SAN ANTONIO WATER SYSTEM

CENTRAL WATER INTEGRATION PIPELINE TERMINUS TANK PROJECT

SAWS Job No. 18-8609
SAWS Solicitation No. CO-00170

ADDENDUM No. 3

March 23, 2018

To Bidder of Record:

This addendum, applicable to work referenced above, is an amendment to the bidding documents and as such will be made a part of and included in the Contract Documents. Acknowledge receipt of this addendum by entering the addendum number and issue date in the space provided in submitted copies of the proposal.

QUESTIONS AND CLARIFICATIONS

Q1. Specification Section 01025, Article 1.12, lists that Bid Item 1 shall include the cost for the site excavation and fill placement. Bid Item No. 4 states that it shall include the removal of the existing overburden above limestone layer and import and placement of the select fill material as specified. Please clarify which Bid Item the excavation and fill placement should be included in.

A1. Please refer to the updated Section 01025 (as given in Addendum No. 1). Select Fill is now in Bid Item No. 6 and indicates that the base bid quantity in Item No. 1 shall include the select fill volume required based on the estimated grade of the limestone layer shown in the Drawings. Bid Item No. 6 only includes any overages of select fill quantities required to grade in accordance with the Drawings.

Q2. Page 3 of the Bid Proposal in Addendum No.1 (and elsewhere in the Bid documents) states that Substantial Completion is required within 250 calendar days. Can the time for Substantial Completion be extended to 280 calendar days?

A2. The Contractor must complete the Phase 1 construction activities within 175 calendar days of the Notice to Proceed (NTP) date. As part of this addendum, the duration for Substantial Completion will be extended to 280 calendar days.

Q3. Article 5.8.1 of the General Conditions requires that all materials that come in direct contact with potable water must conform to ANSI/NSF 61. This requirement (NSF 61 certification) is impractical for many of the components of the prestressed concrete tank, such as the (a) concrete and shotcrete, (b) interior stainless steel ladders, (c) wall man-ways, and (d) stainless steel weirs. TCEQ regulations (Chapter 290, Subchapter D, Rule

§290.43 Water Storage) state that only all newly installed coatings must conform to ANSI/NSF 61 and be certified. This same requirement was in the same article in earlier versions of the SAWS General Conditions contained in the Bid Documents for the Old Pearsall Road Pump Station Phase I project (SAWS Job No. 13-8610-220) and DSP Clayton Tank Replacement Project (SAWS Job No. P-14-6101). Prior to the bid on those two projects, addenda were issued in which responses to a question regarding this requirement stated: "**The intent of the General Conditions is to cover protective coatings. The components listed above are not coated and thus are not included under this article. Only ANSI/NSF requirements contained in TCEQ regulations are relevant to the tank."** Attached are copies of the relevant pages from those addenda. Can it be confirmed, as it was on the two aforementioned SAWS projects, that the intent of the General Conditions is to cover protective coatings and that only ANSI/NSF requirements contained in TCEQ regulations are relevant to the tank?

A3. Yes, this is correct. The intent of the General Conditions is to cover protective coatings. Only ANSI/NSF requirements, as given in TCEQ regulations, are relevant to the tank.

Q4. Article 9.2.3 of the Supplemental Conditions, as modified by Addendum No. 1, requires that Final Completion be achieved within 615 calendar days. We find this to be unclear with regards to the amount of time allowed, after the completion of work by others, for the Contractor to reach Final Completion. What amount of time will be allowed from the time the Contractor returns to the site until Final Completion is required?

A4. From the time that the Contractor receives notice to return to the site, Final Completion will need to be completed within 30 calendar days. Overall, it is anticipated that Final Completion will be achieved within 515 calendar days of the NTP date. As part of this addendum, Section 9.2 of the Supplementary Conditions has been updated to reflect these changes.

Q5. Article 1.02.E of Section 01015 states that at no time shall the site be left unattended by Contractor without existing, temporary or permanent fencing, gates and locks in place, meeting TCEQ regulations. Can the required limits for temporary fencing be defined? Also, since TCEQ regulations appear to only describe intruder-resistant fencing of a permanent nature, can it be confirmed that TCEQ regulations do not apply to temporary fencing?

A5. As per Addendum No. 1, the second sentence "All temporary and permanent fencing shall meet Texas Commission on Environmental Quality (TCEQ) regulations." was deleted. Fencing is not required and is not shown on the Drawings but the Contractor shall be responsible for ensuring that the construction site is secure. The limits (and need) for temporary fencing shall be at the Contractor's discretion.

