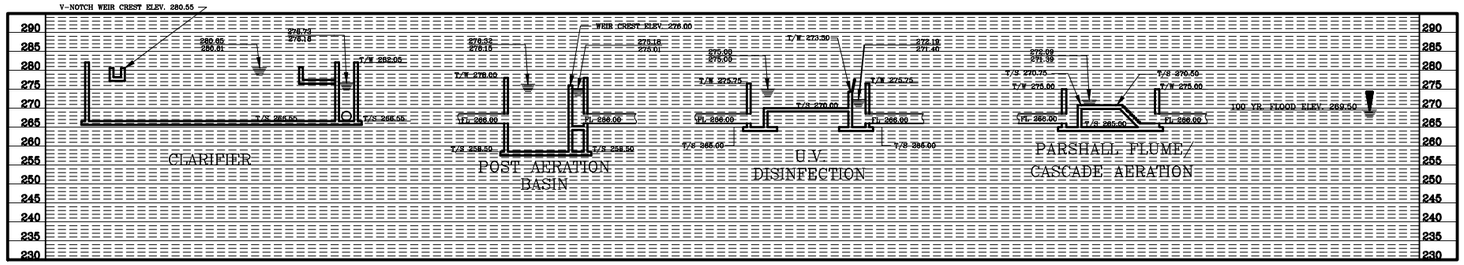
Job No.:TWU-02-23
Scale: N.T.S.
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7-20-26

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HYDRAULIC PROFILE

EXISTING DESIGN DATA

DESIGN FLOW, MGD	
Average Wet Weather Flow	0.95
Peak Hour Wet Weather Flow	3.00
DESIGN PARAMETERS, MG/L	
BOD_5	200
TSS^5	200
NH_3–N	35
DO^3	1
PERMIT PARAMETERS, MG/L (MONTHLY AVERAGE) MAY–OCTOBER	
CBOD	10
TSS^5	15
NH_3–N	4
DO^3	5
PERMIT PARAMETERS, MG/L (MONTHLY AVERAGE) NOVEMBER–APRIL	
CBOD	10
TSS^5	15
NH_3–N	6
DO^3	7
FCB	
APRIL – SEPT.	200 COLONIES/100ml
OCT. – MARCH	1000 COLONIES/100ml
PH	6–9 S.U.
INFLUENT PUMP STATION	
Number of Pumps	2
Single Pump Capacity, GPM	2140
SCREENING/GRIT REMOVAL	
Manual Bar Rack Spacing, IN.	1 3/8"
Automatic Screen Openings, Diameter IN.	0.25
Vortex Grit Removal, MGD	7.0
AERATION BASIN	
Volume, Cu. Ft. 2 EACH ●	51,520
Hydraulic Detention Time ● Avg. Flow, Hr.	19.50
Number of Blowers	2
Blower Hp., Each	75
Design Aerator O_2 Transfer ● Std. Cond., Lbs/Hr, Each	0.35
Organic Loading Rate lbs BOD/1000CF	15.40
FINAL CLARIFIER	
Diameter, Ft.	65
Sidewater Depth, Ft.	14
Surface Loading, GPD/SF	
Average Flow	143
Peak Flow	452
Weir Loading Rate ● Peak Flow, GPD/L.F.	4682
POST AERATION BASIN	
Volume, Cu. Ft.	4,135
Detention Time ● Peak Hour, Min.	15
U.V. DISINFECTION	
CHANNELS	2
MODULES	4
METERING BASIN	
FLUME THROAT WIDTH, IN.	18"
W/ INSERT, IN.	9"
R.A.S. (RETURN ACTIVATED SLUDGE) PUMP STATION	
Number of Pumps	2
Capacity, EA. PUMP GPM	1100
W.A.S. (WASTE SLUDGE) PUMP STATION	
Number of Pumps	2
Capacity, EA. PUMP GPM	120

PROPOSED DESIGN DATA

DESIGN FLOW, MGD	
Average Wet Weather Flow	1.95
Peak Hour Wet Weather Flow	6.00
DESIGN PARAMETERS, MG/L	
BOD_5	200
TSS^5	200
NH_3–N	35
DO^3	1
PERMIT PARAMETERS, MG/L (MONTHLY AVERAGE) MAY–OCTOBER	
CBOD	10
TSS^5	15
NH_3–N	4
DO^3	5
PERMIT PARAMETERS, MG/L (MONTHLY AVERAGE) NOVEMBER–APRIL	
CBOD	10
TSS^5	15
NH_3–N	6
DO^3	7
FCB	
APRIL – SEPT.	200 COLONIES/100ml
OCT. – MARCH	1000 COLONIES/100ml
PH	6–9 S.U.
INFLUENT PUMP STATION	
Number of Pumps	3
Single Pump Capacity, GPM	2140
SCREENING/GRIT REMOVAL	
Manual Bar Rack Spacing, IN.	1 3/8"
Automatic Screen Openings IN.	0.25
Vortex Grit Removal, MGD	7.0
AERATION BASIN	
Volume, Cu. Ft. 4 EACH ●	51,520
Hydraulic Detention Time ● Avg. Flow, Hr.	19.50
Number of Blowers	3
Blower Hp., Each	75
Design Aerator O_2 Transfer ● Std. Cond., Lbs/Hr, Each	0.35
Organic Loading Rate lbs BOD/1000CF	15.40
FINAL CLARIFIER	
Diameter, Ft.	65
Sidewater Depth, Ft.	14
Surface Loading, GPD/SF	
Average Flow	143
Peak Flow	452
Weir Loading Rate ● Peak Flow, GPD/L.F.	4682
POST AERATION BASIN	
Volume, Cu. Ft.	4,135
Detention Time ● Peak Hour, Min.	15
U.V. DISINFECTION	
CHANNELS	2
MODULES	6
METERING BASIN	
FLUME THROAT WIDTH, IN.	18"
W/ INSERT, IN.	9"
R.A.S. (RETURN ACTIVATED SLUDGE) PUMP STATION	
Number of Pumps	3
Capacity, EA. PUMP GPM	1100
W.A.S. (WASTE SLUDGE) PUMP STATION	
Number of Pumps	2
Capacity, EA. PUMP GPM	120

LEGEND

PEAK HOUR WATER SURFACE ELEV. AT 6.0 MGD

AVERAGE WATER SURFACE ELEV. AT 1.90 MGD

FL : FLOWLINE OF PIPE ELEVATION
T/S : TOP OF SLAB ELEVATION
T/W : TOP OF WALL ELEVATION

Date	Revision	By

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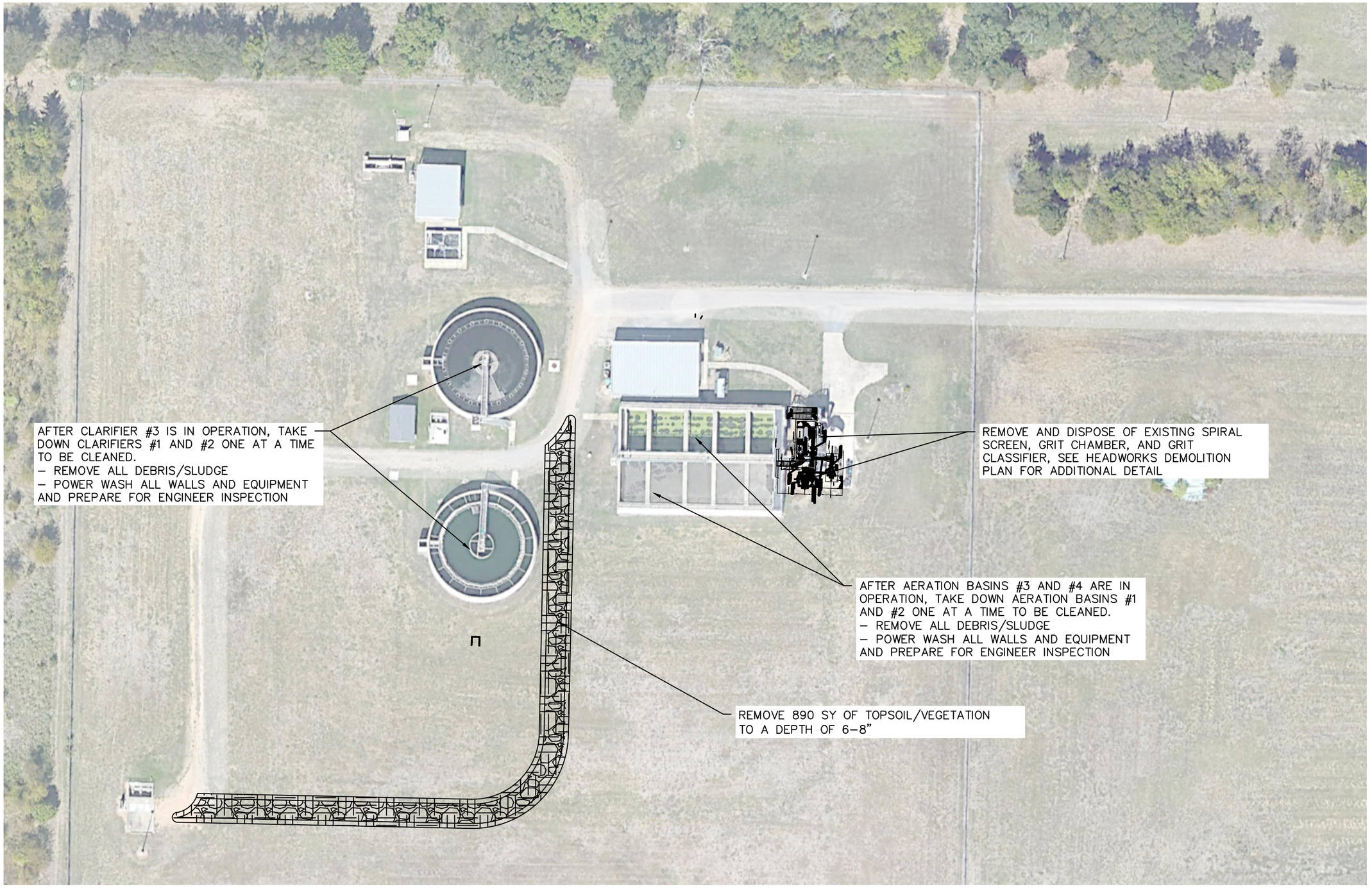
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NORTH WWTP
TEXARKANA, ARKANSAS 71854

HYDRAULIC PROFILE

Job No.:TWU–02–23
Scale: N/A
Date: 5/2026
Sheet 6

STATE OF ARKANSAS
LICENSED PROFESSIONAL ENGINEER
CALEB J. MUDFORD
No.17723
7-20-26

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SCALE: 1”=60’–0”

60

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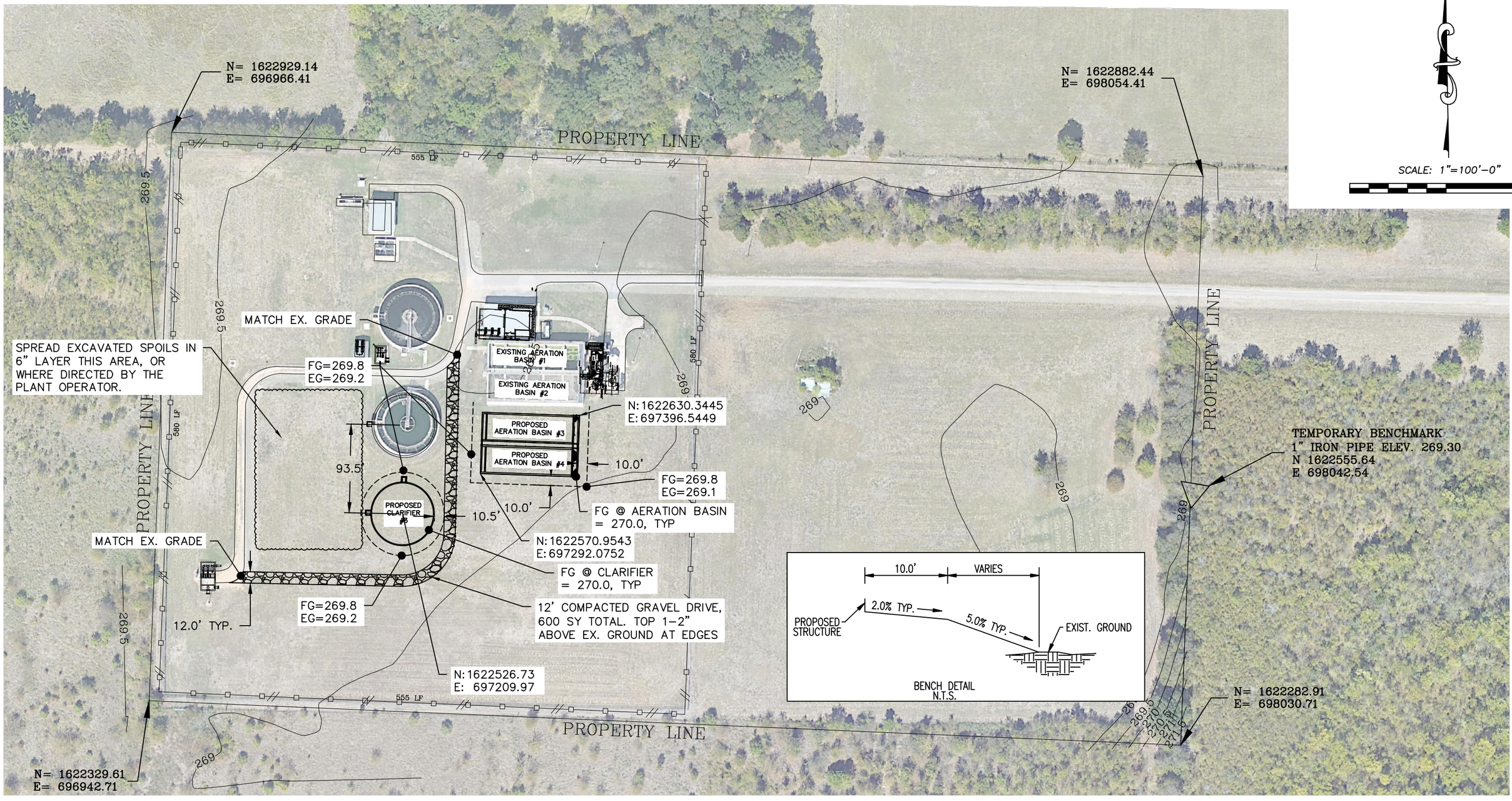
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TEXARKANA WATER UTILITIES
NORTH WWTP
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DEMOLITION PLAN

Job No.:TWU–02–23
Scale: 1”=60’
Date: 5/2026
Sheet 7

STATE OF ARKANSAS
LICENSED PROFESSIONAL ENGINEER
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CALEB J. MUDFORD
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TEXARKANA WATER UTILITIES
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SITE & GRADING PLAN

Job No.:	TWU-02-23
Scale:	1"=100'
Date:	5/2026
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STATE OF ARKANSAS
LICENSED PROFESSIONAL ENGINEER
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SCALE: 1"=30'-0"

30

CONNECT TO EX. 4" WAS WITH 4"X4" WYE

4" MJ 45° BEND

15" DRAIN TO INF.

EX. MANHOLE 3
RIM=270.00
6" CLAR#2 SCUM=265.00
12" RAS OVERFLOW=263.00
6" CLAR#1 DRAIN/SCUM=260.00
6" AERATION DRAIN=260.00
15" OUT (EX.)=260.00

CONNECT TO EX. 24" EFFLUENT, REMOVE EX. BLIND FLANGE, INSTALL FLANGE COUPLING ADAPTER & 24" MJ SLEEVE INV.=266.60

90 L.F. OF 24" CLASS 200 D.I. EFFLUENT PIPE @ 0.20% SLOPE

245 L.F. OF 4" CLASS 200 D.I. WAS PIPE

24" STUB OUT W/BLIND FLANGE

4" MJ 45° BEND INV.=267.00

INSTALL 1" CORP STOP ON EX. 4" NON-POTABLE WATER MAIN

4"WAS DISCHARGE

15" DRAIN TO INF.

EX. MANHOLE 1
RIM=270.00
12" IN (NEW)=264.30 (DROP)
15" IN (EX.)=256.53
15" OUT (EX.)=256.53

4" WAS

6" SCUM

12" RAS OVFL

15" DRAIN TO INF.

SWM "A"

24" EFFLUENT

WDS "B"

8" RAS

6" MAS DRAIN

18" MIX. LIQ.

CORE 14" HOLE IN SIDE OF RAS BASIN, CONNECT CLARIFIER #3 RAS LINE INV.=266.00

CLAR#3 RAS INV.=266.09
CLAR#2 RAS INV.=263.80

6" DRAIN

RAS INV.=266.36
DRAIN INV.=263.70

RAS INV.=266.36
MX LQ INV.=265.50
FIELD VERIFY!

216 L.F. OF 10" D.I. RAS PIPE @ 0.45% SLOPE

SEE CLARIFIER #3 PLANS FOR PIPING CONTINUATION

PROPOSED MANHOLE
RIM=270.00
6" CLARIFIER DRAIN IN=267.00
6" SCUM LINE IN=267.00
12" DRAIN OUT=265.90

160 L.F. OF 12" C900 PVC DRAIN @ 1.0% SLOPE

REMOVE EX. BLIND FLANGE, CONNECT TO EX. 18" AIR LINE W/ 18" FLANGE COUPLING ADAPTER

INSTALL 3" D.I. TEE & 3" BALL VALVE ON NON POTABLE WATER MAIN

10" MJ 45° BEND
INV. N=266.82
INV. S=266.91

SEE AERATION BASIN PLANS FOR PIPING CONTINUATION

18" MJ TEE, W/ 18" MJ PLUG SOUTH
INV.=262.80

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TEXARKANA WATER UTILITIES
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YARD PIPING

Job No.:TWU-02-23
Scale: 1"=30'
Date: 5/2026
Sheet 9

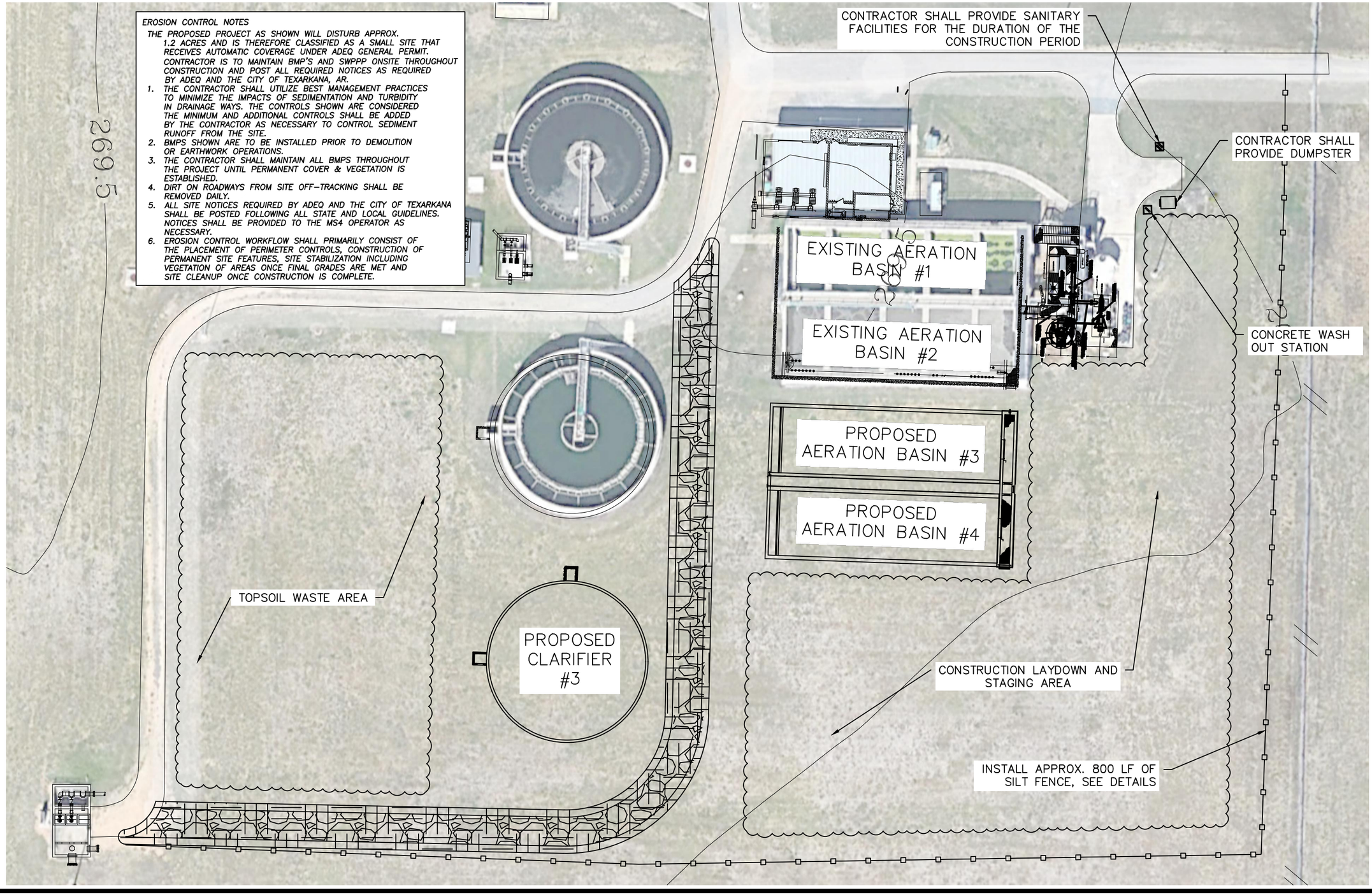
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EROSION CONTROL NOTES

THE PROPOSED PROJECT AS SHOWN WILL DISTURB APPROX. 1.2 ACRES AND IS THEREFORE CLASSIFIED AS A SMALL SITE THAT RECEIVES AUTOMATIC COVERAGE UNDER ADEQ GENERAL PERMIT. CONTRACTOR IS TO MAINTAIN BMP'S AND SWPPP ONSITE THROUGHOUT CONSTRUCTION AND POST ALL REQUIRED NOTICES AS REQUIRED BY ADEQ AND THE CITY OF TEXARKANA, AR.