Q6. Article 1.12.A of Section 01025 in Addendum No. 1 describes the application of Bid Item No.6. Is it the intent that the unit price for Select Fill Material would apply to any additional quantity of that material (and additional excavation) required as a result of the limestone being at a lower elevation than shown on the drawings?

A6. Yes, the intent is that Bid Item No. 1 shall include the select fill volume required based on the estimated grade of the limestone layer shown in the Drawings. Bid Item No. 6 only includes an allowance to cover any overages of select fill required to grade in accordance with the Drawings.

Q7. Plans Sheet D-1302, Detail 4, indicates the use of a weir cone for the inlet riser. Typically inlet risers terminate in a plain end, please confirm if this is acceptable for this project.

A7. A weir cone will not be installed on the inlet riser. As part of this addendum, Detail 4 (on Sheet D-1302) has been updated to show a short radius 90-degree bend (in lieu of a weir cone) at the terminus point. The invert of this 90-degree bend shall correspond to that of a plain end pipe (if it were used instead).

Q8. Article 2.01.A of Section 03300 requires testing of cement every 250 barrels and article 2.02.B of that same section requires testing of aggregates every 100 cubic yards. We find this to be a very unusual requirement. As some of the required testing takes days to complete, it would not be possible to obtain test results before placing the majority of the concrete required in the tank construction. Can it be confirmed that these required testing frequencies do not apply to tank construction? If not, can the required frequency of testing be relaxed and can it be clarified that test results, other than for the initial testing, are not required prior to placing concrete?

A8. As part of this addendum, Section 03300 has been replaced and includes an entirely new testing program. Please review the updated specification and determine if a problem still exists.

Q9. Changes made in Addendum No. 1 to the Bid Proposal and Supplementary Conditions appear to have removed the original requirement to complete Phase 1 in 175 calendar days. This, in effect, seems to nullify any time requirement for the completion of Phase 1 and to establish the first milestone as being Substantial Completion in 250 calendar days. However, page SS-4, Section 8.6 of the Supplementary Conditions still contains two specified Liquidated Damages amounts pertaining to Phase 1. Can it be confirmed that there is no longer any completion time requirement, or related Liquidated Damages, for Phase 1?

A9. As part of this addendum, Section 9.2 of the Supplementary Conditions has been updated. There is still a completion time requirement (of 175 calendar days) and related Liquidated Damages for Phase 1.

Q10. Page BP-3 of the Bid Proposal, and Section 9.2.3 of the Supplementary Conditions, as modified by Addendum No. 1, require that Final Completion be achieved within 615 calendar days, while no longer mentioning a Contractor demobilization being required or the need for work by others to be complete prior to Final Completion. We find this to be unclear in regards to the amount of time allowed, after the completion of work by others, for the Contractor to reach Final Completion. What amount of time will be allowed from the time the Contractor returns to the site until Final Completion is required?

A10. Final Completion will need to be completed within 30 calendar days of the date that the Contractor receives notice to return to the site. As part of this addendum, Section 9.2 of the Supplementary Conditions has been updated to reflect this change.

Q11. Article 5.18 of the General Conditions states that no work will be allowed at night or on Saturdays without approval. It is common that wire-winding be performed at night and on Saturdays. Will the Contractor be allowed to perform wire-winding at night and on Saturdays?

A11. As stipulated by this article, the Contractor will need to obtain approval to perform this operation at either of these times.

Q12. Article 1.05 of Section 03713 contains temperature-related environmental requirements for shotcrete that are impractical for wire-wound tank construction and far more restrictive than AWWA D110. Can it be clarified that these requirements do not apply to shotcrete operations related to the tank and that the weather limitations for shotcrete shall be in accordance with the requirements of AWWA D110?

A12. Placement of shotcrete shall comply with the weather restrictions listed in AWWA D110. The specification has been revised accordingly.

Q13. Articles 2.02.A.2 and 2.04.B.1 of Section 13207 require that the minimum depth of the tank ring footing be 3.5 feet. Ring footings of wire-wound tanks typically range from 1.0 foot to 1.5 feet deep. A 3.5-feet deep ring footing is, in fact, inadvisable. In instances where ring footings need to extend deeper than 1.5 feet, standard industry practice is to augment the footing depth by using lean concrete. Can a lean concrete sub-footing be used, so that the sum of its depth plus that of the ring footing itself be a minimum of 3.5 feet?

A13. Provide footing design that is consistent with the requirements of Section 13207.