1. THE CONTRACTOR SHALL UTILIZE BEST MANAGEMENT PRACTICES TO MINIMIZE THE IMPACTS OF SEDIMENTATION AND TURBIDITY IN DRAINAGE WAYS. THE CONTROLS SHOWN ARE CONSIDERED THE MINIMUM AND ADDITIONAL CONTROLS SHALL BE ADDED BY THE CONTRACTOR AS NECESSARY TO CONTROL SEDIMENT RUNOFF FROM THE SITE.
2. BMPS SHOWN ARE TO BE INSTALLED PRIOR TO DEMOLITION OR EARTHWORK OPERATIONS.
3. THE CONTRACTOR SHALL MAINTAIN ALL BMPS THROUGHOUT THE PROJECT UNTIL PERMANENT COVER & VEGETATION IS ESTABLISHED.
4. DIRT ON ROADWAYS FROM SITE OFF-TRACKING SHALL BE REMOVED DAILY.
5. ALL SITE NOTICES REQUIRED BY ADEQ AND THE CITY OF TEXARKANA SHALL BE POSTED FOLLOWING ALL STATE AND LOCAL GUIDELINES. NOTICES SHALL BE PROVIDED TO THE MS4 OPERATOR AS NECESSARY.
6. EROSION CONTROL WORKFLOW SHALL PRIMARILY CONSIST OF THE PLACEMENT OF PERIMETER CONTROLS, CONSTRUCTION OF PERMANENT SITE FEATURES, SITE STABILIZATION INCLUDING VEGETATION OF AREAS ONCE FINAL GRADES ARE MET AND SITE CLEANUP ONCE CONSTRUCTION IS COMPLETE.



SCALE: 1"=40'-0"

40

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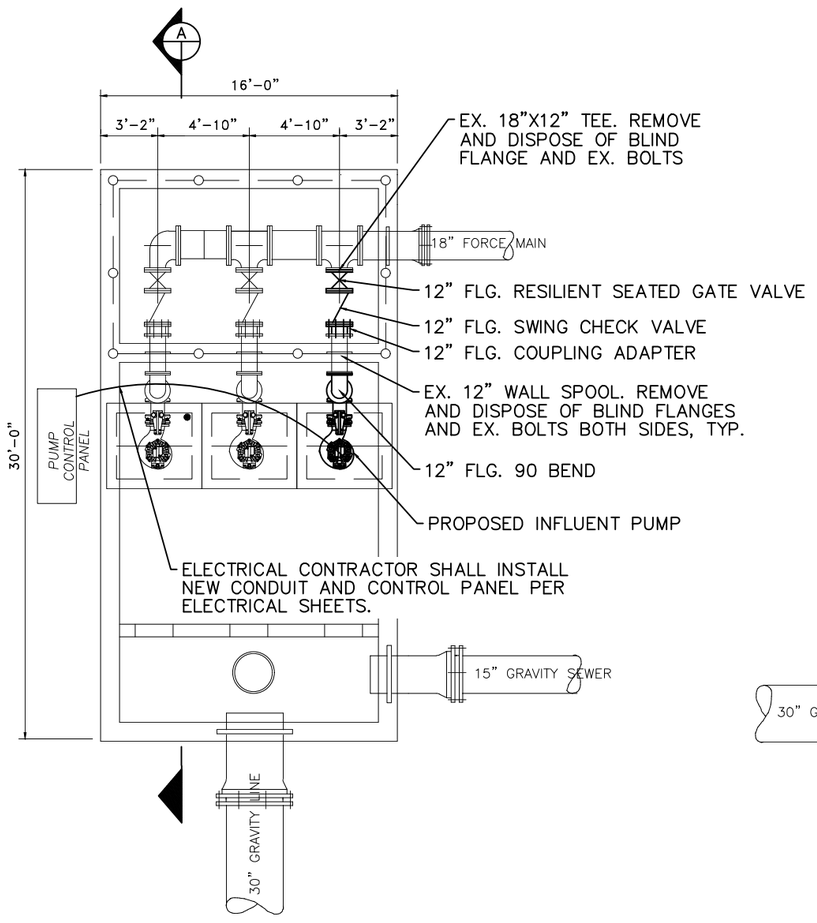
EROSION & SEDIMENT CONTROL PLAN

Job No.:TWU-02-23
Scale: 1"=40'
Date: 5/2026
Sheet 10

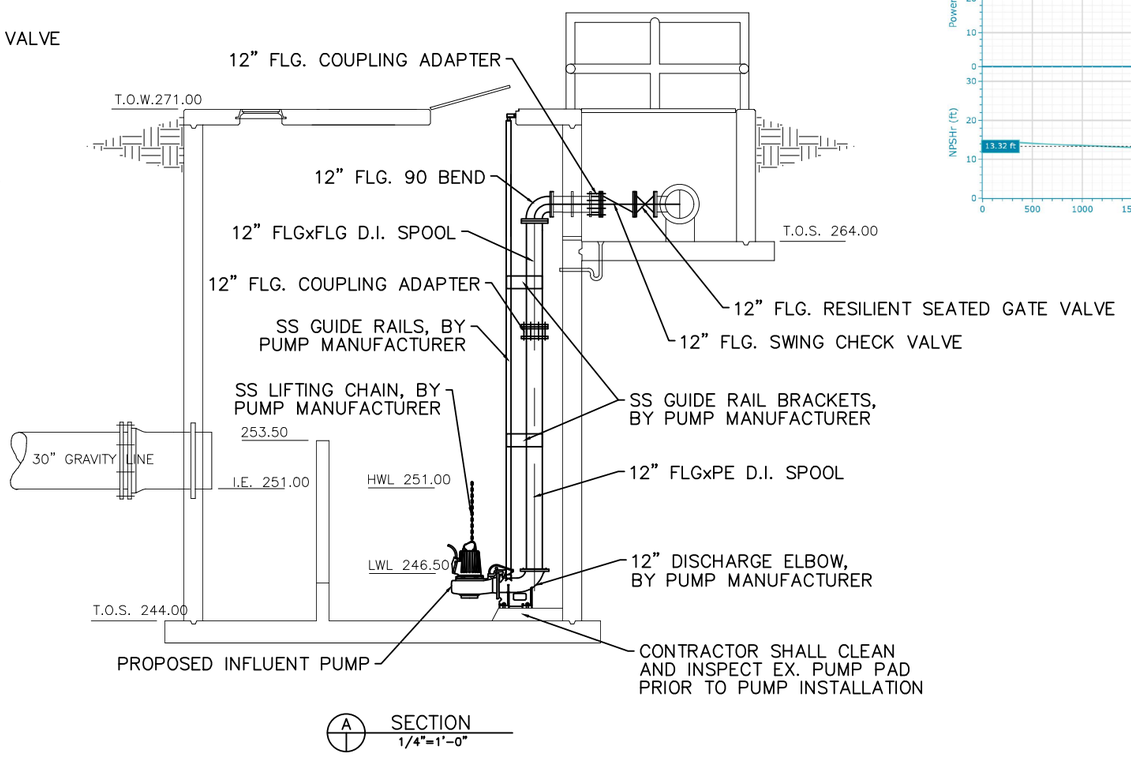
STATE OF ARKANSAS
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LIFT STATION DATA	
TOP ELEVATION	271.00
BOTTOM ELEVATION	244.00
30" INFLUENT PIPE FL. EL.	251.00
PUMP CAPACITY (GPM)	2149
PUMP DESIGN TDH (FT)	46
MOTOR BHP	35
MINIMUM EFFICENCY	75%
FLYGT NP 3202 MT 3-642 OR EQUAL	

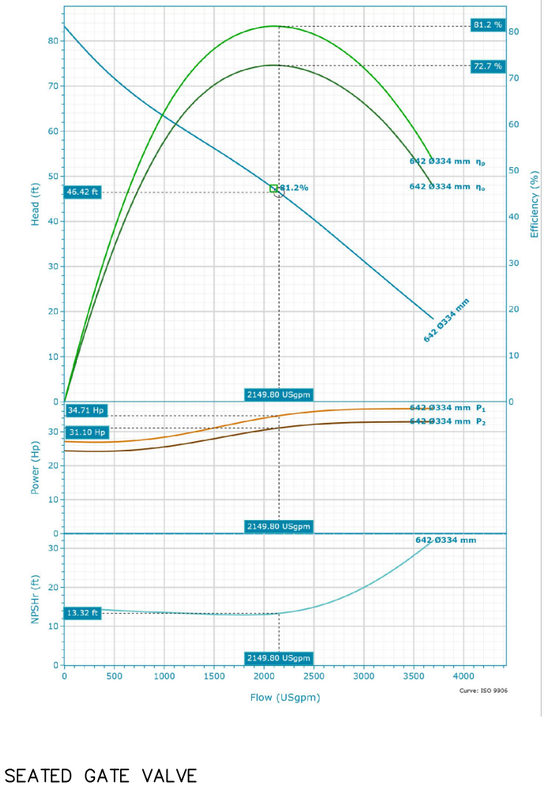
NOTE: MOTOR SHALL BE SIZED FOR FULL RANGE OF PUMP OPERATIONS.



MECHANICAL SECTIONAL PLAN
1/4"=1'-0"



A SECTION
1/4"=1'-0"



Date	Revision	By

Designed CJM
Checked KSB
Drawn CJM
Approved KSB

A.L. FRANKS ENGINEERING
118 East Broad Street
Texarkana, Arkansas 71854
Phone (870) 216-1906
Fax (870) 216-1907

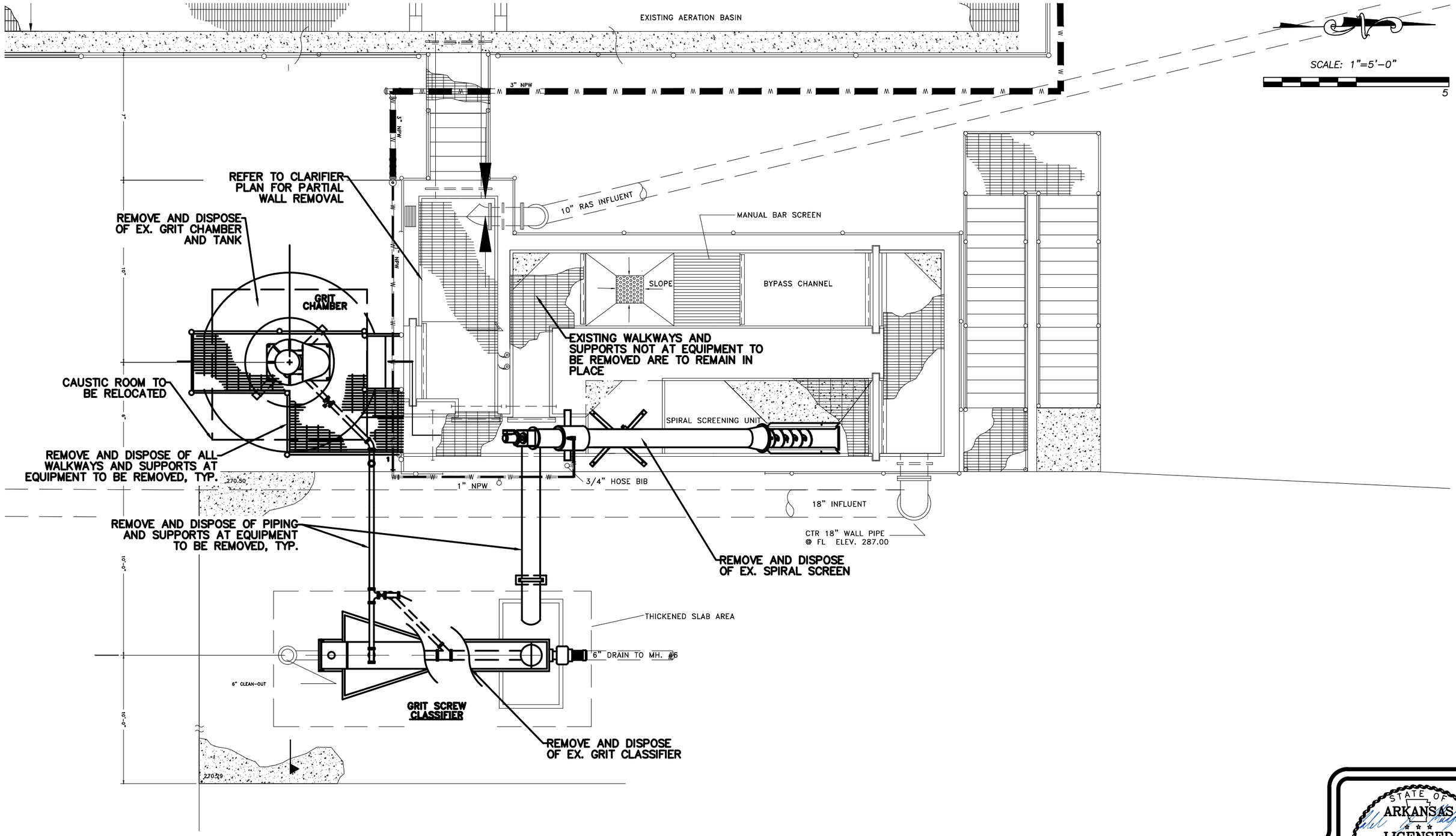
TEXARKANA WATER UTILITIES
NORTH WWTP
TEXARKANA, ARKANSAS 71854

INFLUENT PUMP STATION

Job No.:TWU-02-23
Scale: N/A
Date: 5/2026
Sheet 11

STATE OF ARKANSAS
LICENSED PROFESSIONAL ENGINEER
No.17723
CALEB J. MUDFORD
7-20-26

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Date	Revision	By

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TEXARKANA WATER UTILITIES
NORTH WWTP
TEXARKANA, ARKANSAS 71854

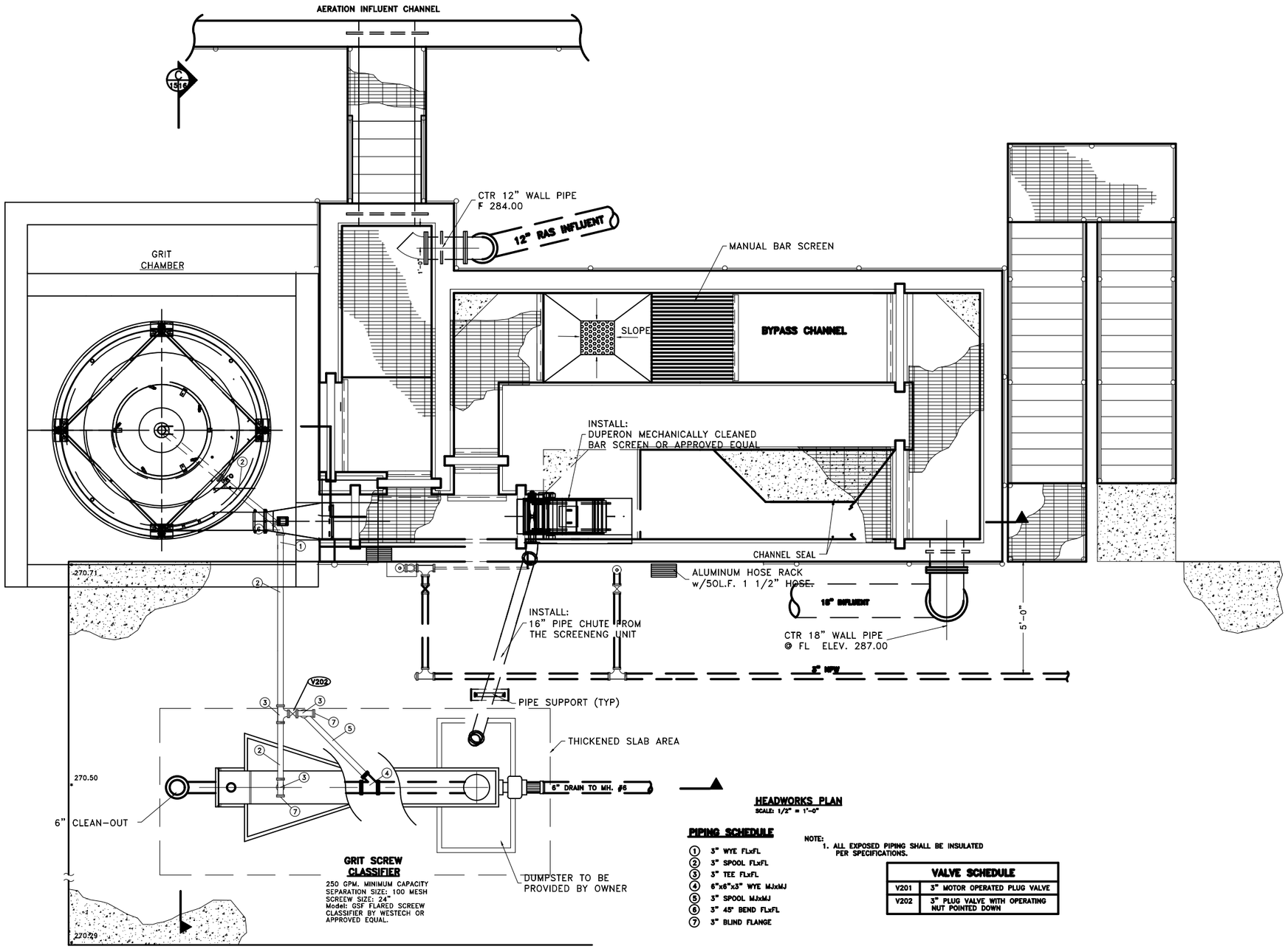
HEADWORKS DEMOLITION PLAN

Job No.:TWU-02-23
Scale: 1"=5'
Date: 5/2026
Sheet 12

STATE OF ARKANSAS
LICENSED PROFESSIONAL ENGINEER
No.17723
CALEB J. MUDFORD
7-20-26

SCALE: 1"=5'-0"

5



GRIT SCREW CLASSIFIER

250 GPM. MINIMUM CAPACITY
SEPARATION SIZE: 100 MESH
SCREEW SIZE: 24"
Model: GSF FLARED SCREEW
CLASSIFIER BY WESTECH OR
APPROVED EQUAL.

HEADWORKS PLAN
SCALE: 1/2" = 1'-0"

PIPING SCHEDULE

1. 3" WYE FLxFL
2. 3" SPOOL FLxFL
3. 3" TEE FLxFL
4. 6"x6"x3" WYE MJxMJ
5. 3" SPOOL MJxMJ
6. 3" 45° BEND FLxFL
7. 3" BLIND FLANGE

NOTE:
1. ALL EXPOSED PIPING SHALL BE INSULATED PER SPECIFICATIONS.

VALVE SCHEDULE	
V201	3" MOTOR OPERATED PLUG VALVE
V202	3" PLUG VALVE WITH OPERATING NUT POINTED DOWN

Date	Revision	By

Designed CJM
Checked KSB
Drawn CJM
Approved KSB

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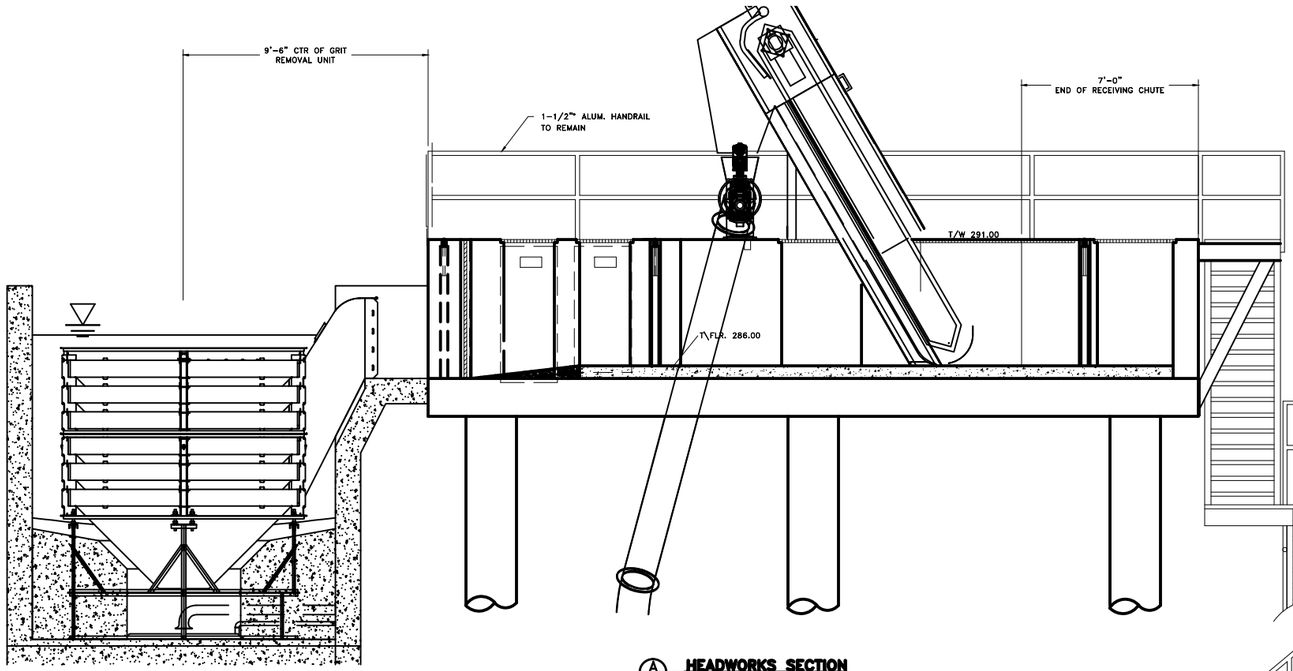
TEXARKANA WATER UTILITIES
NORTH WWTP
TEXARKANA, ARKANSAS 71854

HEADWORKS PLAN

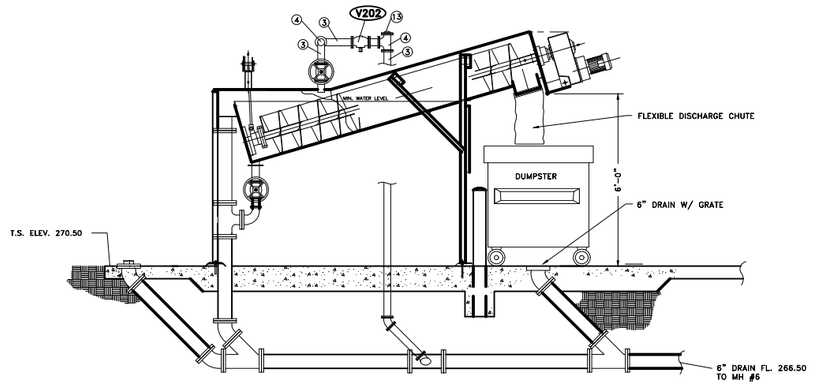
Job No.:TWU-02-23
Scale: 1"=5'
Date: 5/2026
Sheet 13