Q14. Article 2.03.C of Section 13207 (and Q&A #17) in Addendum 2 references Section 03713 (Shotcrete) for concrete aggregate. The aggregate type set forth in Section 03713 is for shotcrete, having 100% passing the ½-inch sieve, and not suitable for concrete. Can it be confirmed that concrete aggregate may conform to ASTM C33, with the coarse aggregate being No. 57 or No. 67?

A14. Section 13207 has been modified to refer to Section 03300 (which lists ASTM C33).

Q15. Q&A #4 in Addendum No. 2 states that the seismic design criteria shall be per the General Structural Notes as found on Sheet S-1301. The values for S_S, S_1, S_{DS} and S_{D1} shown on Sheet S-1301 (and indicated in the Geotechnical Report) appear to be incorrect, in that they far exceed (by a factor of 10) those values shown on the USGS Seismic Design Maps available on the USGS website. The values shown on the USGS Seismic Design Maps are as follows: $S_S = 0.074g$; $S_1 = 0.030g$; $S_{DS} = 0.049g$; $S_{D1} = 0.020g$. Can it be confirmed that the correct values for S_S, S_1, S_{DS} and S_{D1} are those shown on the USGS Seismic Design Maps?

A15. Yes, that is correct. As part of this addendum, Sheet S-1301 has been updated to reflect those values.

Q16. The amount of area required to assemble the crane for this project is larger than previously anticipated. Crane assembly will require that a temporary work road, with a minimum width of 12 feet, be extended from the tank to a point approximately 300 feet west of the tank, for use during Phase 1. This road would extend approximately 35 feet beyond the western boundary of the Phase 1 Work Area, as shown on Sheet C-1303. Can it be confirmed that a temporary work road may be installed, which would extend approximately 35 feet beyond the western boundary of the Phase 1 Work Area, for use during Phase 1?

A16. Yes, that can be done. As part of this addendum, Sheet C-1303 has been updated to reflect these new limits.

Q17. With respect to the <u>seismic loads</u> specified in the updated Sheet S-1301:

- The values specified in Note 7 of "Design Load Criteria" in that drawing (S_S = 0.74g and S_1 = 0.30g; and S_{DS} = 0.49g and S_{D1} = 0.20g) are still apparently in error.
- The values of S_S and S_1 should be 0.074g and 0.030g, respectively (In which case, S_{DS} = 0.049g and S_{D1} = 0.020g).

A17. Yes, that is correct. As part of this addendum, Sheet S-1301 has been updated to reflect those values.

<u>REVISIONS TO CONTRACT DOCUMENTS AND TECHNICAL SPECIFICATIONS</u>

<u>BID PROPOSAL</u>

a) Remove and replace the Bid Proposal in its entirety with the revised version attached to this Addendum. This version should be used when submitting a bid for this project.

<u>PROPOSAL CERTIFICATION</u>

a) Remove and replace the Proposal Certification page in its entirety with the revised version attached to this Addendum. This version should be used when submitting a bid for this project.

<u>SUPPLEMENTARY CONDITIONS</u>

a) Page SS-5, Section 9.2, delete in its entirety and replace with the following:

"9.2 Add the following paragraph:

9.2.3 Phase 1 Completion of the Project will be considered only after the casting beds have been fully removed from the project site and the project laydown area is condensed to the limits as indicated in the Drawings. The milestone date for this portion of the Work is **175 calendar days** after the Notice to Proceed (NTP) date.

Substantial Completion must be achieved within **280 calendar days** of the NTP date. For Phase 2 Completion, to be considered Substantially Complete at a project level, the following portions of the Work must be completed:

1. Piping and Appurtenant Fittings (as shown on the Drawings)
2. Concrete Ground Storage Tank
3. Minor Cleanup Work
4. Demobilization

Upon demobilization, the CONTRACTOR will wait for the completion of work by other contractors before beginning the Work to achieve Final Completion.

Final Completion is achieved within **515 calendar days** of the NTP date. Final Completion occurs once the following portions of the Work are successfully finished (after the work by other contractors is completed):

1. Mobilization
2. Leak Testing
3. Tank Disinfection
4. Minor Cleanup Work

The duration for Final Completion shall be within 30 calendar days of the date on which the CONTRACTOR receives notice to remobilize on the job site.

Note that, for startup activities associated with the Terminus Facility to commence, the tank must be operational. This will require the CONTRACTOR to mobilize and successfully complete the leak testing and tank disinfection operations listed above within this timeframe.