STATE OF ARKANSAS
LICENSED PROFESSIONAL ENGINEER
CALEB J. MUDFORD
No.17723
5-18-26

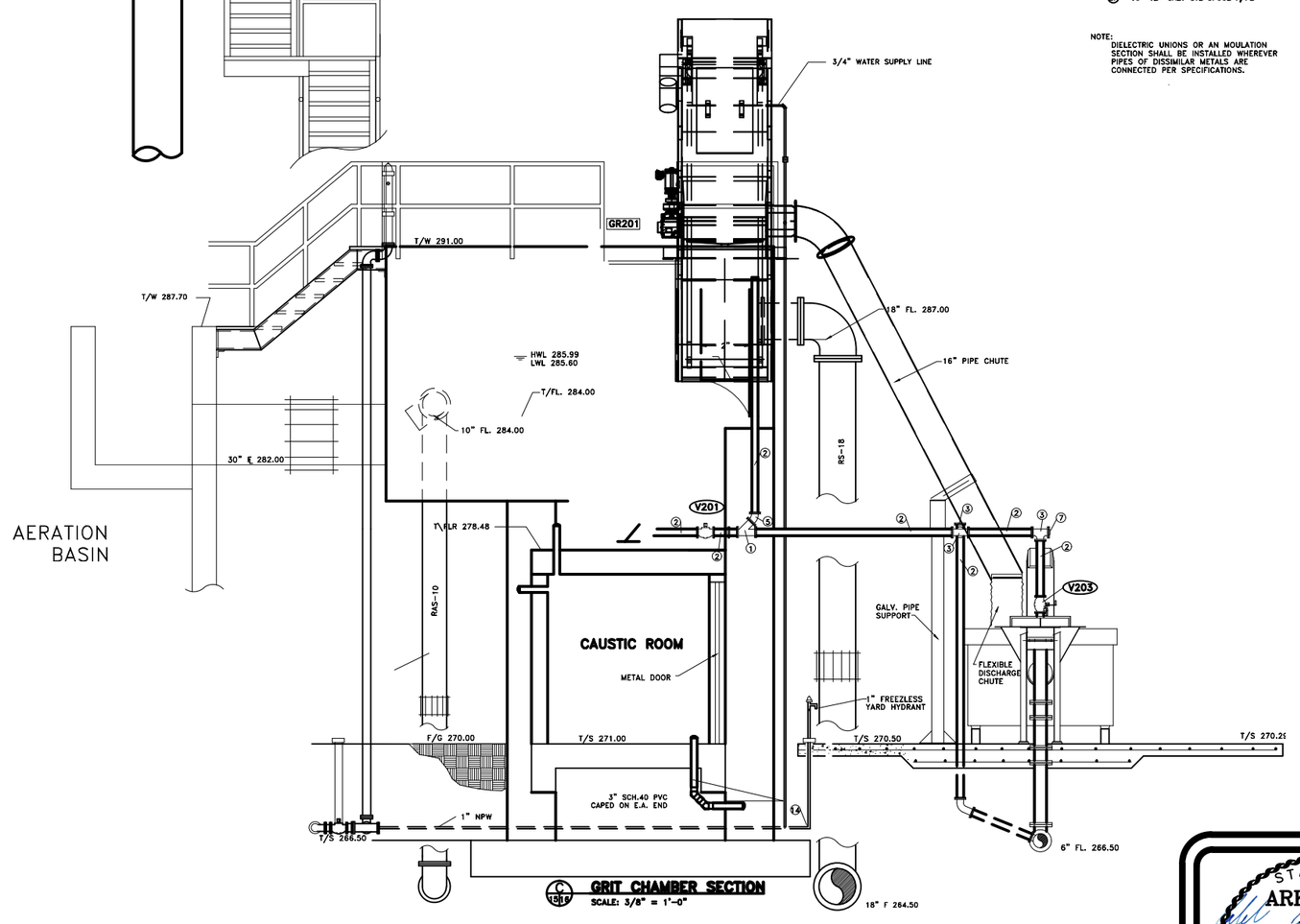
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A 1SHT **HEADWORKS SECTION**
SCALE: 3/8" = 1'-0"



B 1SHT **GRIT SCREW CLASSIFIER**
SCALE: 3/8" = 1'-0"



C 1SHT **GRIT CHAMBER SECTION**
SCALE: 3/8" = 1'-0"

1. 3" WYE FLxFL
2. 3" 90° BEND FLxFL
3. 3" SPOOL FLxFL
4. 3" TEE FLxFL
5. 6"x6"x3" WYE MJxMJ
6. 3" SPOOL MJxMJ
7. 3" 45° BEND FLxFL
8. 12" WALL PIPE FLxPE
9. 12" GALV STL 90° BEND F/F
10. 18" WALL PIPE FLxPE
11. 18" GALV STL 90° BEND F/F
12. 3"x1" REDUCER
13. 3" BLIND FLANGE
14. 1" 90° BEND T/T
15. 1" SPOOL T/T
16. 1" BALL VALVE T/T
17. 12" GALV STL 45° BEND F/PE
18. 2" SPOOL FLxFL
19. 4"x2" REDUCING 90° BEND FLxFL
20. 6"x4" TEE FLxFL
21. 6" SPOOL FLxFL
22. 6" 45° BEND FLxFL
23. 6" WYE MJxMJ
24. 18" FLEXIBLE COUPLING ADAPTER
25. 18" GALV STL SPOOL F/PE
26. 10"-18" FLEXIBLE COUPLING ADAPTER
27. 10"-18" GALV STL SPOOL F/PE

NOTE:
DIELECTRIC UNIONS OR AN MOULATION SECTION SHALL BE INSTALLED WHEREVER PIPES OF DISSIMILAR METALS ARE CONNECTED PER SPECIFICATIONS.

Date	Revision	By

Designed CJM
Checked KSB
Drawn CJM
Approved KSB

A.L. FRANKS ENGINEERING
118 East Broad Street
Texarkana, Arkansas 71854
Phone (870) 216-1906
Fax (870) 216-1907

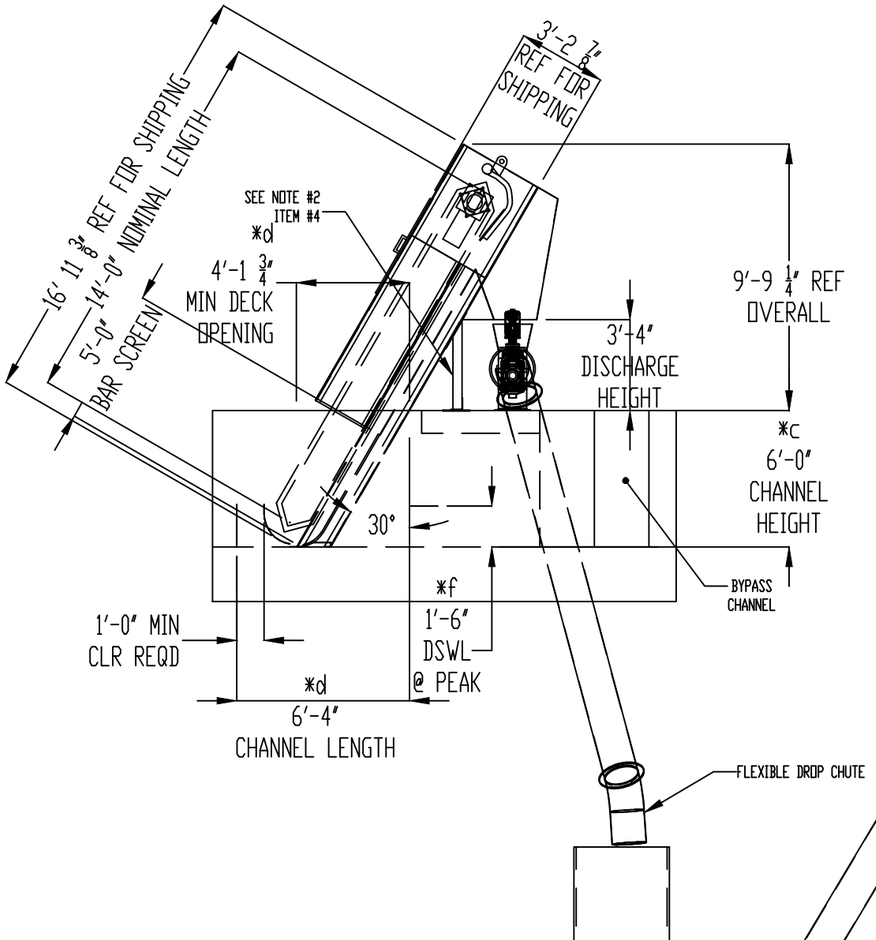
TEXARKANA WATER UTILITIES
NORTH WWTP
TEXARKANA, ARKANSAS 71854

HEADWORKS DETAILS

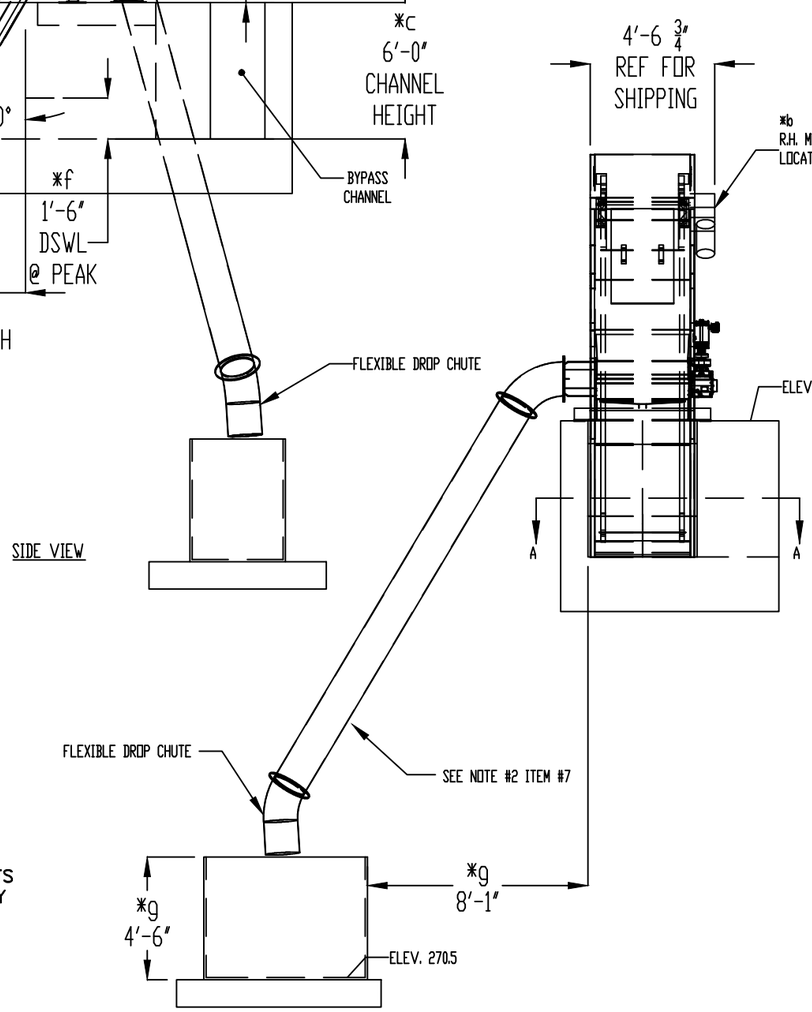
Job No.: TWU-02-23
Scale: N/A
Date: 5/2026
Sheet 14

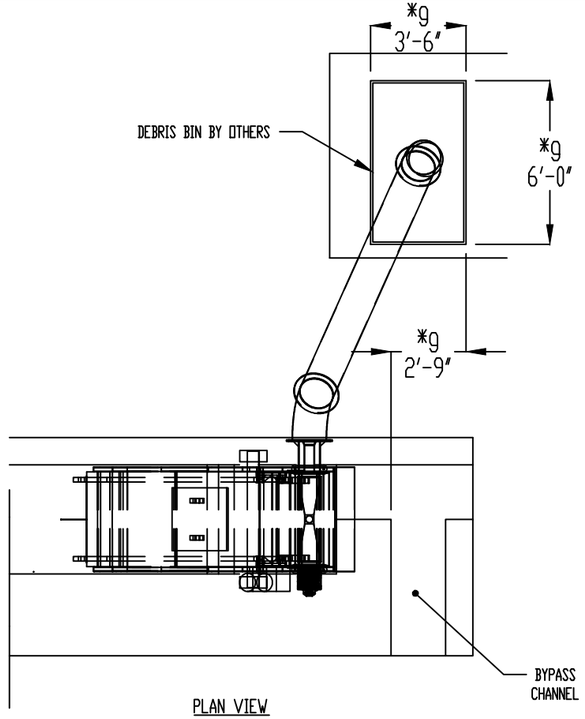
STATE OF ARKANSAS
LICENSED PROFESSIONAL ENGINEER
No. 17723
CALEB J. MUDFORD
5-18-26

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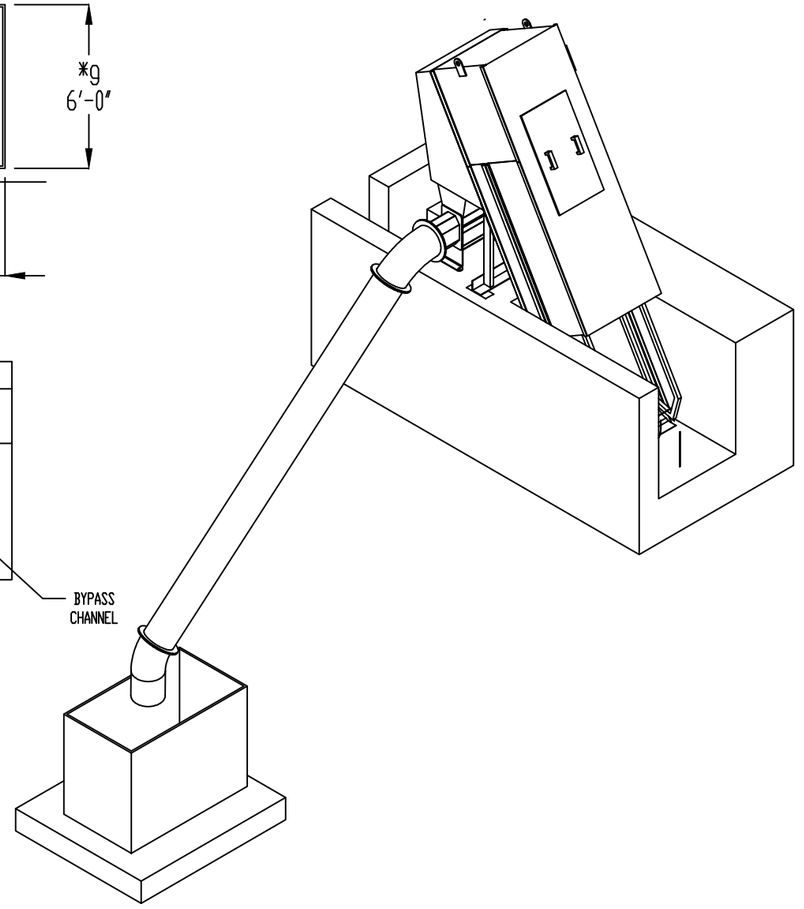


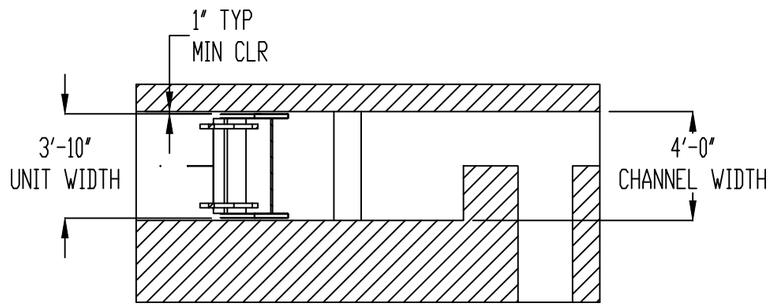
SIDE VIEW





PLAN VIEW





SECTION A-B

NOTES
VERIFY ALL DIMENSIONS PRIOR TO INSTALLATION

COMPACTOR CHUTE ROUTING SHOWN IS CONCEPTUAL AND FLOOR SUPPORTS SHALL BE PROVIDED AS REQUIRED BY DUPERON

MECHANICAL BAR SCREEN TO BE DUPERON FLEX RAKE

Date	Revision	By

Designed CJM
Checked KSB
Drawn CJM
Approved KSB

A. L. FRANKS ENGINEERING
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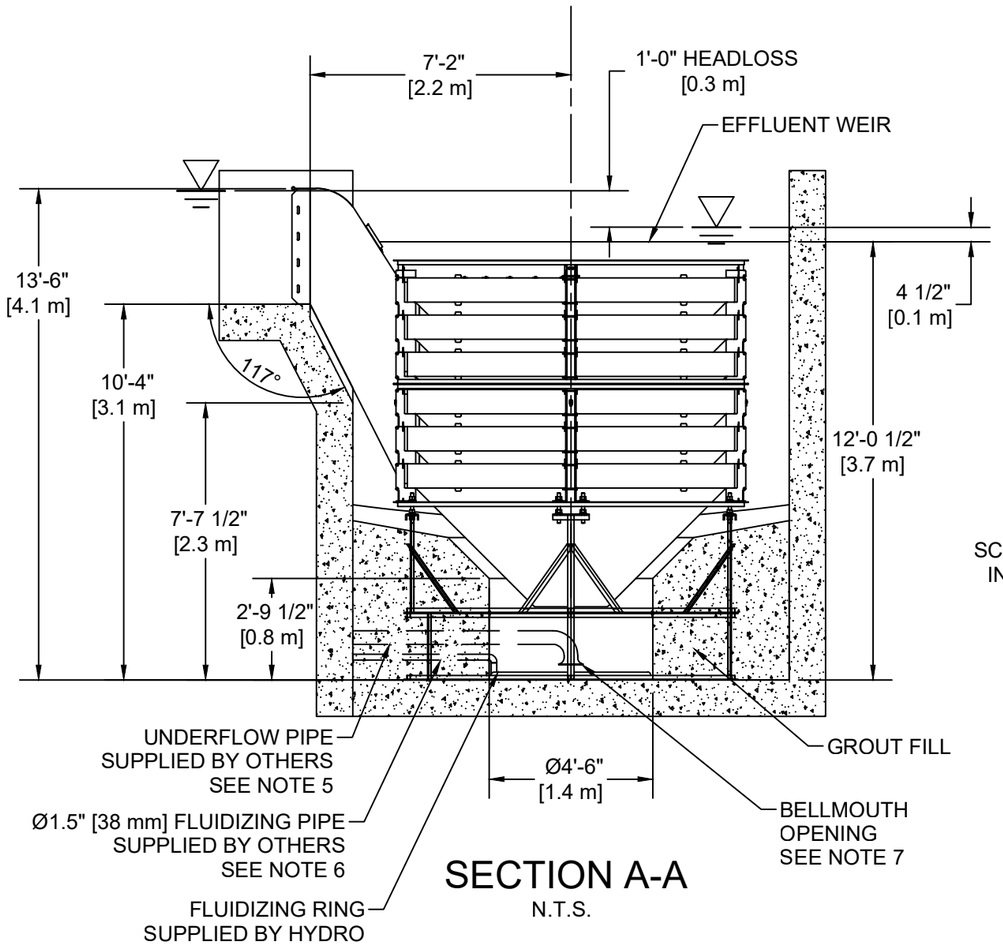
TEXARKANA WATER UTILITIES
NORTH WWTP
TEXARKANA, ARKANSAS 71854

MECHANICAL BAR SCREEN

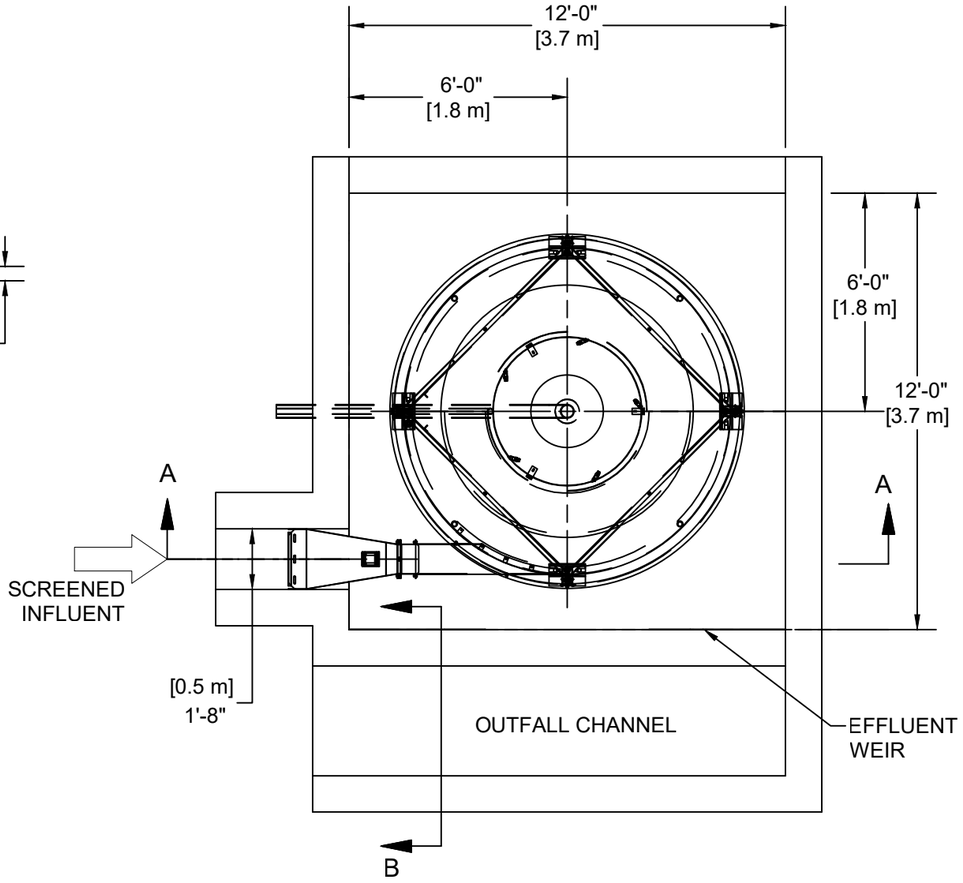
Job No.:TWU-02-23
Scale: N/A
Date: 5/2026
Sheet 15

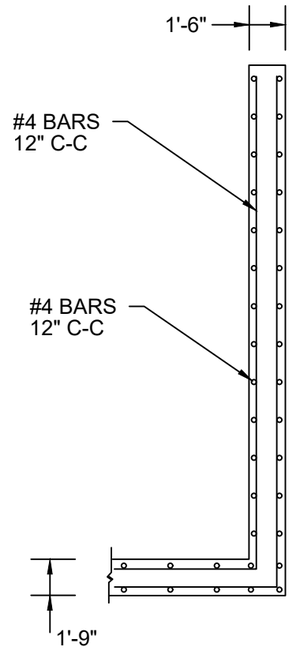
STATE OF ARKANSAS
LICENSED PROFESSIONAL ENGINEER
No.17723
CALEB J. MUDFORD
5-18-26

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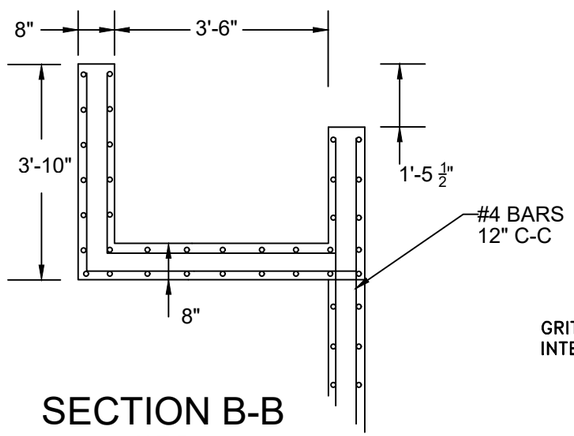
SECTION A-A
N.T.S.





WALL SECTION

DEGRITTED
EFFLUENT



SECTION B-B
N.T.S.

NOTE:

FOUNDATION SHALL BE OVER EXCAVATED TO A MINIMUM DEPTH OF 3.0' AND REPLACED WITH SELECT FILL. CONTRACTOR SHALL FOLLOW GUIDANCE IN GEOTECHNICAL REPORT PERFORMED BY ETTL ENGINEERS & CONSULTANTS DATED SEPTEMBER 4, 2025 FOR ALL FOUNDATION AND SITE PREPARATION REQUIREMENTS.

GRIT CHAMBER TO BE HYDRO INTERNATIONAL HEADCELL

STATE OF ARKANSAS
LICENSED PROFESSIONAL ENGINEER
CALEB J. MUDFORD
No.17723
7-20-26

Date	Revision	By

Designed CJM
Checked KSB
Drawn CJM
Approved KSB

A.L. FRANKS ENGINEERING
118 East Broad Street
Texarkana, Arkansas 71854
Phone (870) 216-1906
Fax (870) 216-1907

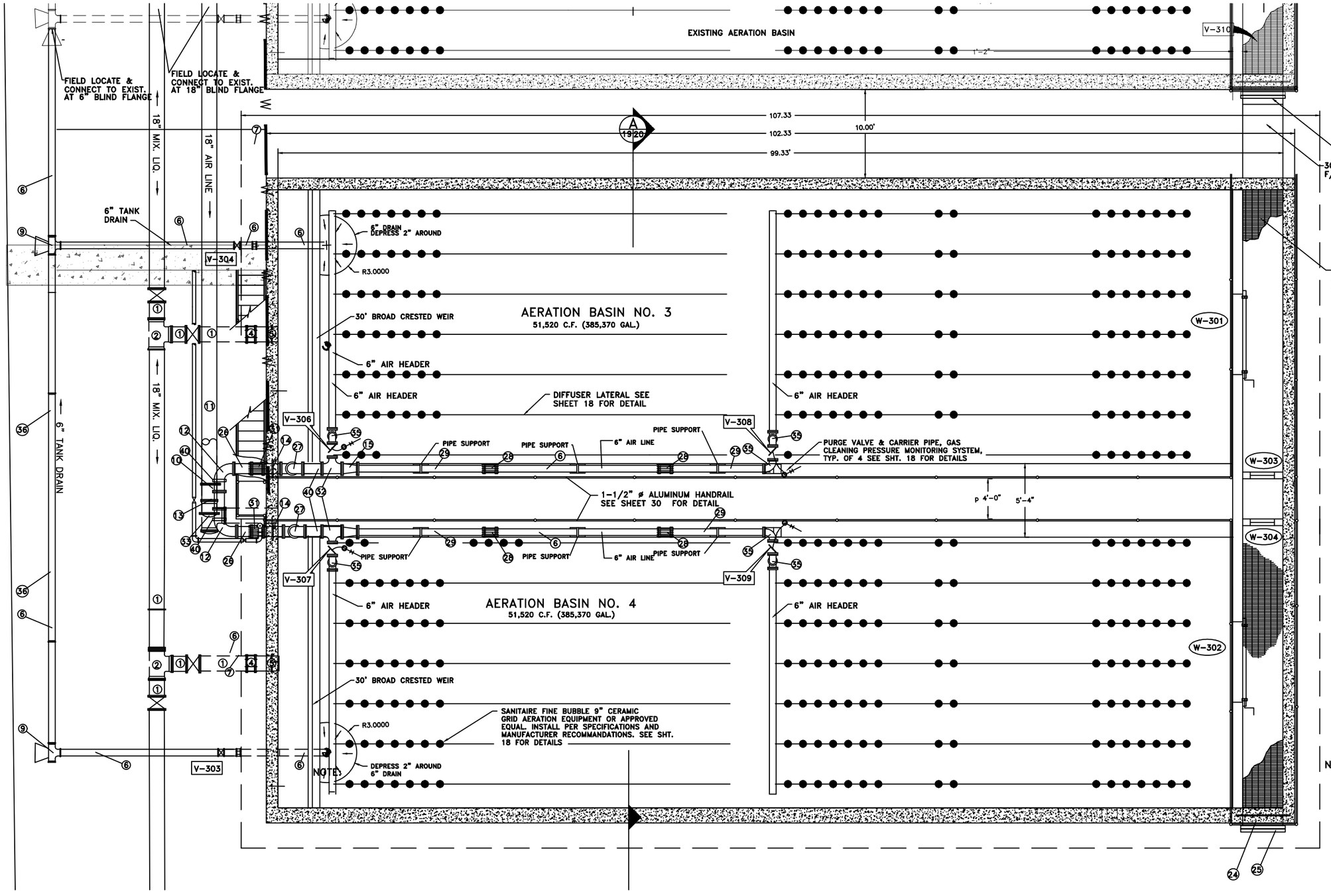
FRONT VIEW

TEXARKANA WATER UTILITIES
NORTH WWTP
TEXARKANA, ARKANSAS 71854

GRIT CHAMBER

Job No.:TWU-02-23
Scale: N/A
Date: 5/2026
Sheet 16

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PIPING SCHEDULE

1	18" SPOOL PE xPE
2	18" TEE MJ/MJ
3	18" x 18" CROSS MJ/MJ
4	18" FLANGE COUPLING ADAPTOR
5	18" WALL PIPE PE/PE
6	6" SPOOL PE x PE
7	6" FLANGE COUPLING ADAPTOR
8	6" 90° BEND MJ/MJ
9	6" x 6" TEE MJ/MJ
10	18" x 12" TEE F/F
11	18" SPOOL FxF
12	12"x8" RED. SR 90° BEND FxF
13	12" TEE FxF
14	8" WALL PIPE FXF
15	8" X 6" ECCEENTRIC REDUCER F X F
16	30" FLANGE COUPLING ADAPTOR
17	30" SPOOL PE/PE
18	3" SPOOL F/F
19	3" WALL PIPE F/F
20	3" BLIND FLANGE
21	3" X 3" TEE F/F
22	3" 90 ° BEND F/F
23	30" WALL PIPE F/F
24	30" WALL PIPE F/F
25	30" BLIND FLANGE
26	8" SPOOL F/PE
27	8" 90° BEND F/F
28	6" DRESSER COUPLING
29	6" SPOOL F/PE
30	6X6 TEE F/F
31	8" FLANGED COUPLING ADAPTOR
32	8"x6" TEE F/F
33	18" BLIND FLANGE
34	6" MJ PLUG
35	6" 90° BEND F/F
36	6" SPOOL MJ/PE
37	3" 45° BEND F/F
38	18" MJ PLUG
39	3" FCA
40	8" SPOOL F/F

NOTE:

DIELECTRIC UNIONS OR AN MOULATION SECTION SHALL BE INSTALLED WHEREVER PIPES OF DISSIMILAR METALS ARE CONNECTED PER SPECIFICATIONS.

Date	Revision	By

Designed CJM
Checked KSB
Drawn CJM
Approved KSB

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TEXARKANA WATER UTILITIES
NORTH WWTP
TEXARKANA, ARKANSAS 71854

AERATION BASIN PLAN

Job No.:TWU-02-23
Scale: 1"=10'
Date: 5/2026
Sheet 17

STATE OF ARKANSAS
LICENSED PROFESSIONAL ENGINEER
CALEB J. MUDFORD
No.17723
7-20-26

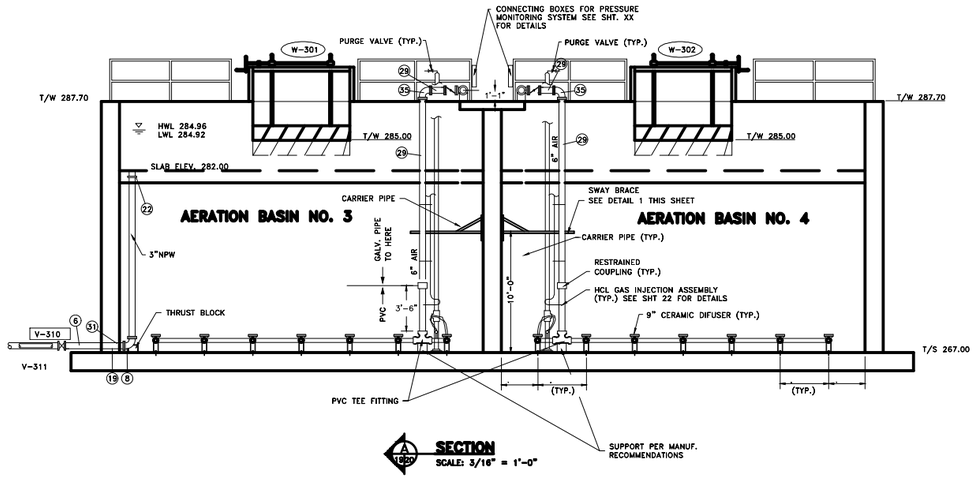
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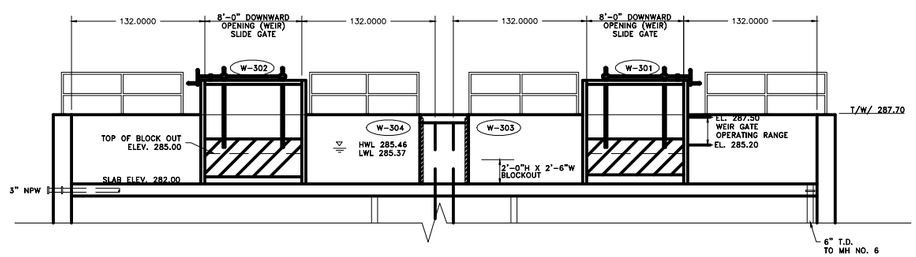
FOUNDATION SHALL BE OVER EXCAVATED TO A MINIMUM DEPTH OF 3.0' AND REPLACED WITH SELECT FILL. CONTRACTOR SHALL FOLLOW GUIDANCE IN GEOTECHNICAL REPORT PERFORMED BY ETTL ENGINEERS & CONSULTANTS DATED SEPTEMBER 4, 2025 FOR ALL FOUNDATION AND SITE PREPARATION REQUIREMENTS.

VALVE SCHEDULE			
V-301	18" MJ PLUG VALVE WITH BOX	V-306	6" BUTTERFLY VALVE – WAFER
V-302	18" MJ PLUG VALVE WITH BOX	V-307	6" BUTTERFLY VALVE – WAFER
V-303	6" MJ PLUG VALVE WITH BOX	V-308	6" BUTTERFLY VALVE – WAFER
V-304	6" MJ PLUG VALVE WITH BOX	V-309	6" BUTTERFLY VALVE – WAFER
V-305	18" MJ PLUG VALVE WITH BOX	V-310	6" MJ PLUG VALVE WITH BOX
		V-311	3" MJ GATE VALVE WITH BOX

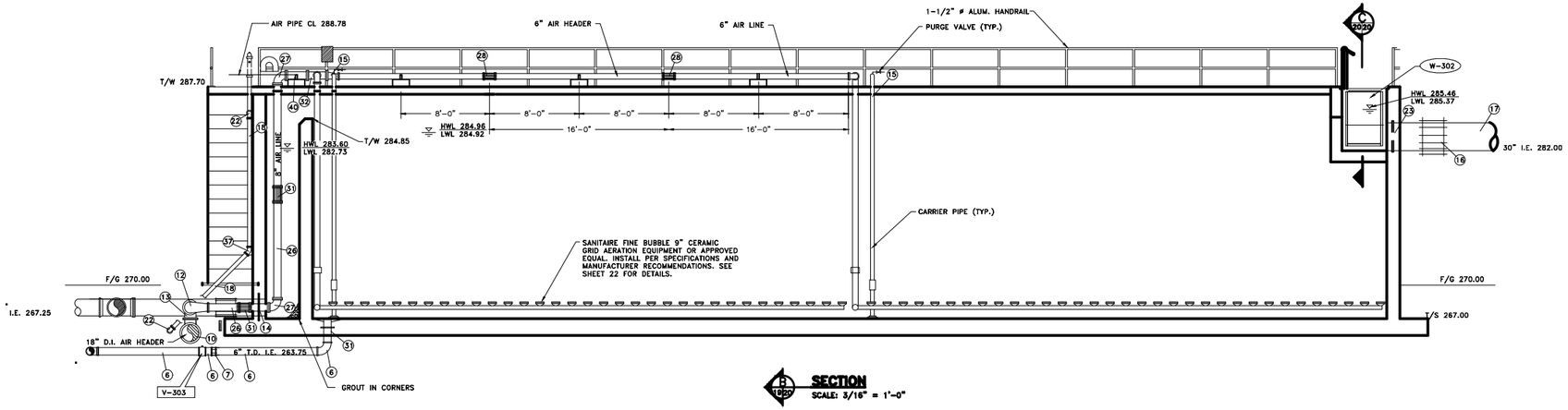
WEIR GATE SCHEDULE	
W-301	8' x 36" DOWNWARD OPENING WEIR GATE W/ TANDEM ACTIVATOR
W-302	8' x 36" DOWNWARD OPENING WEIR GATE W/ TANDEM ACTIVATOR
W-303	30" ALUMINUM STOP GATE
W-304	30" ALUMINUM STOP GATE



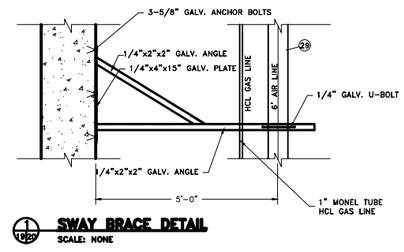
A 1D20 **SECTION**
SCALE: 3/16" = 1'-0"



C 2D20 **SECTION**
SCALE: 3/16" = 1'-0"



B 1D20 **SECTION**
SCALE: 3/16" = 1'-0"



1 1D20 **SWAY BRACE DETAIL**
SCALE: NONE

Date	Revision	By

Designed CJM
Checked KSB
Drawn CJM
Approved KSB

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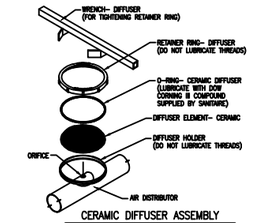
TEXARKANA WATER UTILITIES
NORTH WWTP
TEXARKANA, ARKANSAS 71854

AERATION BASIN DETAILS

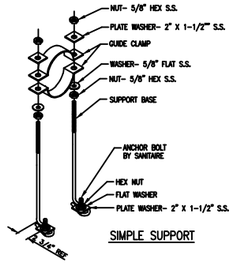
Job No.:TWU-02-23
Scale: N/A
Date: 5/2026
Sheet 18

STATE OF ARKANSAS
LICENSED PROFESSIONAL ENGINEER
No.17723
CALEB J. MUDFORD
7-20-26

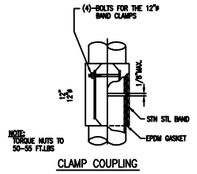
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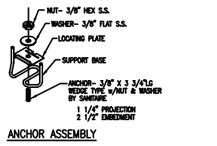
CERAMIC DIFFUSER ASSEMBLY



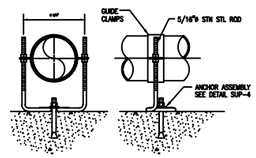
SIMPLE SUPPORT



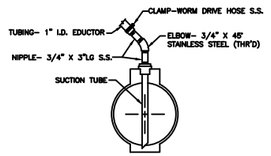
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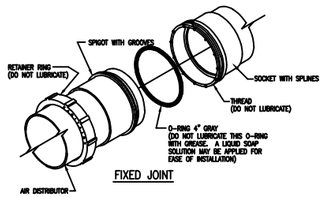
ANCHOR ASSEMBLY



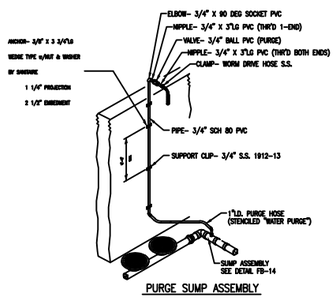
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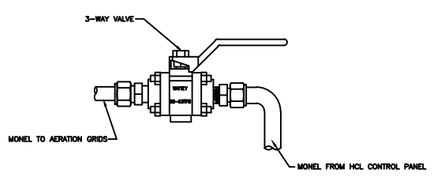
PURGE SUMP



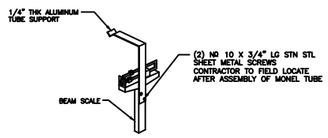
FIXED JOINT



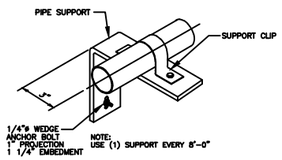
PURGE SUMP ASSEMBLY



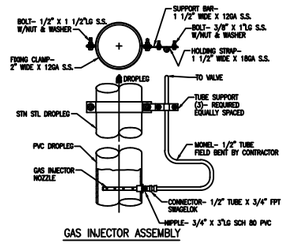
2-WAY VALVE



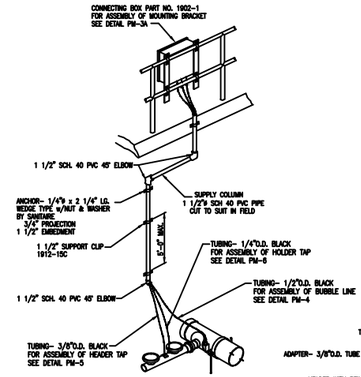
TUBE SUPPORT DETAIL GC-23



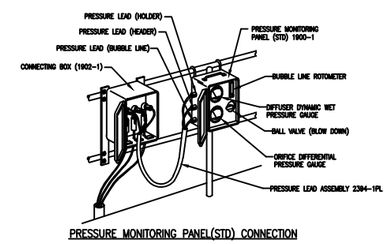
MONEL TUBE SUPPORT



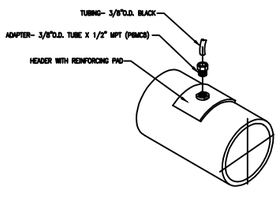
GAS INJECTOR ASSEMBLY



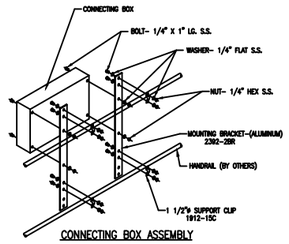
PRESSURE MONITORING ASSEMBLY



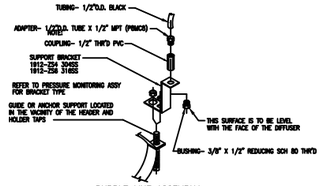
PRESSURE MONITORING PANEL(STD) CONNECTION



HEADER TAP ASSEMBLY



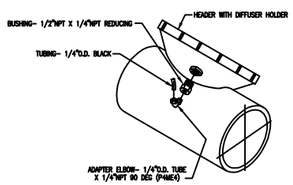
CONNECTING BOX ASSEMBLY



BUBBLE LINE ASSEMBLY

NOTE:

ALL SUBMERGED BOLTS, NUTS, WASHERS, CONNECTOR, ETC. SHALL BE STAINLESS STEEL.



HOLDER TAP ASSEMBLY

Date	Revision	By

Designed CJM
Checked KSB
Drawn CJM
Approved KSB

A.L. FRANKS ENGINEERING
118 East Broad Street
Texarkana, Arkansas 71854
Phone (870) 216-1906
Fax (870) 216-1907

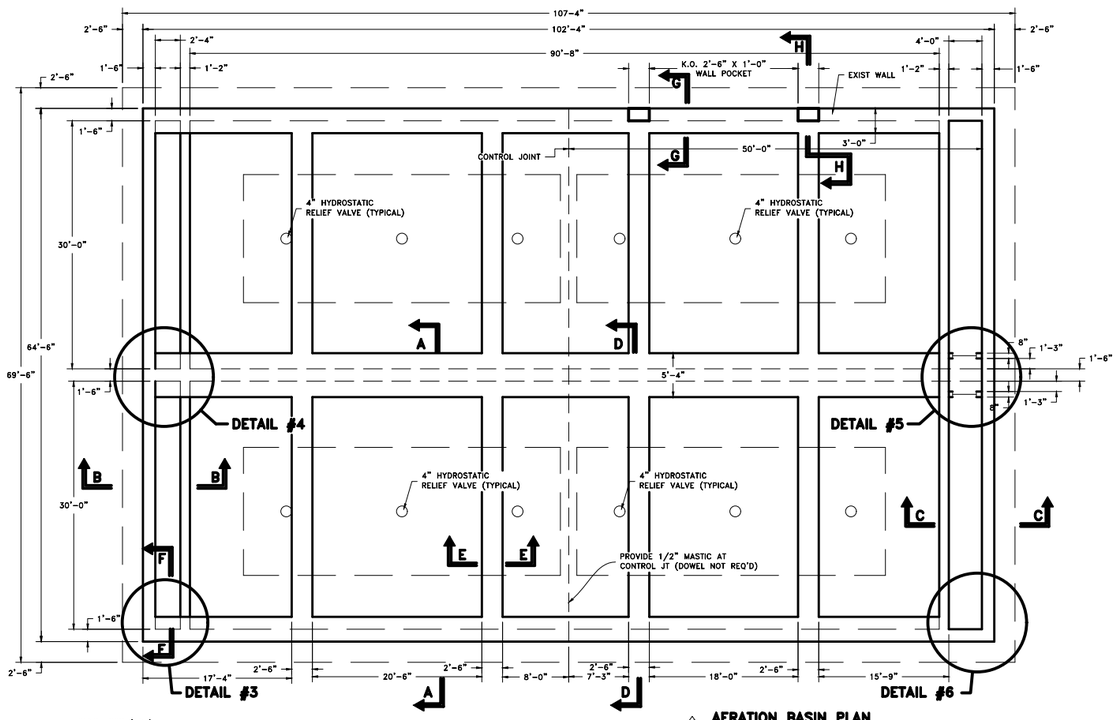
TEXARKANA WATER UTILITIES
NORTH WWTP
TEXARKANA, ARKANSAS 71854

AERATION BASIN DETAILS

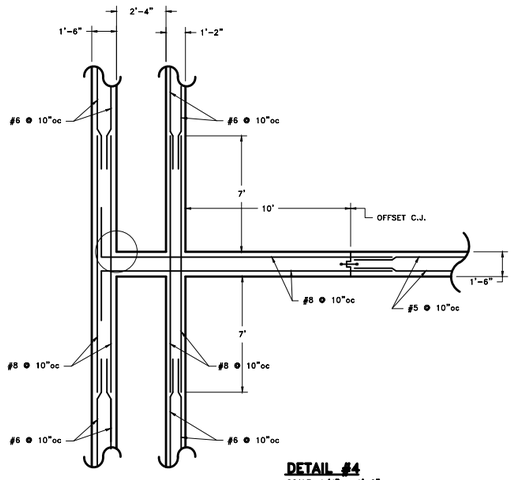
Job No.:TWU-02-23
Scale: N/A
Date: 5/2026
Sheet 19

STATE OF ARKANSAS
LICENSED PROFESSIONAL ENGINEER
No.17723
CALEB J. MUDFORD
5-18-26

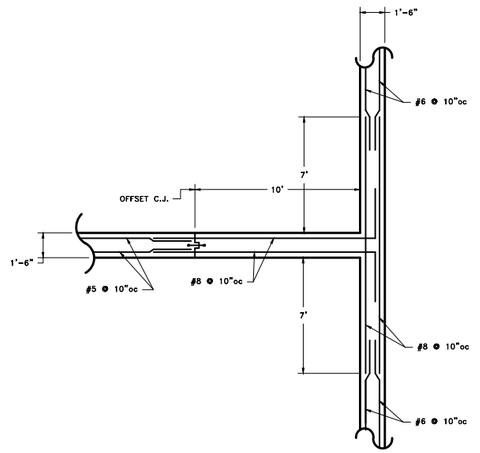
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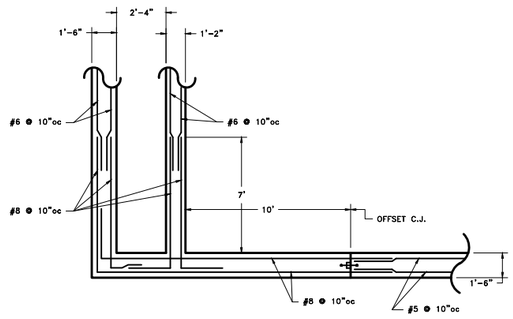
AERATION BASIN PLAN
SCALE: 1/8" = 1'-0"



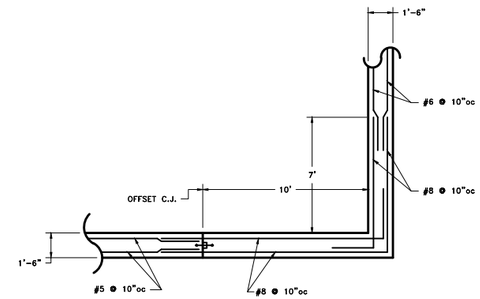
DETAIL #4
SCALE: 1/4" = 1'-0"



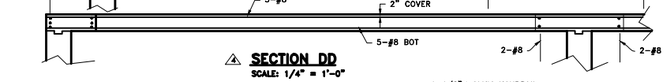
DETAIL #5
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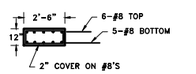
DETAIL #3
SCALE: 1/4" = 1'-0"



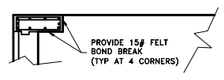
DETAIL #6
SCALE: 1/4" = 1'-0"



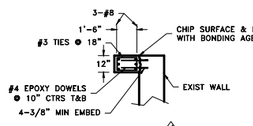
SECTION DD
SCALE: 1/4" = 1'-0"



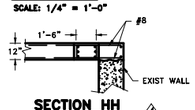
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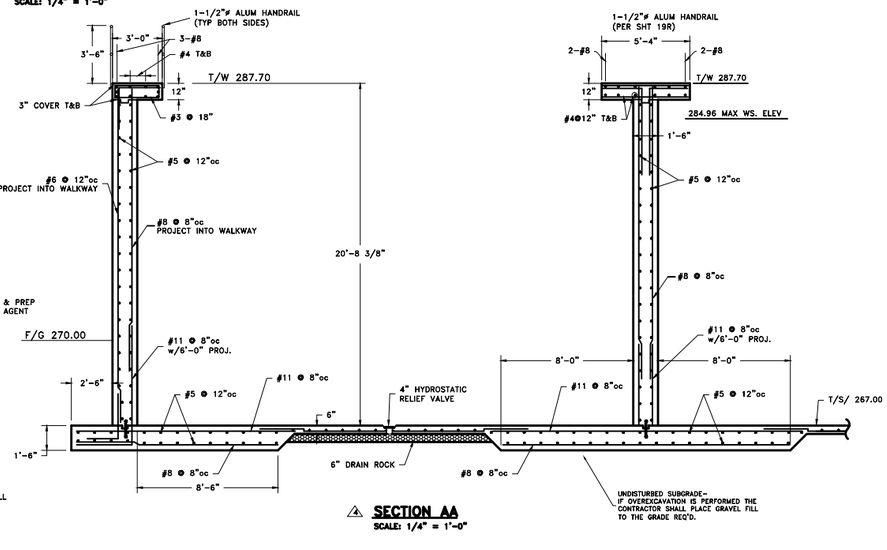
SECTION FF
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SECTION GG
SCALE: 1/4" = 1'-0"

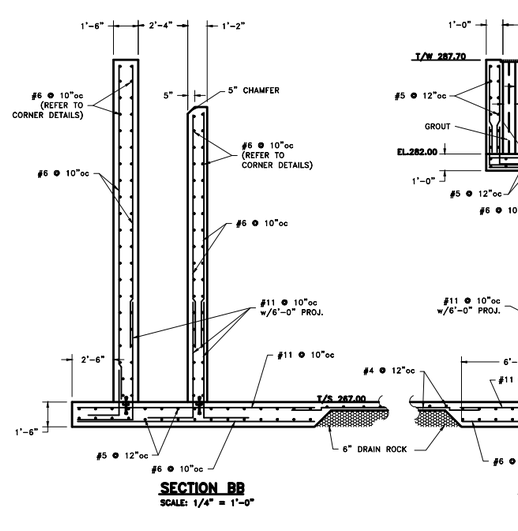


SECTION HH
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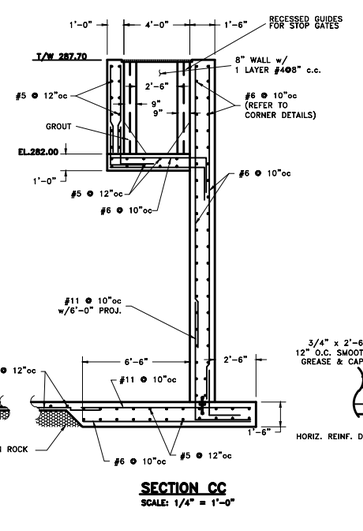


SECTION AA
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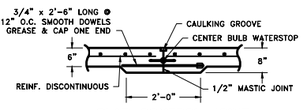
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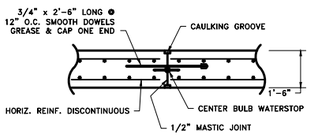
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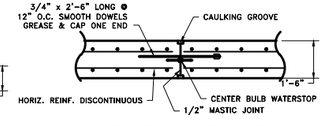
SECTION CC
SCALE: 1/4" = 1'-0"



SLAB CONTROL JOINT
SCALE: 3/8" = 1'-0"



WALL CONTROL JT.
SCALE: 3/8" = 1'-0"



FOOTING CONTROL JT.
SCALE: 3/8" = 1'-0"

Date	Revision	By

Designed	CJM
Checked	KSB
Drawn	CJM
Approved	KSB

A.L. FRANKS ENGINEERING
118 East Broad Street
Texarkana, Arkansas 71854
Phone (870) 216-1906
Fax (870) 216-1907

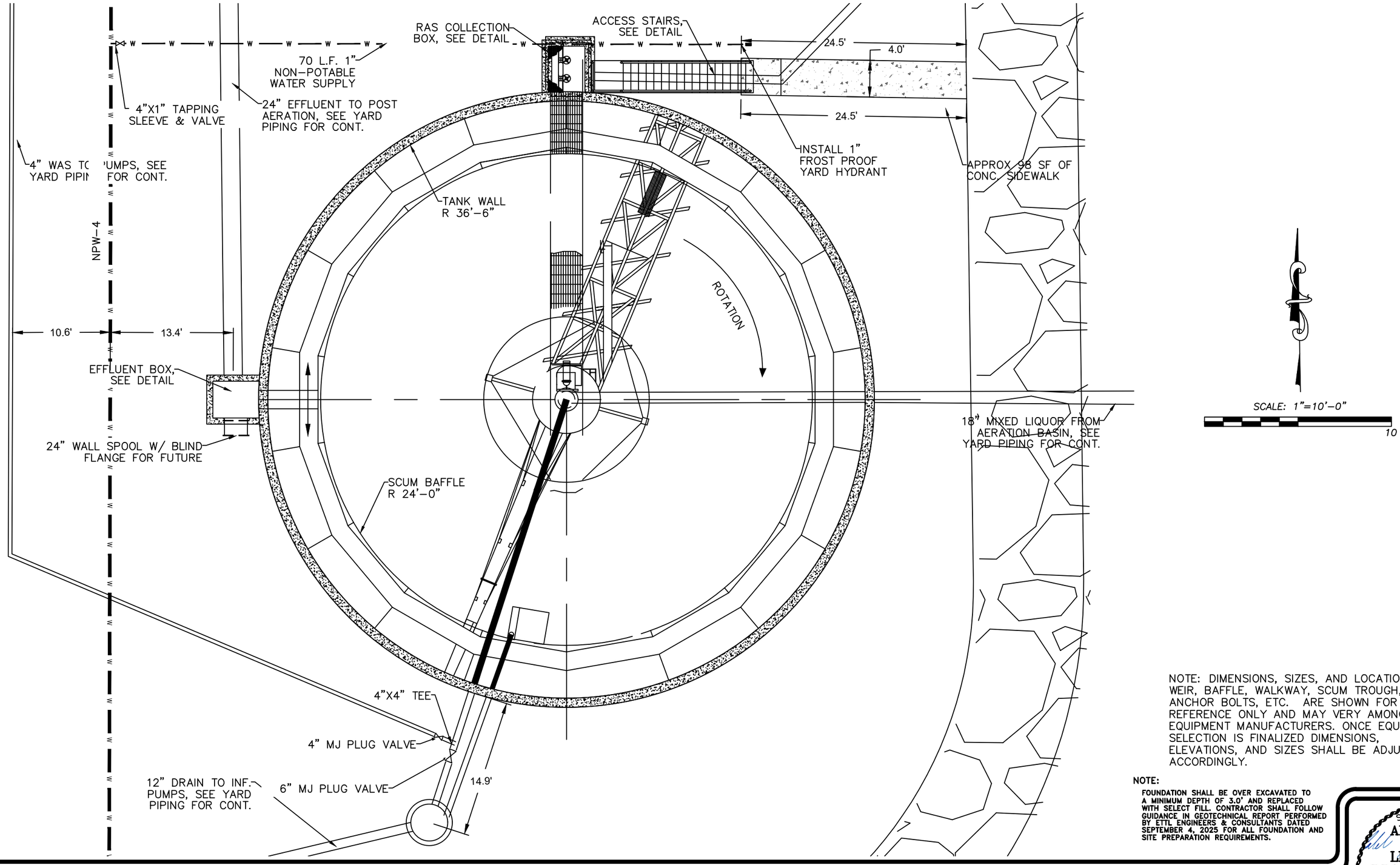
TEXARKANA WATER UTILITIES
NORTH WWTP
TEXARKANA, ARKANSAS 71854

AERATION BASIN
STRUCTURAL DETAILS

Job No.:	TWU-02-23
Scale:	N/A
Date:	5/2026
Sheet	20

STATE OF ARKANSAS
LICENSED PROFESSIONAL ENGINEER
No.17723
CALEB J. MUDFORD
5-18-26

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NOTE: DIMENSIONS, SIZES, AND LOCATIONS OF WEIR, BAFFLE, WALKWAY, SCUM TROUGH, AND ANCHOR BOLTS, ETC. ARE SHOWN FOR REFERENCE ONLY AND MAY VERY AMONG EQUIPMENT MANUFACTURERS. ONCE EQUIPMENT SELECTION IS FINALIZED DIMENSIONS, ELEVATIONS, AND SIZES SHALL BE ADJUSTED ACCORDINGLY.

NOTE:

FOUNDATION SHALL BE OVER EXCAVATED TO A MINIMUM DEPTH OF 3.0' AND REPLACED WITH SELECT FILL. CONTRACTOR SHALL FOLLOW GUIDANCE IN GEOTECHNICAL REPORT PERFORMED BY ETTL ENGINEERS & CONSULTANTS DATED SEPTEMBER 4, 2025 FOR ALL FOUNDATION AND SITE PREPARATION REQUIREMENTS.

Date	Revision	By

Designed	CJM
Checked	KSB
Drawn	CJM
Approved	KSB

A. L. FRANKS ENGINEERING
118 East Broad Street
Texarkana, Arkansas 71854
Phone (870) 216-1906
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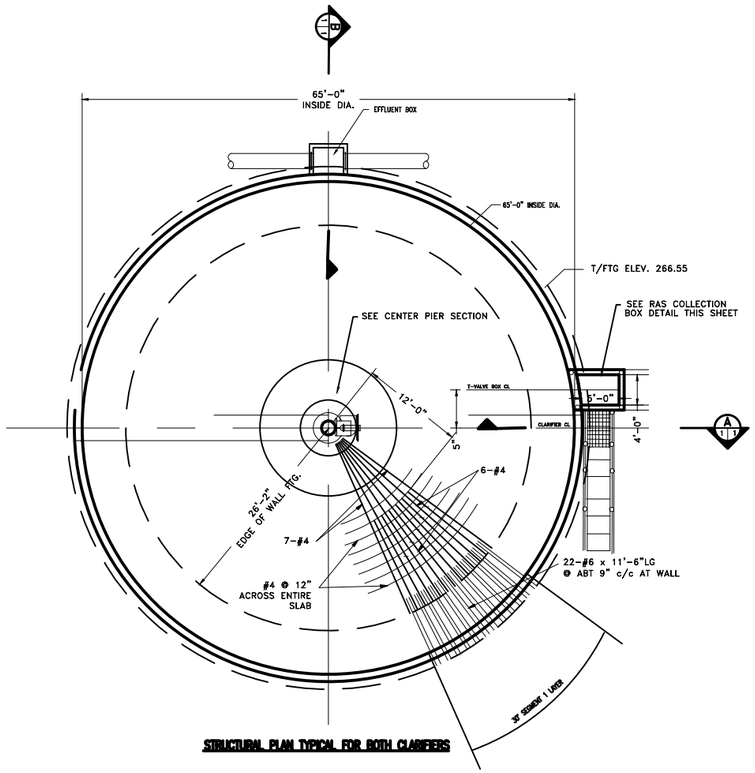
TEXARKANA WATER UTILITIES
NORTH WWTP
TEXARKANA, ARKANSAS 71854

CLARIFIER #3 PLAN

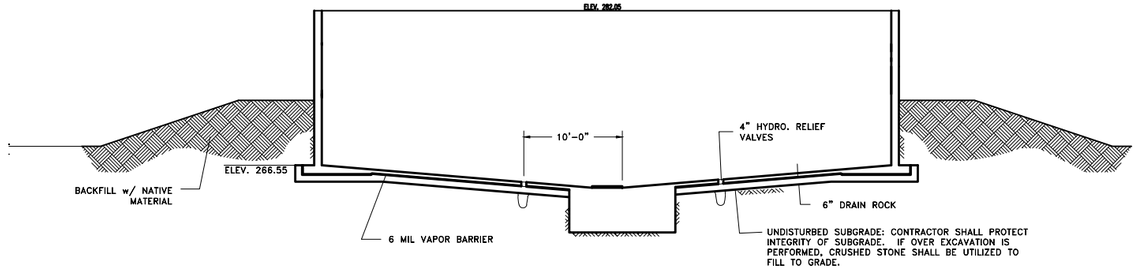
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Scale:	1"=10'
Date:	5/2026
Sheet	21

STATE OF ARKANSAS
LICENSED PROFESSIONAL ENGINEER
CALEB J. MUDFORD
No.17723
7-20-26

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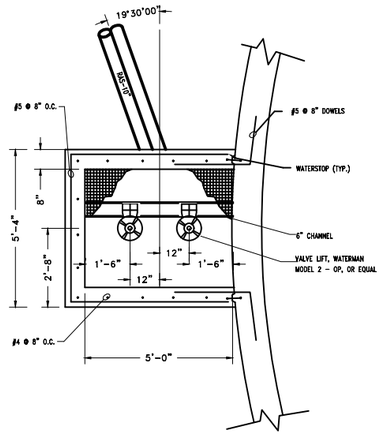


STRUCTURAL PLAN TYPICAL FOR BOTH CLARIFIERS

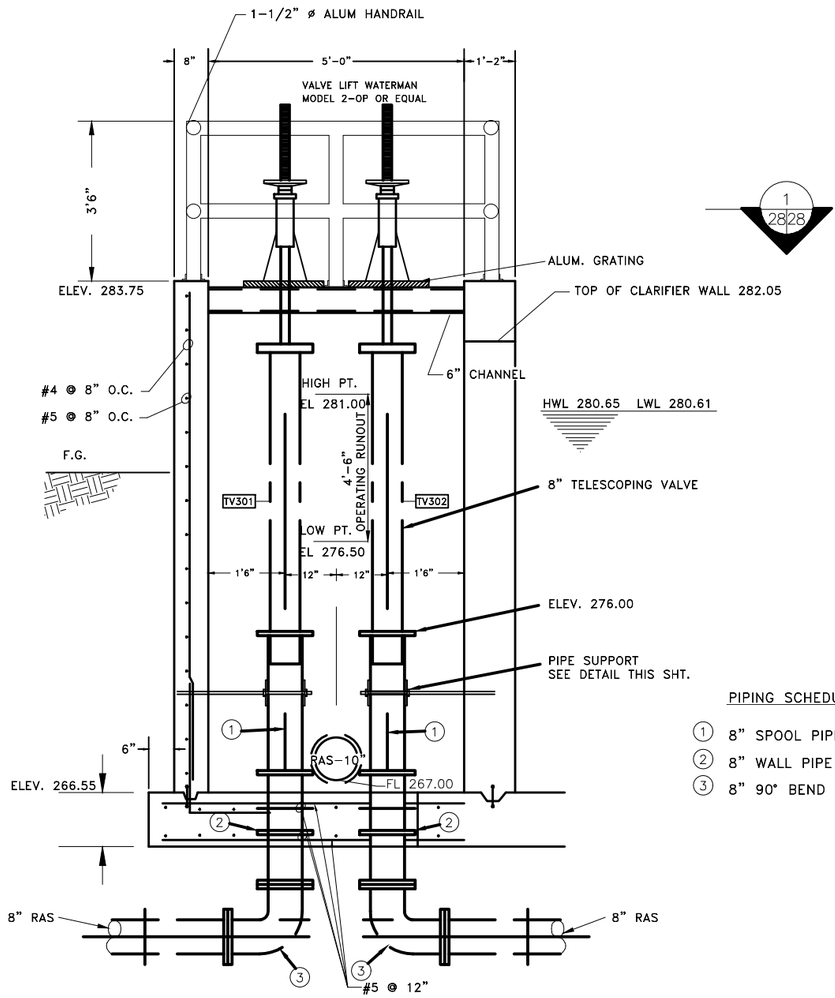


BACKFILL CROSS - SECTION

C 28/28 **CLARIFIER SECTION A**
N.T.S.



1 28/28 **R.A.S. COLLECTION BOX**
N.T.S.



1 28/28

PIPING SCHEDULE

1. 8" SPOOL PIPE
2. 8" WALL PIPE F/F
3. 8" 90° BEND

C 28/28 **R.A.S. COLLECTION BOX SECTION**
N.T.S.

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Date	Revision	By

Designed CJM
Checked KSB
Drawn CJM
Approved KSB

A. L. FRANKS ENGINEERING

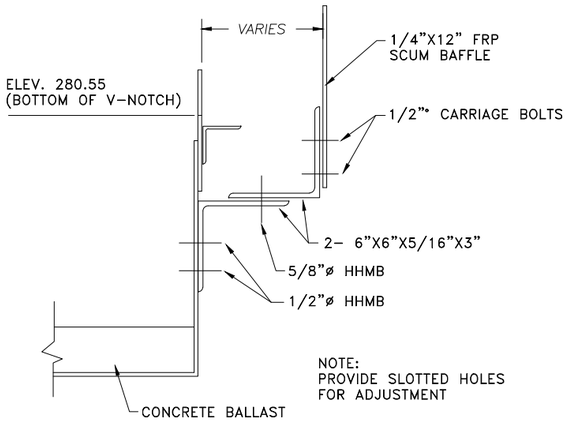
118 East Broad Street
Texarkana, Arkansas 71854
Phone (870) 216-1906
Fax (870) 216-1907

TEXARKANA WATER UTILITIES
NORTH WWTP
TEXARKANA, ARKANSAS 71854

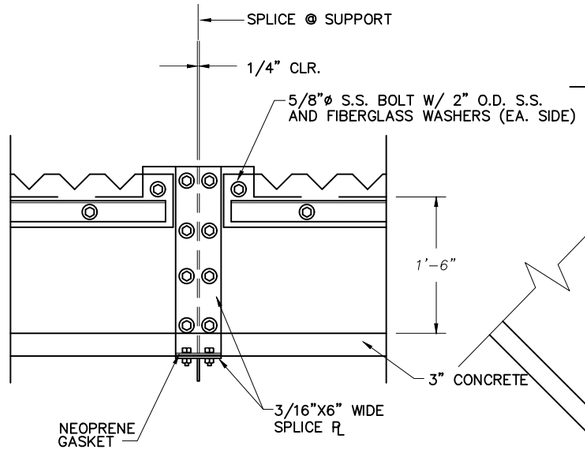
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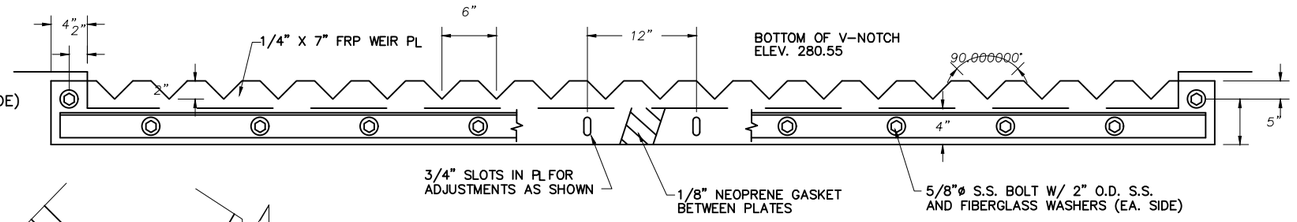
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Scale: N/A
Date: 5/2026
Sheet 22

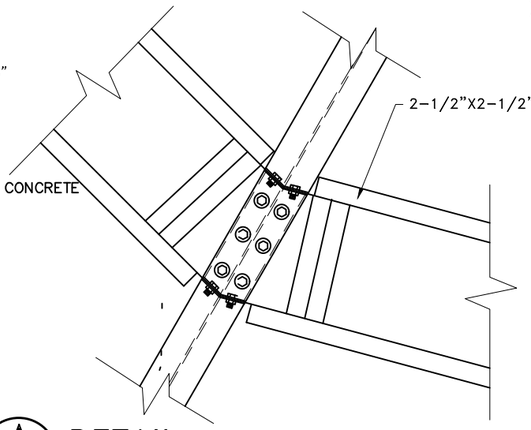
STATE OF ARKANSAS
LICENSED PROFESSIONAL ENGINEER
No.17723
CALEB J. MUDFORD
5-18-26



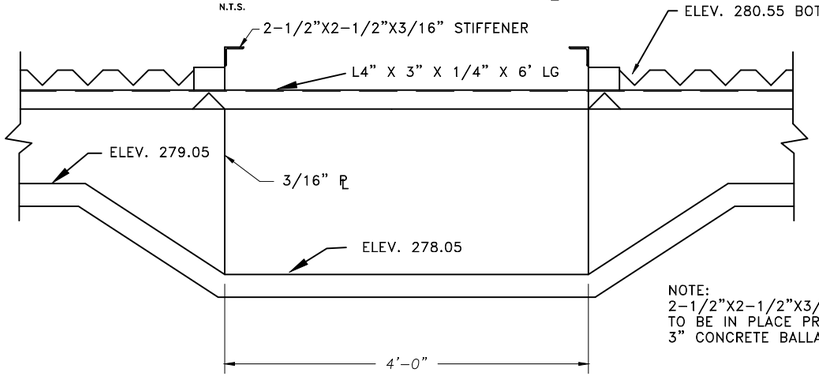
INTERMEDIATE BAFFLE SUPPORT DETAIL
N.T.S.





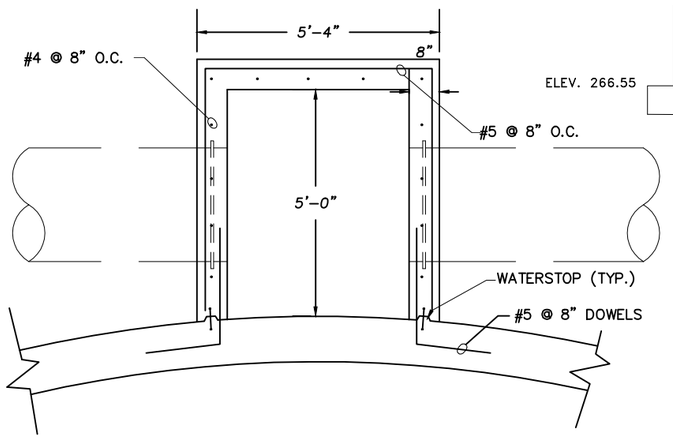


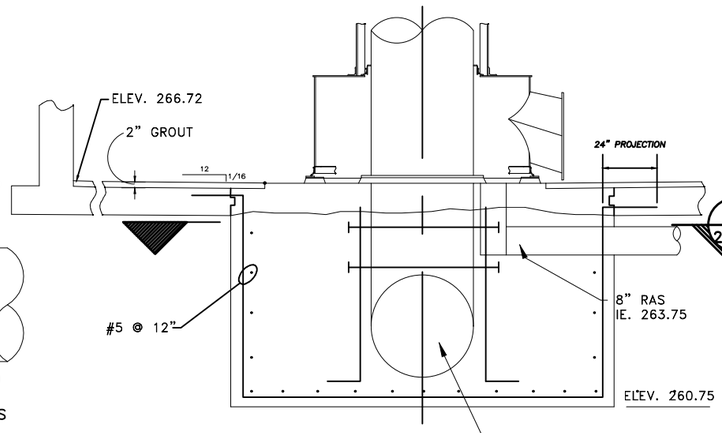
A 30|27 DETAIL
N.T.S.



NOTE:
2-1/2"X2-1/2"X3/16" STIFFENER ANGLES TO BE IN PLACE PRIOR TO PLACEMENT OF 3" CONCRETE BALLAST.

3 30|28 SECTION
N.T.S.

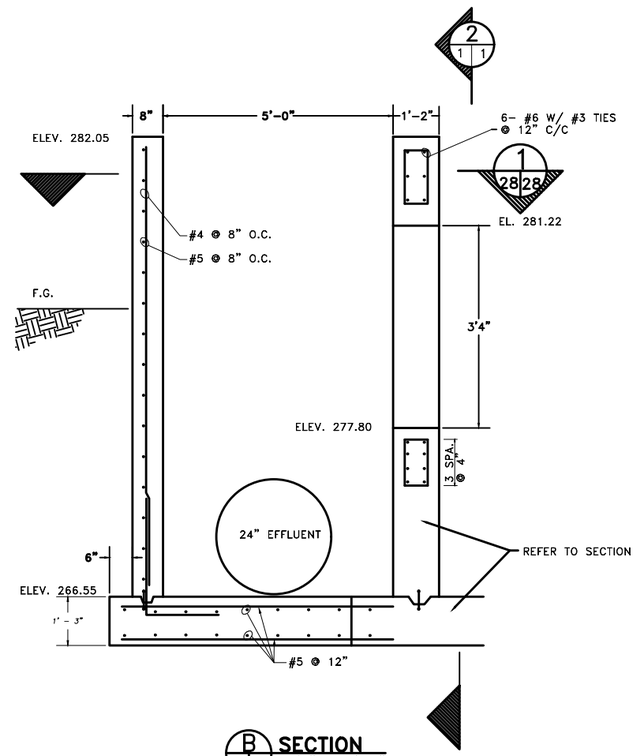




4 27|27

C 29|27 ILLUSTRATIVE SECTION
N.T.S.

A 1|1 DETAIL
SCALE



B 28|27 SECTION
3/8" = 1'-0"

Date	Revision	By

Designed CJM
Checked KSB
Drawn CJM
Approved KSB

A.L. FRANKS ENGINEERING
118 East Broad Street
Texarkana, Arkansas 71854
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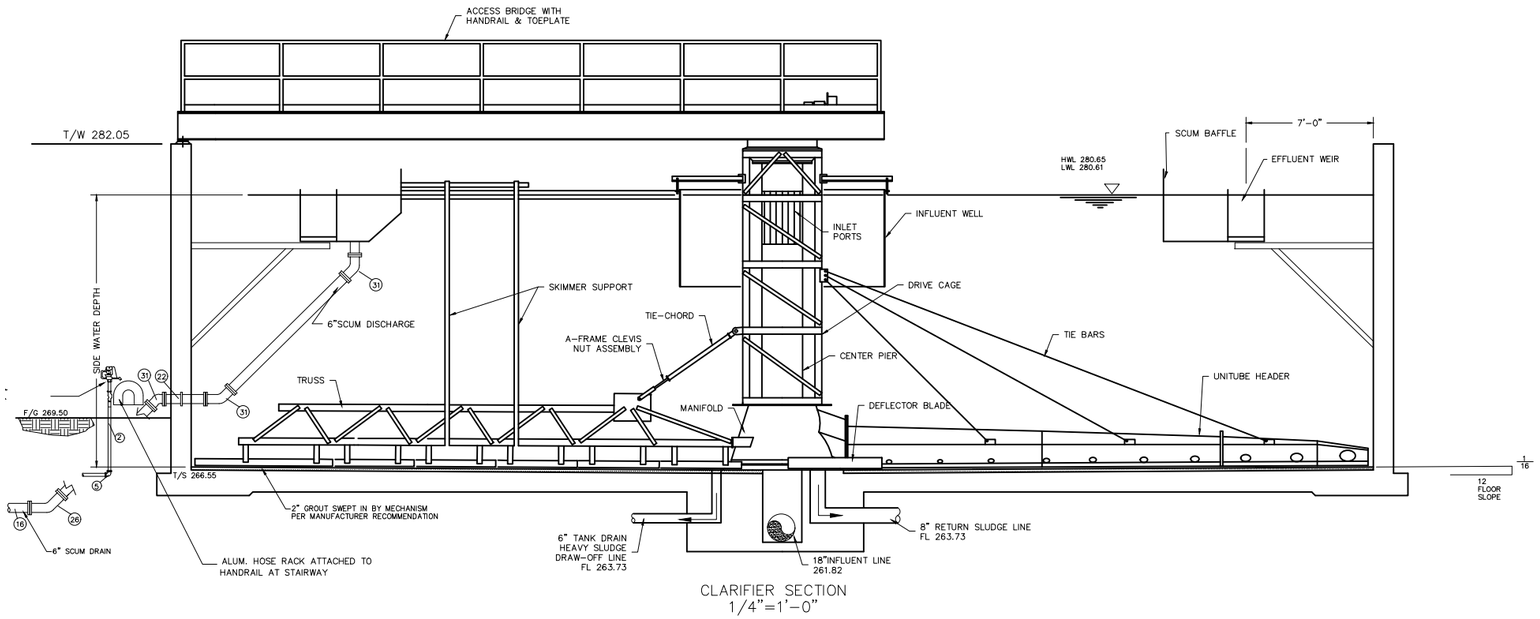
TEXARKANA WATER UTILITIES
NORTH WWTP
TEXARKANA, ARKANSAS 71854

CLARIFIER #3 DETAILS

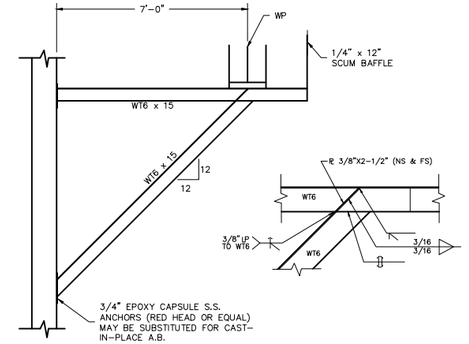
Job No.:TWU-02-23
Scale: N/A
Date: 5/2026
Sheet 23

STATE OF ARKANSAS
LICENSED PROFESSIONAL ENGINEER
No.17723
CALEB J. MUDFORD
5-18-26

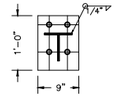
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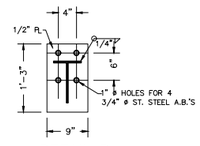
CLARIFIER SECTION
1/4"=1'-0"



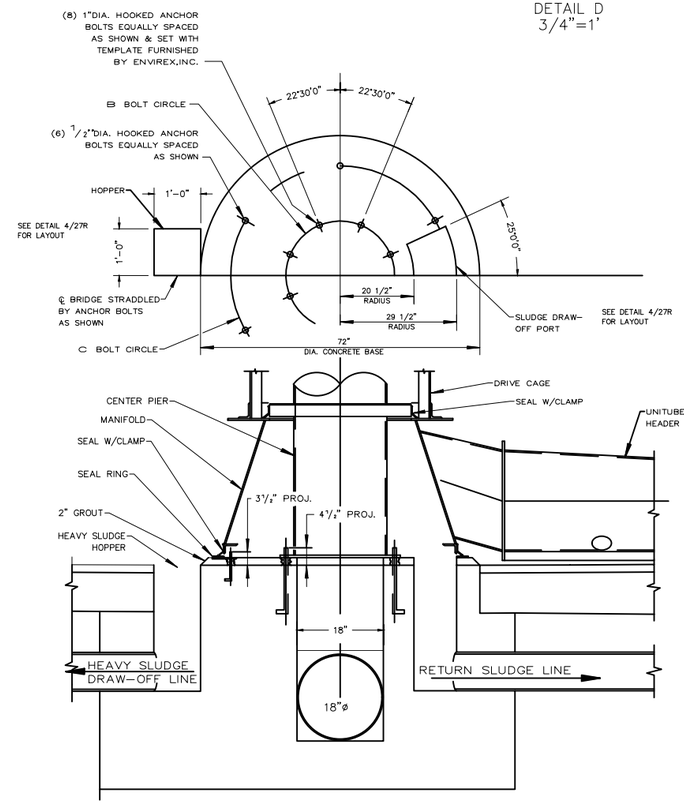
SECTION 5
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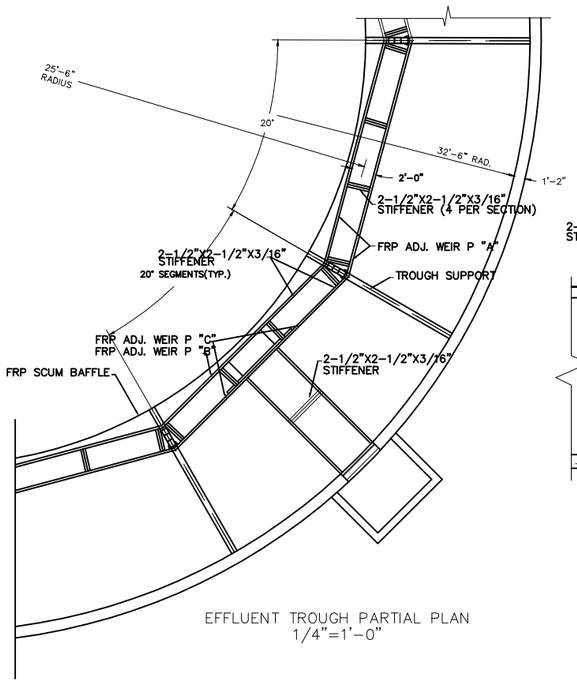
DETAIL C
3/4"=1'



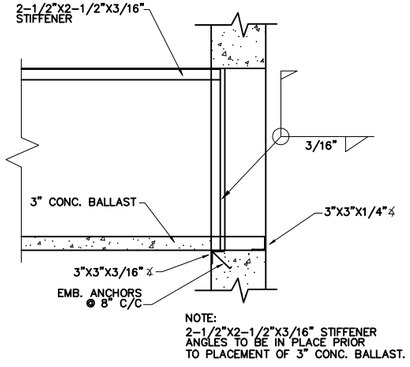
DETAIL D
3/4"=1'



CENTER PIER
MANIFOLD & HOPPER DETAIL
1/2"=1'-0"

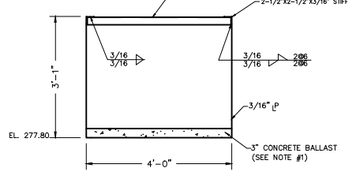


EFFLUENT TROUGH PARTIAL PLAN
1/4"=1'-0"

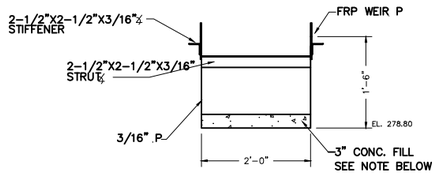


NOTE:
2-1/2"X2-1/2"X3/16" STIFFENER ANGLES TO BE IN PLACE PRIOR TO PLACEMENT OF 3" CONC. BALLAST.

SECTION 2
3/4"=1'



SECTION 2
1/2"=1'-0"



SECTION 4
3/4"=1'

NOTE:
2-1/2"X2-1/2"X3/16" STIFFENERS TO BE IN PLACE PRIOR TO PLACEMENT OF 3" CONC BALLAST.
ALL STEEL SHALL BE A-36 HOT DIP GALVANIZED.

Date	Revision	By

Designed CJM
Checked KSB
Drawn CJM
Approved KSB

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118 East Broad Street
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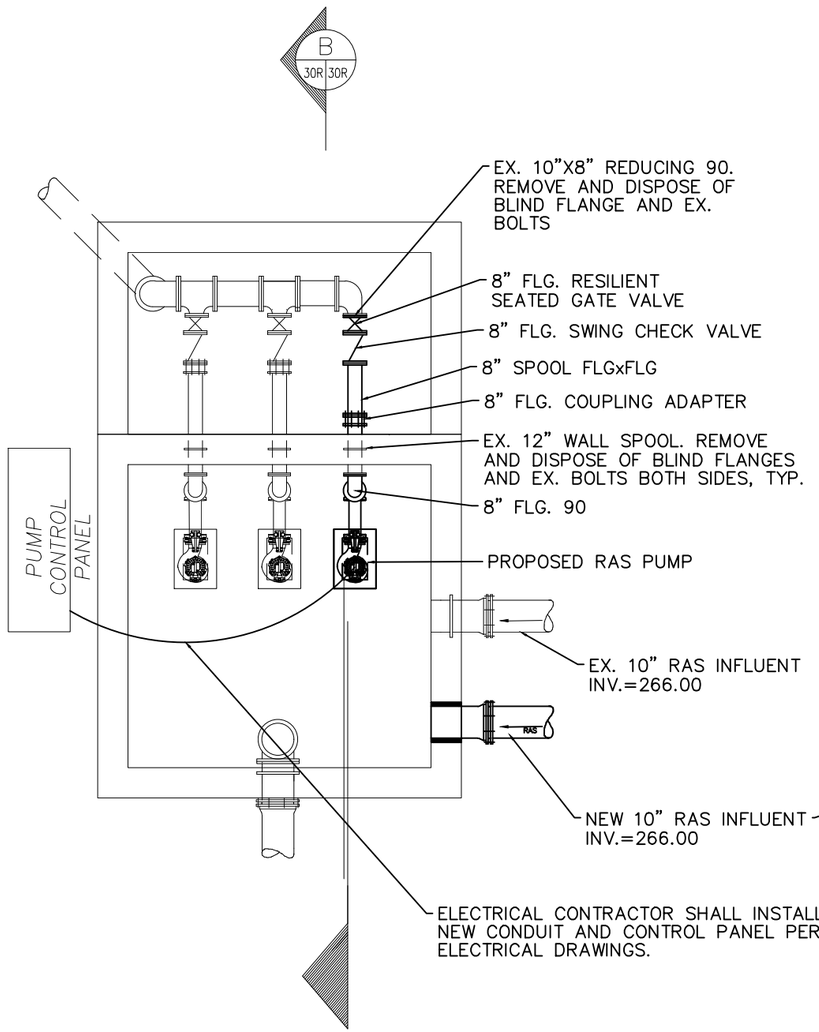
TEXARKANA WATER UTILITIES
NORTH WWTP
TEXARKANA, ARKANSAS 71854

CLARIFIER #3 DETAILS

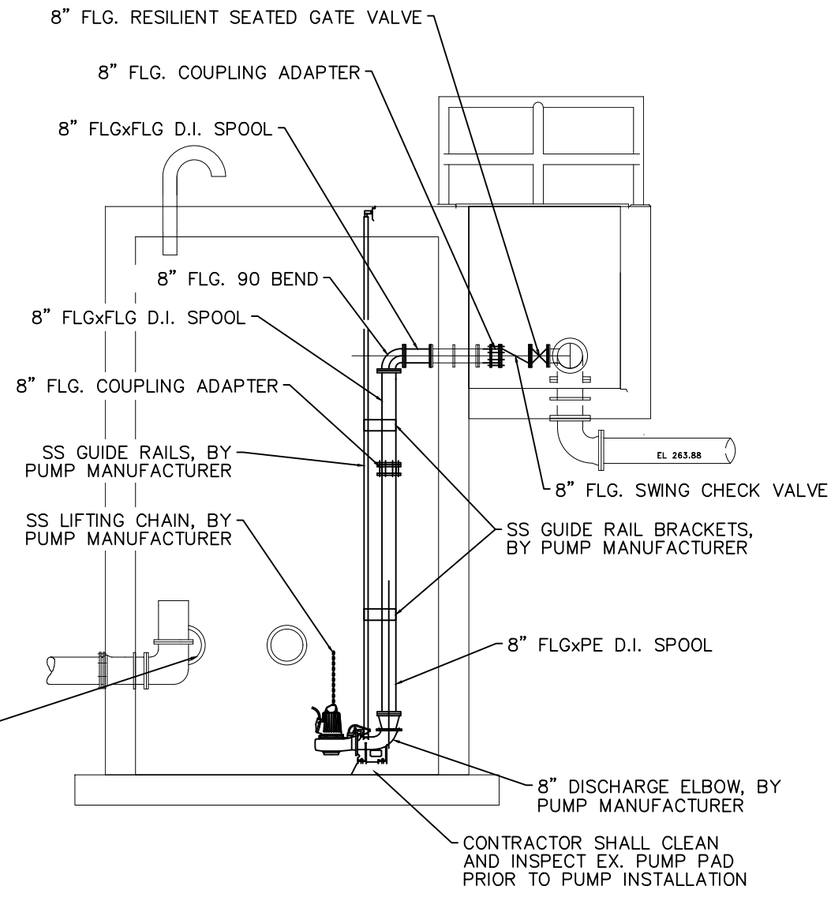
Job No.:TWU-02-23
Scale: N/A
Date: 5/2026
Sheet 24

STATE OF ARKANSAS
LICENSED PROFESSIONAL ENGINEER
No.17723
CALEB J. MUDFORD
5-18-26

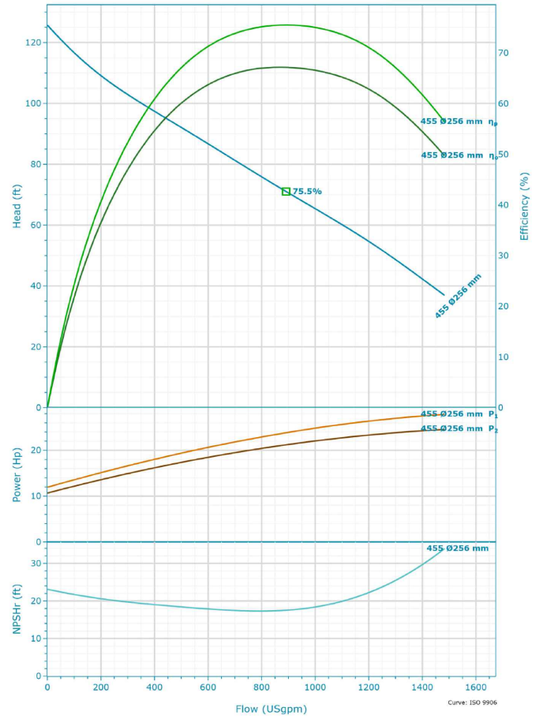
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MECHANICAL SECTIONAL PLAN
N.T.S.



B 30R 30R STRUCTURAL SECTION
N.T.S.



LIFT STATION DATA	
TOP ELEVATION	271.00
BOTTOM ELEVATION	262.25
PUMP ON ELEV	266.00
ALL PUMPS OFF ELEV	263.75
10" R.A.S. INFLUENT PIPE	266.00
12" OVERFLOW	268.00
EPUMP CAPACITY (GPM)	1483
PUMP DESIGN TDH (FT)	36.9
MOTOR HP	34
MINIMUM EFFICENCY	75%
FLYGT MODEL# NP3171 OR EQUAL	

NOTE: MOTOR SHALL BE SIZED FOR FULL RANGE OF PUMP OPERATIONS.

STATE OF ARKANSAS
LICENSED PROFESSIONAL ENGINEER
No.17723
CALEB J. MUDFORD
7-20-26

Date	Revision	By

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Checked KSB
Drawn CJM
Approved KSB

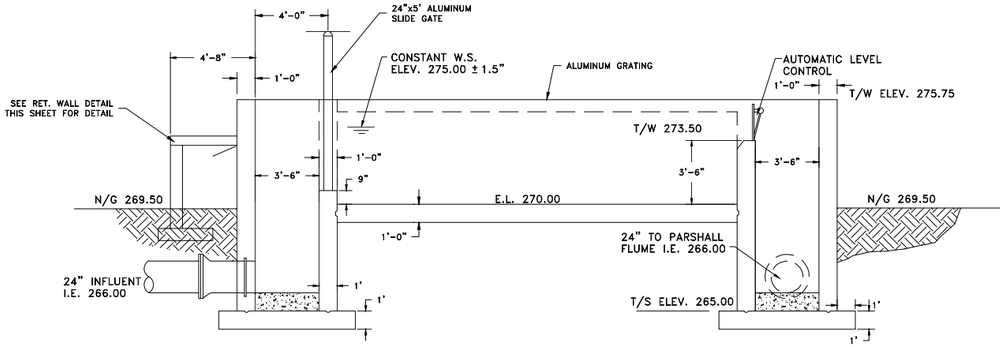
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TEXARKANA WATER UTILITIES
NORTH WWTP
TEXARKANA, ARKANSAS 71854

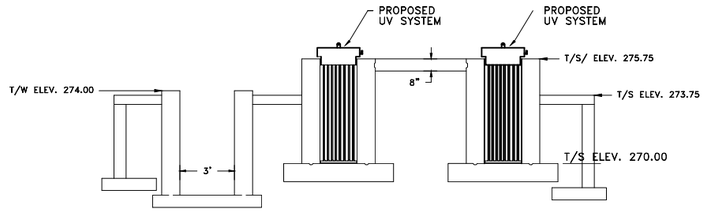
RAS PUMP PLAN

Job No.:TWU-02-23
Scale: N/A
Date: 5/2026
Sheet 25

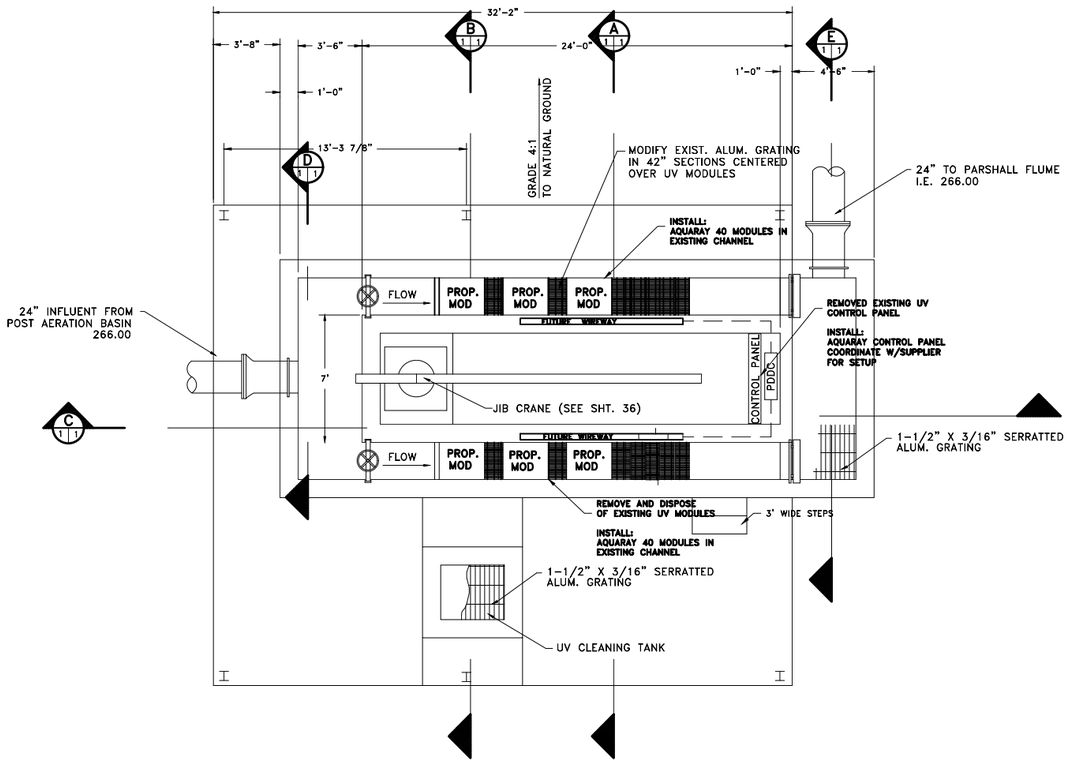
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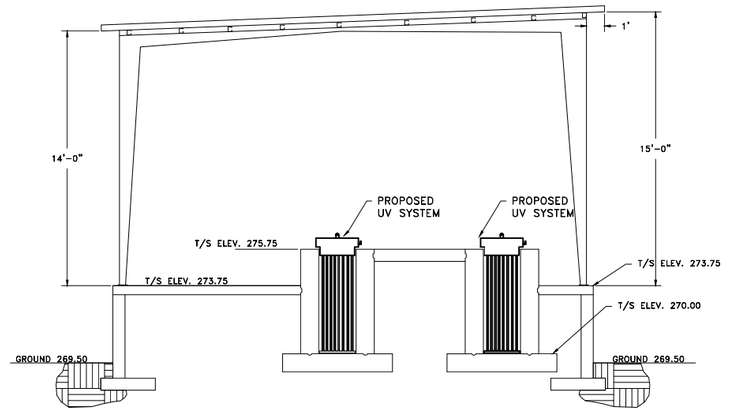
C SECTION
35 35 1/4" = 1'-0"



B DETAIL
1 1 SCALE



PLAN VIEW
SCALE: 1/4" = 1'-0"



A SECTION
35 35 1/4" = 1'-0"

Date	Revision	By

Designed CJM
Checked KSB
Drawn CJM
Approved KSB

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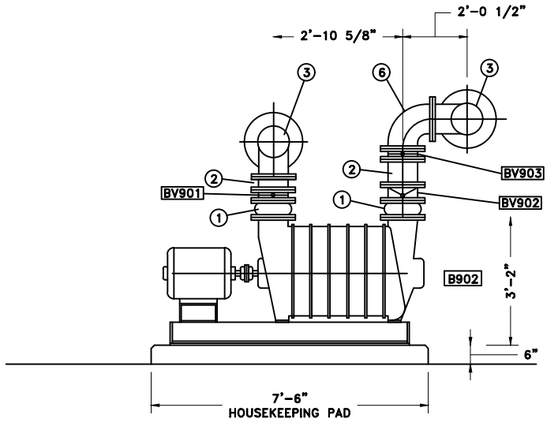
TEXARKANA WATER UTILITIES
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TEXARKANA, ARKANSAS 71854

UV DISINFECTION

Job No.:TWU-02-23
Scale: N/A
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No.17723
CALEB J. MUDFORD
5-18-26

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VALVE SCHEDULE

VALVE NO.	SIZE	CONECTION	TYPE	COMMENTS
BV901	8"	F	BUTTERFLY VALVE	LOCKING HANDLE
BV902	8"	F	CHECK VALVE	DOUBLE DISC
BV903	8"	F	BUTTERFLY VALVE	LOCKING HANDLE

BLOWER SCHEDULE

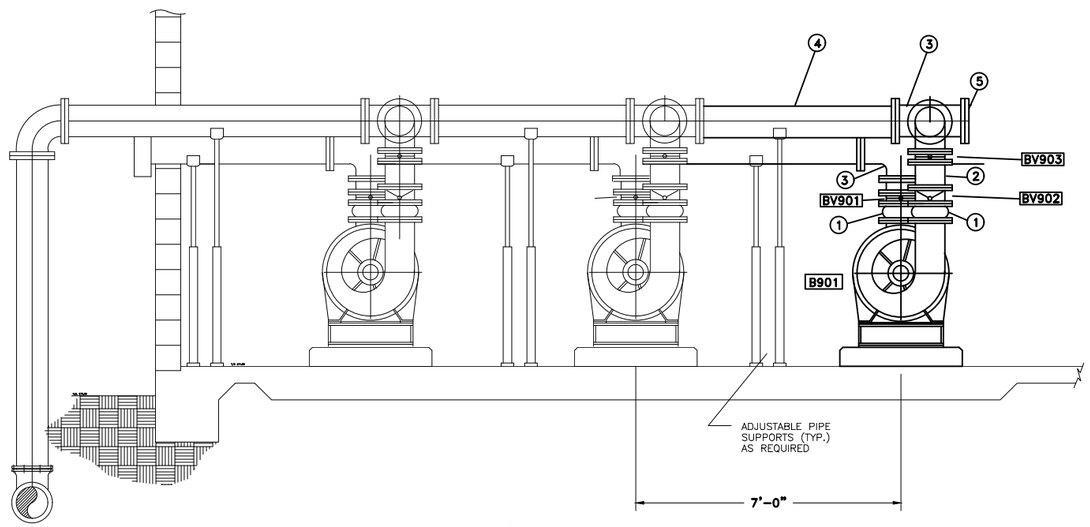
BLOWER NO.	TYPE	HP	DESCRIPTION
B901	CENTRIFUGAL BLOWER	75	8" DISCHARGE

NOTE
BLOWER TO BE CONTINENTAL MODEL 51.08 RATED FOR 1270 CFM AT 8.2 PSIG OR APPROVED EQUAL

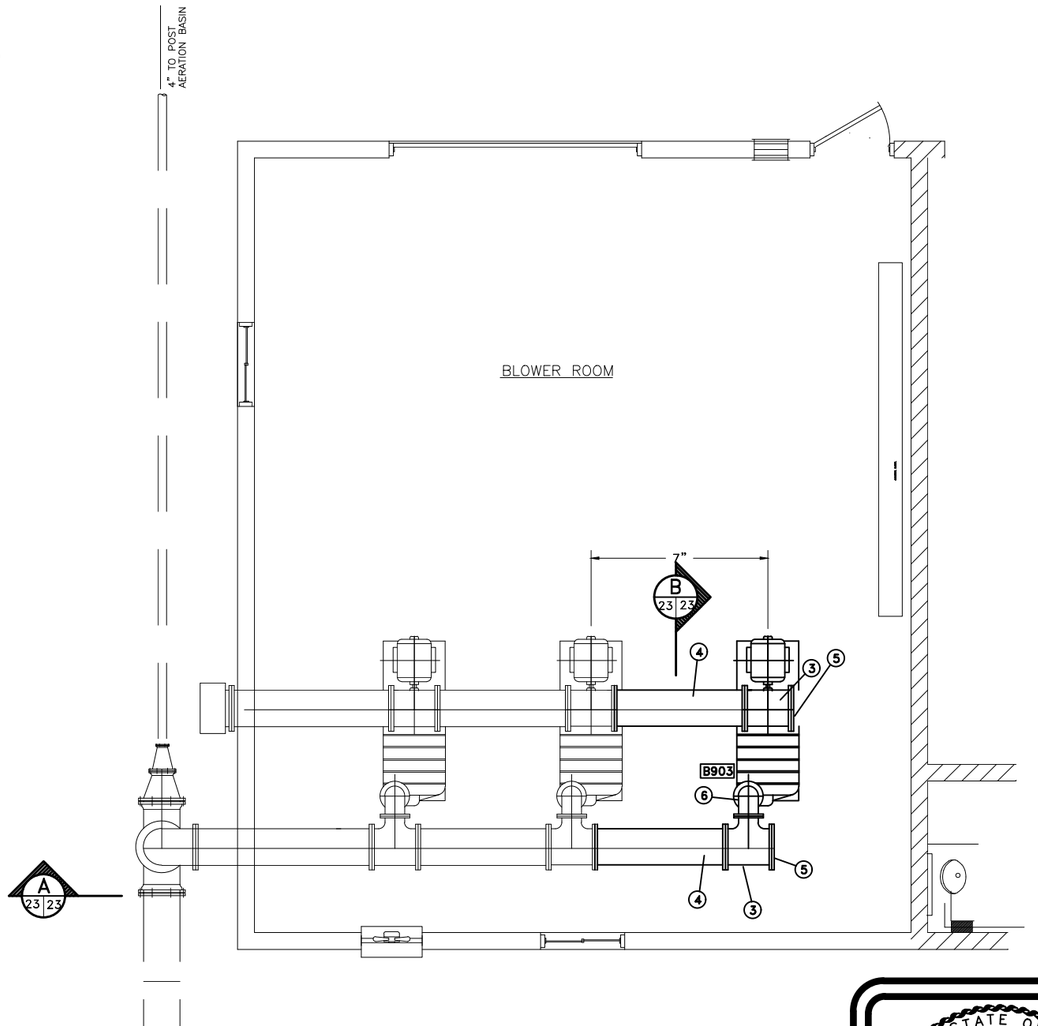
PIPING SCHEDULE

1 8" EXPANSION JOINT, F/F
2 8" D.I. SPOOL, F/F
3 18" X 18" X 8" D.I. TEE, F/F
4 18" D.I. SPOOL, F/F
5 18" D.I. BLIND FLANGE
6 8" D.I. 90° S/R BEND, F/F

B 23|23 SECTION
NTS



A 23|23 SECTION
NTS



Date	Revision	By

Designed CJM
Checked KSB
Drawn CJM
Approved KSB

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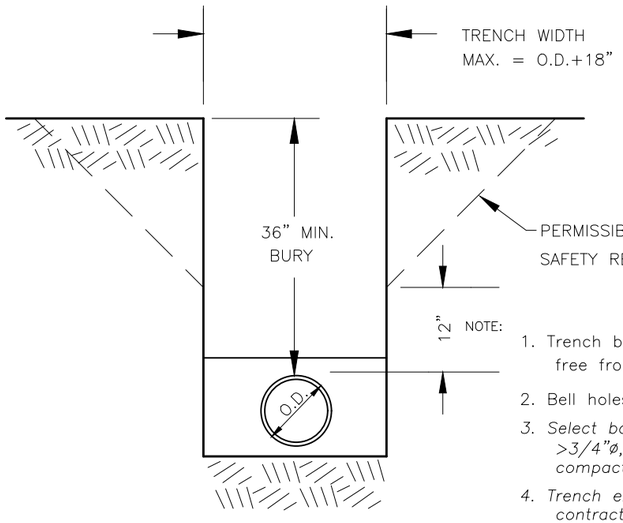
TEXARKANA WATER UTILITIES
NORTH WWTP
TEXARKANA, ARKANSAS 71854

AIR BLOWER PLAN

Job No.:TWU-02-23
Scale: N/A
Date: 5/2026
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STATE OF ARKANSAS
LICENSED PROFESSIONAL ENGINEER
No.17723
CALEB J. MUDFORD
5-18-26

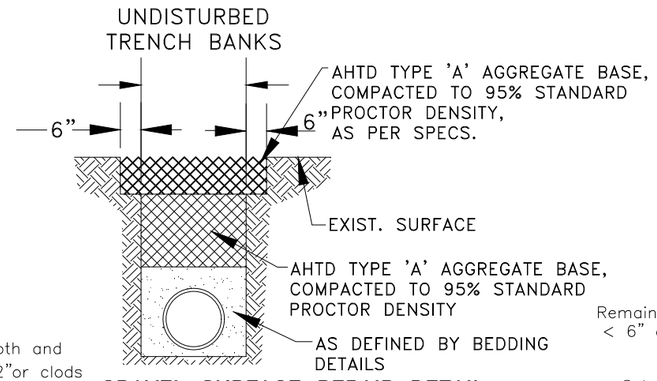
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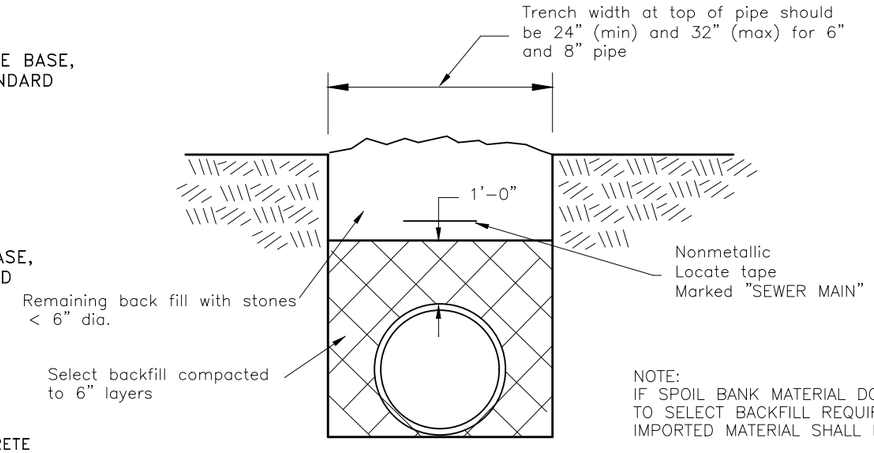
TYPICAL TRENCH SECTION
N.T.S.

NOTE:

1. Trench bottom should be smooth and free from large stones > 1/2"or clods
2. Bell holes shall be dug at each joint.
3. *Select back fill shall be free of rocks >3/4"ø, clods or frozen material compacted to 90% standard proctor.*
4. *Trench excavation is unclassified; contractors bid shall include excavation of all materials and shall include bedding or back fill as shown in type 1,2,or 3 laying conditions.*
5. *Pipe bedding must meet AWWA C605 standard.*

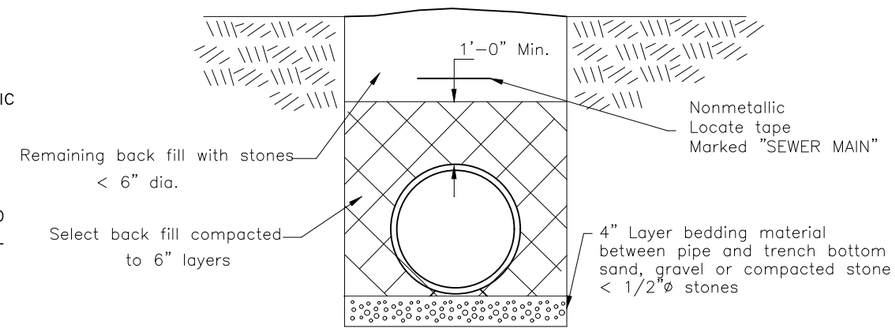


GRAVEL SURFACE REPAIR DETAIL
N.T.S. (NOT A PAY ITEM)

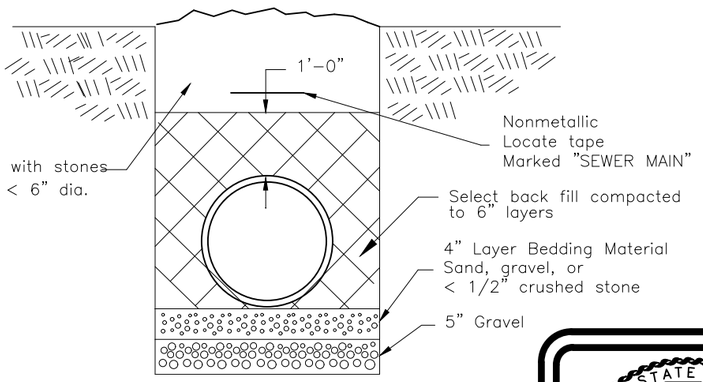


NOTE:
IF SPOIL BANK MATERIAL DOES NOT CONFORM TO SELECT BACKFILL REQUIREMENTS, A IMPORTED MATERIAL SHALL BE PLACED AROUND PIPE.

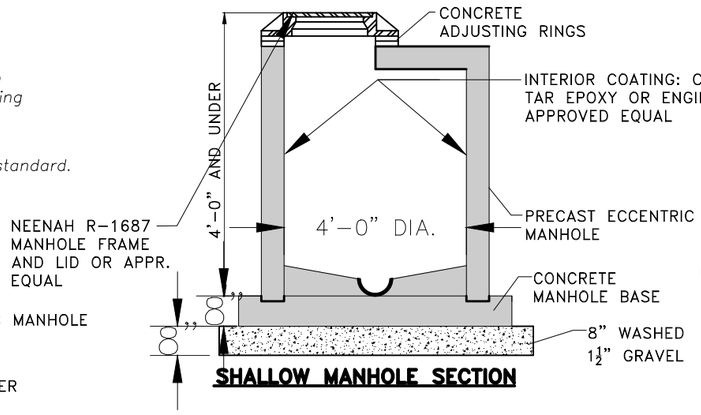
TYPE 1 LAYING CONDITION
(USE UNDER NORMAL CONDITIONS)



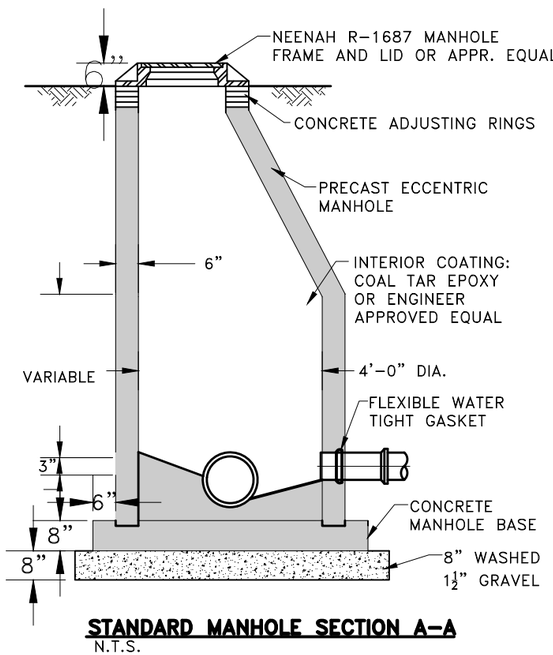
TYPE 2 LAYING CONDITION
(USE FOR ROCKY OR HARD TRENCH BOTTOM)



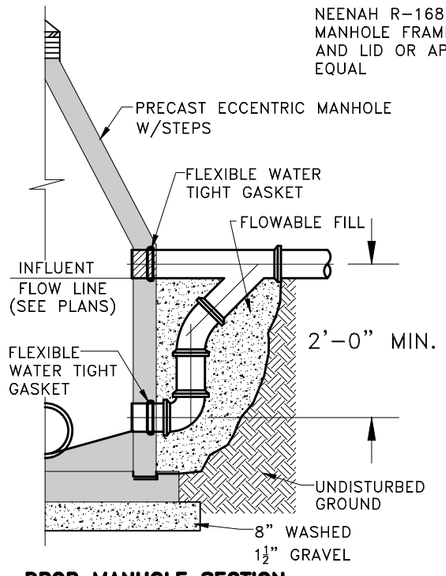
TYPE 3 LAYING CONDITION
(USE FOR SOFT OR WET TRENCH BOTTOM)



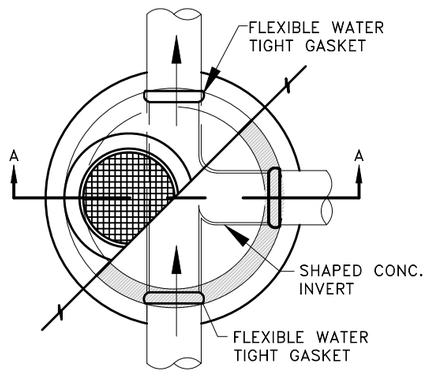
SHALLOW MANHOLE SECTION



STANDARD MANHOLE SECTION A-A
N.T.S.



DROP MANHOLE SECTION
N.T.S.



STANDARD MANHOLE PLAN
N.T.S.

STANDARD MANHOLE DETAILS
N.T.S.

Date	Revision	By

Designed CJM
Checked KSB
Drawn CJM
Approved KSB

A. L. FRANKS ENGINEERING
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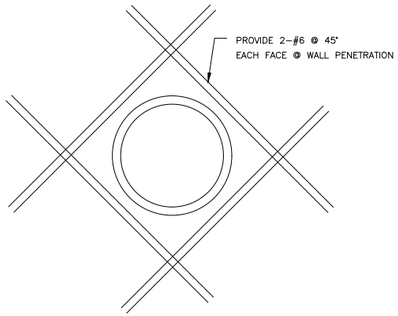
TEXARKANA WATER UTILITIES
NORTH WWTP
TEXARKANA, ARKANSAS 71854

MISCELLANEOUS DETAILS

Job No.:TWU-02-23
Scale: N/A
Date: 5/2026
Sheet 28

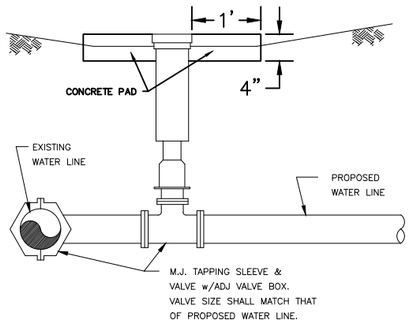
STATE OF ARKANSAS
LICENSED PROFESSIONAL ENGINEER
CALEB J. MUDFORD
No.17723
5-18-26

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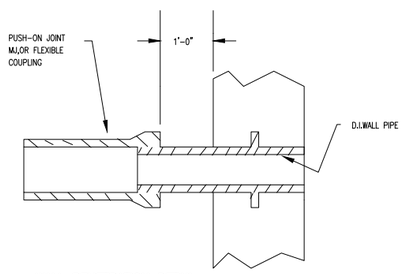
TYPICAL PIPE PENETRATION

N.T.S.



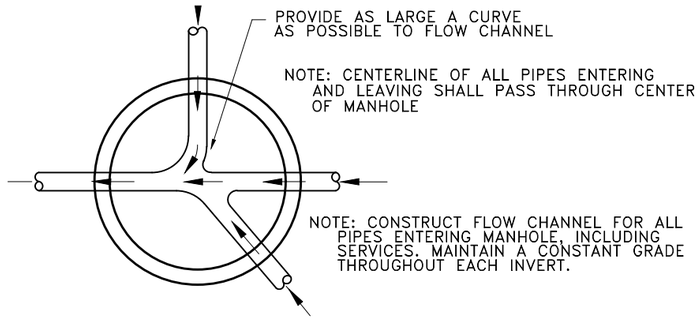
PROPOSED TIE-IN & INSTALLATION OF WATER LINE

N.T.S.



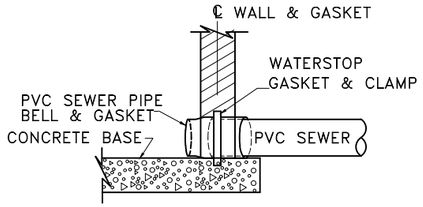
WALL PENETRATION DETAIL

N.T.S.



MANHOLE BOTTOM DETAIL

N.T.S.



PVC SEWER PIPE
MANHOLE CONNECTION DETAIL

N.T.S.

Date	Revision	By

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Checked KSB
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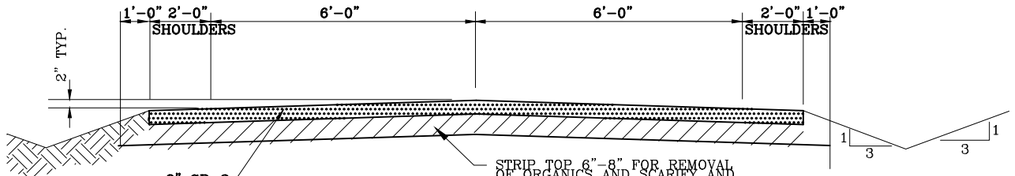
TEXARKANA WATER UTILITIES
NORTH WWTP
TEXARKANA, ARKANSAS 71854

MISCELLANEOUS DETAILS

Job No.:TWU-02-23
Scale: N/A
Date: 5/2026
Sheet 29

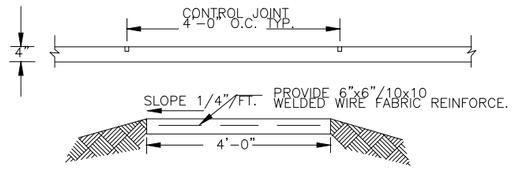
STATE OF ARKANSAS
LICENSED PROFESSIONAL ENGINEER
No.17723
CALEB J. MUDFORD
5-18-26

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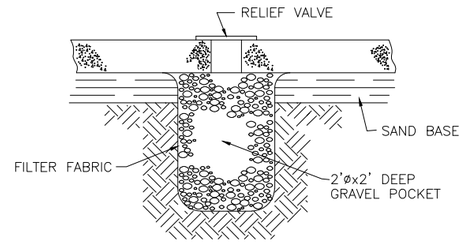
TYPICAL SECTION - OPEN DITCH ACCESS ROAD

N.T.S.



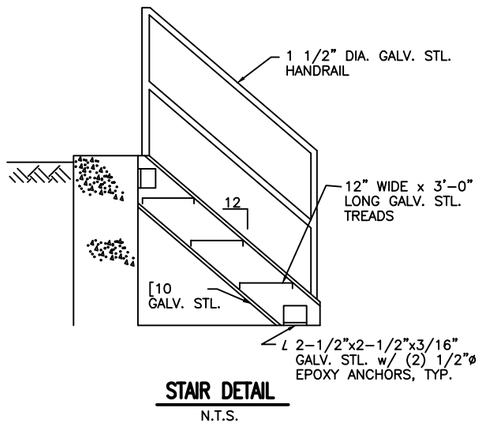
TYPICAL SIDEWALK DETAILS

N.T.S.



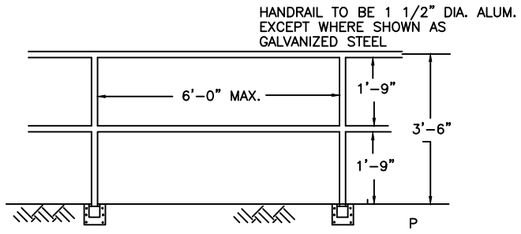
TYPICAL RELIEF VALVE DETAIL

N.T.S.



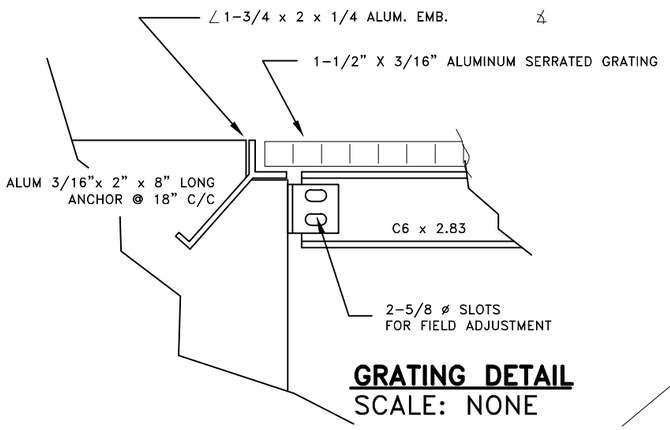
STAIR DETAIL

N.T.S.



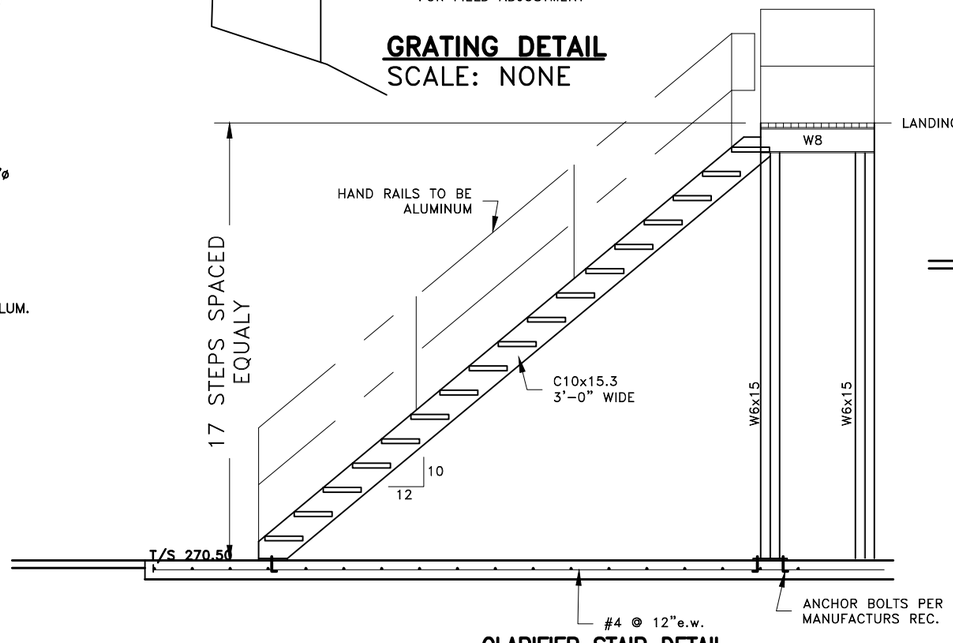
TYPICAL HANDRAIL DETAIL

N.T.S.



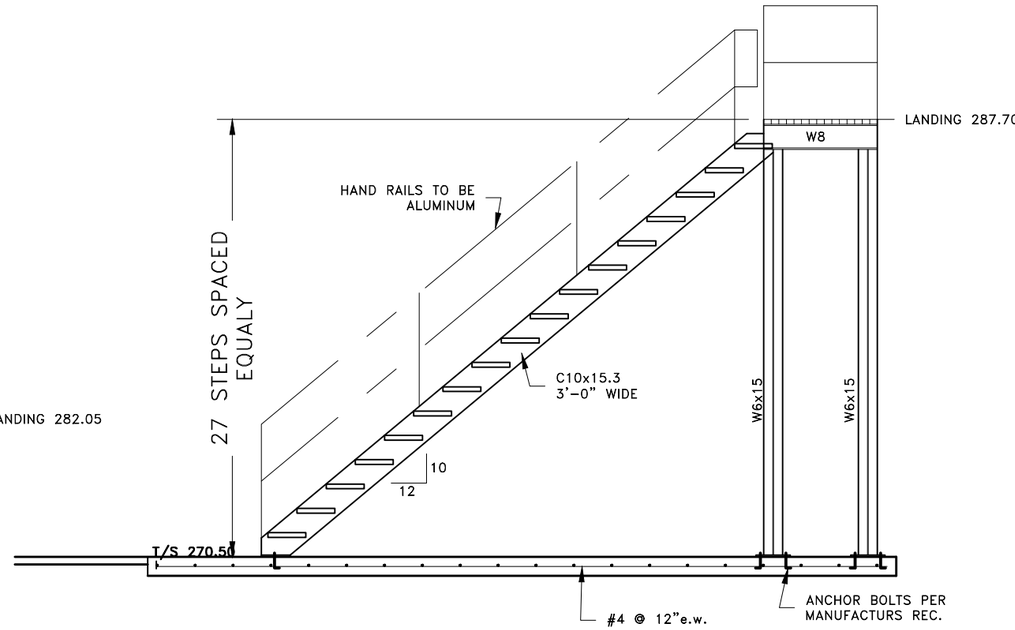
GRATING DETAIL

SCALE: NONE



CLARIFIER STAIR DETAIL

N.T.S.



AERATION BASIN STAIR DETAIL

N.T.S.

Date	Revision	By

Designed CJM
Checked KSB
Drawn CJM
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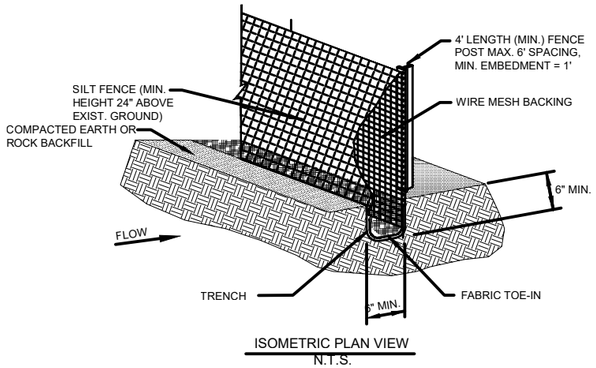
TEXARKANA WATER UTILITIES
NORTH WWTP
TEXARKANA, ARKANSAS 71854

MISCELLANEOUS DETAILS

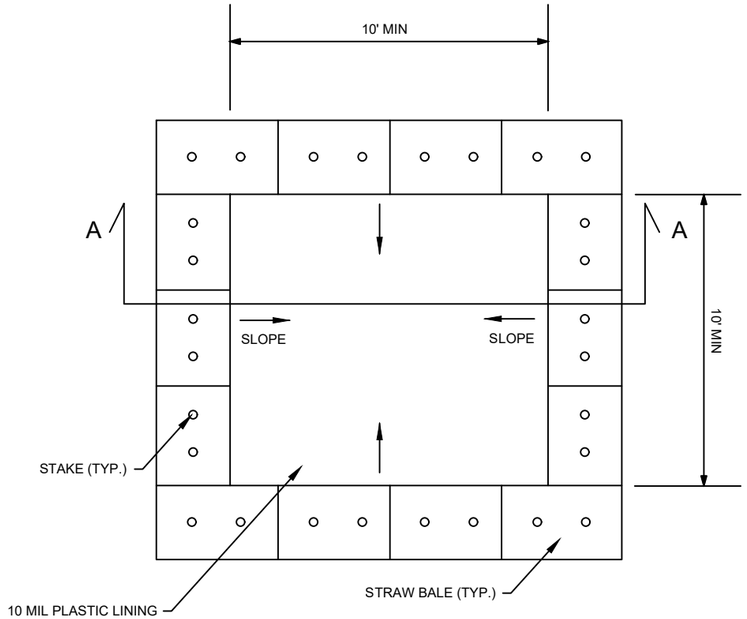
Job No.:TWU-02-23
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Date: 5/2026
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STATE OF ARKANSAS
LICENSED PROFESSIONAL ENGINEER
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CALEB J. MUDFORD
5-18-26

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ISOMETRIC PLAN VIEW
N.T.S.



PLAN VIEW
N.T.S.

SILT FENCE GENERAL NOTES:

1. POSTS WHICH SUPPORT THE SILT FENCE SHALL BE INSTALLED ON A SLIGHT ANGLE TOWARD THE ANTICIPATED RUNOFF SOURCE. POST MUST BE EMBEDDED A MINIMUM OF ONE FOOT.

2. THE TOE OF THE SILT FENCE SHALL BE TRENCHED IN WITH A SPADE OR MECHANICAL TRENCHER, SO THAT THE DOWNSLOPE FACE OF THE TRENCH IS FLAT AND PERPENDICULAR TO THE LINE OF FLOW. WHERE FENCE CANNOT BE TRENCHED IN (e.g. PAVEMENT), WEIGHT FABRIC FLAP WITH ROCK ON UPHILL SIDE TO PREVENT FLOW FROM SEEPING UNDER FENCE

3. THE TRENCH MUST BE A MINIMUM OF 6 INCHES DEEP AND 6 INCHES WIDE TO LLOW FOR THE SILT FENCE FABRIC TO BE LAID IN THE GROUND AND BACKFILLED WITH COMPACTED MATERIAL.

4. SILT FENCE SHOULD BE SECURELY FASTENED TO EACH STEEL SUPPORT POST OR TOWIRE BACKING, WHICH IN TURN IS ATTACHED TO THE STEEL FENCE POST. THERE SHALL BE A 3 FOOT OVERLAP, SECURELY FASTENED WHERE ENDS OF FABRIC MEET.

5. INSPECTION SHALL BE MADE EVERY TWO WEEKS AND AFTEREACH 1/2" RAINFALL. REPAIR OR REPLACEMENT SHALL BE MADE PROMPTLY AS NEEDED.

6. SILT FENCE SHALL BE REMOVED WHEN FINAL STABILIZATION IS ACHIEVED OR ANOTHER EROSION OR SEDIMENT CONTROL DEVICE IS EMPLOED.

7. ACCUMULATED SILT SHALL BE REMOVED WHEN IT REACHES A DEPTH OF HALF THE HEIGHT OF THE FENCE. THE SILTSHALL BE DISPOSED OF AT AN APPROVED SITE AND IN SUCH A MANNER AS TO NOT CONTRIBUTE TO ADDITIONAL SILTATION.

GENERAL NOTES:

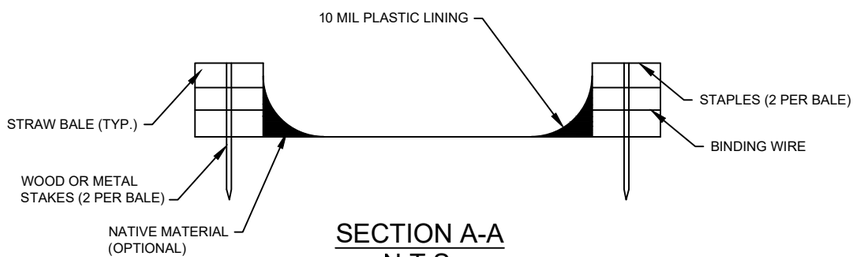
1. CONTRACTOR SHALL DESIGNATE CONCRETE WASHOUT AREA ONSITE AND NOTIFY ALL CONCRETE DELIVERY TRUCKS.

2. THE WASHOUT SHALL BE COVERED WITH A PLASTIC LINER (10 MIL) TO CONTAIN CONCRETE WITHIN THE DISPOSAL BASIN.

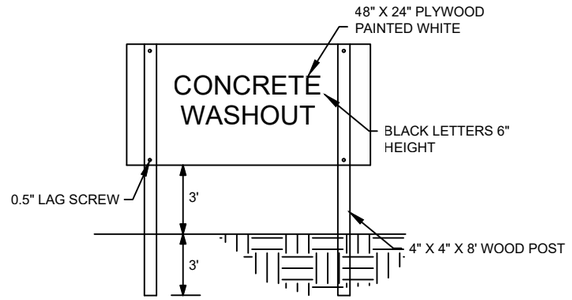
3. INSTALL STAKES TO SECURE PLASTIC SHEETING AROUND THE PERIMETER OF THE WASHOUT BASIN.

4. UPON HARDENING OF CONCRETE DEBRIS THE CONTRACTOR SHALL REMOVE AND DISPOSE OF CONCRETE IN ACCORDANCE WITH STATE AND LOCAL REGULATIONS.

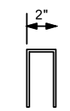
5. SIGN SHALL BE PLACED WITHIN 30 FEET OF WASHOUT AREA.



SECTION A-A
N.T.S.



SIGN DETAIL
N.T.S.



STAPLE DETAIL

CONCRETE WASHOUT

N.T.S.

Date	Revision	By

Designed CJM
Checked KSB
Drawn CJM
Approved KSB

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TEXARKANA WATER UTILITIES
NORTH WWTP
TEXARKANA, ARKANSAS 71854

EROSION & SEDIMENT CONTROL DETAILS

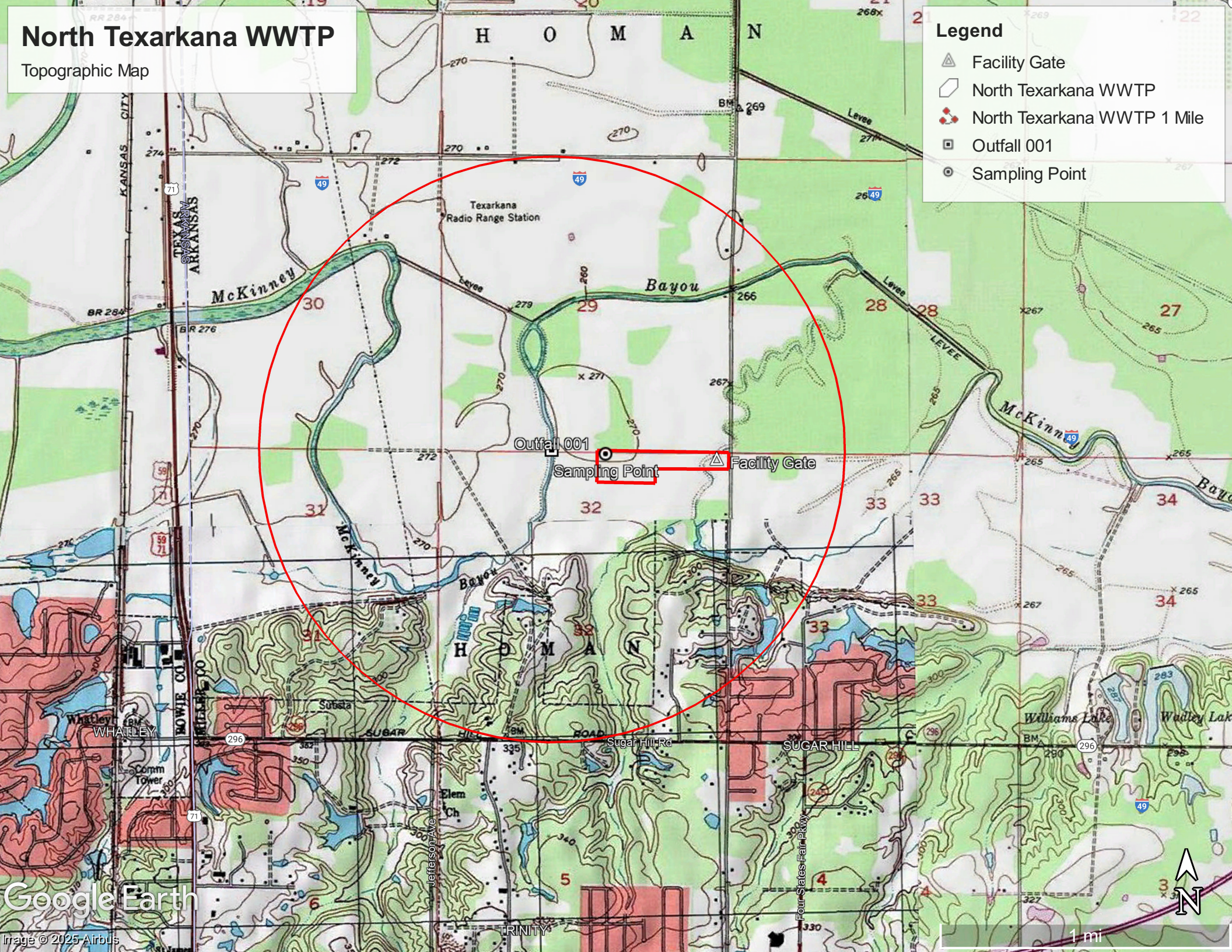
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Date: 5/2026
Sheet 31

STATE OF ARKANSAS
LICENSED PROFESSIONAL ENGINEER
CALEB J. MUDFORD
No.17723
5-18-26

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North Texarkana WWTP

Topographic Map



North Texarkana WWTP

Vicinity Map