Contract time will continue to be charged against the CONTRACTOR until the OWNER approves Final Acceptance of the Project."

SPECIAL CONDITIONS

a) Page SC-1, SC-1.5., add the following paragraph immediately following this special condition:

"1.6 The CONTRACTOR agrees to cooperate and coordinate its work with the work conducted by other contractor(s) within the project area so that this project can be completed in an orderly and coordinated manner, reasonably free of significant disruption to any party. Without limitation of the foregoing, CONTRACTOR understands and agrees that access areas to the project site may be utilized by other contractor(s) or SAWS personnel. All parties shall be solely required and obligated to coordinate and cooperate with each other to accomplish the scope of work required by their respective contracts, meaning SAWS shall have no duty to administer, perform or supervise the coordination for the use of the project site by all contractors. The CONTRACTOR agrees that any delay or hindrance caused by or contributed to by failure to cooperate and/or coordinate among all parties will be governed by this Section and Section 6.8 – NO DAMAGES FOR DELAY CLAUSE of the General Conditions."

SECTION 01025 – MEASUREMENT AND PAYMENT

a) Replace this section in its entirety with attached Section 01025.

SECTION 01500 – CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS

a) Page 01500-5, Paragraph 1.07.D.2., delete this paragraph in its entirety and renumber the subsequent paragraph.

SECTION 03300 – CAST-IN-PLACE CONCRETE

a) Replace this section in its entirety with attached Section 03300.

SECTION 03713 – CAST-IN-PLACE CONCRETE

a) Replace this section in its entirety with attached Section 03713.

SECTION 13207 – WIRE-WOUND, PRESTRESSED CONCRETE TANK WITH STEEL DIAPHRAGM

a) Replace this section in its entirety with attached Section 13207.

SECTION 15067 – STAINLESS STEEL PIPE AND FITTINGS

a) Page 15067-4, Paragraph 2.02.A.1.b., in the first sentence, delete "Section 15044: Pressure Testing of Piping" and replace with "Section 15085: Water Pipeline Testing".

REVISIONS TO DRAWINGS

SHEET C-1302 – TERMINUS TANK DIMENSION CONTROL AND ACCESS PLAN

a) Replace Sheet C-1302 in its entirety with attached sheet.

SHEET C-1303 – TERMINUS PHASED CONTRACTOR LAYDOWN AREAS

a) Replace Sheet C-1303 in its entirety with attached sheet.

SHEET C-1304 – TERMINUS TANK GRADING PLAN

a) Replace Sheet C-1304 in its entirety with attached sheet.

SHEET C-1305 – TERMINUS TANK GRADING SECTIONS

a) Replace Sheet C-1305 in its entirety with attached sheet.

SHEET S-1301 – STRUCTURAL GENERAL NOTES

a) Replace Sheet S-1301 in its entirety with attached sheet.

SHEET D-1301 – TERMINUS SITE GROUND STORAGE TANK PLAN & SECTION

a) Replace Sheet D-1301 in its entirety with attached sheet.

SHEET D-1302 – TERMINUS SITE GROUND STORAGE TANK DETAILS I

a) Replace Sheet D-1302 in its entirety with attached sheet.

SHEET D-1303 – TERMINUS SITE GROUND STORAGE TANK DETAILS II

a) Replace Sheet D-1303 in its entirety with attached sheet.

SHEET D-1304 – TERMINUS SITE GROUND STORAGE TANK DETAILS III

a) Replace Sheet D-1304 in its entirety with attached sheet.

SHEET D-1305 – TERMINUS SITE GROUND STORAGE TANK DETAILS IV

a) Replace Sheet D-1305 in its entirety with attached sheet.

The remainder of the bid documents remain unchanged.

This addendum is comprised of a total of **78** pages (including attachments).

Bill D. Marriott, P.E.
Tetra Tech, Inc.

STATE OF TEXAS
BILL D. MARRIOTT
88701
REGISTERED
PROFESSIONAL ENGINEER

5/23/2018

END OF ADDENDUM No. 3

BID PROPOSAL

PROPOSAL OF ____, a corporation

a partnership consisting of ____

an individual doing business as____

TO THE SAN ANTONIO WATER SYSTEM:

Pursuant to Instructions and Invitations to Bidders, the undersigned proposes to furnish all labor and materials as specified and perform the work required for the project as specified, in accordance with the Plans and Specifications for the following prices to wit:

LUMP SUM PRICES FOR:

ITEM NO.	ITEM DESCRIPTION (PRICE TO BE WRITTEN IN WORDS)	UNIT	QTY	UNIT PRICE (IN FIGURES)	TOTAL (IN FIGURES)
1.	Central Water Integration Pipeline Terminus Tank Project - Furnish all materials, labor, and equipment for construction of a new 10.0 million gallon prestressed concrete ground storage tank, drainage and water supply pipelines, site improvements, and all appurtenances for a complete in-place facility, in accordance with the Contract Documents, complete in place.	LS	1	$_________	$__________
2.	Permit Allowance – See Section 01025 for description.	Not to Exceed Allowance		$ 10,000.00	$ 10,000.00
3.	General Allowance – Contractor shall include an allowance for items unforeseen or not specifically characterized in the Contract Documents, encountered during the course of construction.	Not to Exceed Allowance		$ 100,000.00	$ 100,000.00
A.	SUBTOTAL BASE BID AMOUNT (Items 1 - 3)				$__________

ITEM NO.	ITEM DESCRIPTION (PRICE TO BE WRITTEN IN WORDS)	UNIT	QTY	UNIT PRICE (IN FIGURES)	TOTAL (IN FIGURES)
4.	Mobilization and Demobilization - This item shall include project move-in and move-out of personnel and equipment, for all work including furnishing all labor, materials, tools, equipment and incidentals required to mobilize, demobilize, bond and insure the Work for the project in accordance with the Contract Documents, complete in place. Maximum of 5% of Line Item 'A. SUBTOTAL BASE BID AMOUNT (Items 1 – 3)'	LS	1	$_________	$__________
5.	Roadway Work – This item shall consist of furnishing all labor, equipment, tools and materials associated with the temporary all-weather access road as indicated on the Drawings and in the Contract Documents.	LS	1	$_________	$__________
6.	Select Fill Material – See Section 01025 for description.	CY	1,000	$_________	$__________
B.	TOTAL BID AMOUNT (Items 1 - 6)				$__________

Mobilization and Demobilization lump sum bid shall be limited to a maximum 5% of the Line Item 'A. SUBTOTAL BASE BID AMOUNT (Items 1 - 3)'. Line Item 'A. SUBTOTAL BASE BID AMOUNT (Items 1 - 3)' is defined as all bid items EXCLUDING Item 4 – Mobilization and Demobilization, Item 5 – Roadway Work, and Item 6 – Select Fill Material. **If the Lump Sum price for Item 4 exceeds the allowable maximum stated for Mobilization and Demobilization, SAWS reserves the right to cap the amount at 5% and adjust the extension of the bid item accordingly.**

BIDDER'S SIGNATURE & TITLE

FIRM'S NAME (TYPE OR PRINT)

FIRM'S ADDRESS

FIRM'S PHONE NO./FAX NO.

FIRM'S EMAIL ADDRESS

The Contractor herein acknowledges receipt of the following:

Addendum Nos.________________________________

OWNER RESERVES THE RIGHT TO ACCEPT THE OVERALL MOST RESPONSIBLE BID.

The Bidder offers to construct the Project in accordance with the Contract Documents for the contract price, to substantially complete the work within **280 calendar days** and to complete all work on the Project within **515 calendar days** after the start date, as set forth in the Authorization to Proceed. **The Bidder understands and accepts the provisions of the Contract Documents relating to liquidated damages of the Project if not completed on time.**

Complete the additional requirements of the Bid Proposal which are included on the following pages.

END OF SECTION

PROPOSAL CERTIFICATION

Accompanying this proposal is a Bid Bond or Certified or Cashier's Check on a State or National Bank payable to the Order of the San Antonio Water System for ____________________________________ dollars ($_____________________), which amount represents five percent (5%) of the total bid price. Said bond or check is to be returned to the bidder unless the proposal is accepted and the bidder fails to execute and file a contract within 10 calendar days after the award of the Contract, in which case the check shall become the property of said San Antonio Water System, and shall be considered as payment for damages due to delay and other inconveniences suffered by said San Antonio Water System due to the failure of the bidder to execute the contract. The San Antonio Water System reserves the right to reject any and all bids.

It is anticipated that the Owner will act on this proposal within 60 calendar days after the bid opening. Upon acceptance and award of the contract to the undersigned by the Owner, the undersigned shall execute standard San Antonio Water System Contract Documents and make Performance and Payment Bonds for the full amount of the contract within 10 calendar days after the award of the Contract to secure proper compliance with the terms and provisions of the contract, to insure and guarantee the work until final completion and acceptance, and the guarantee period stipulated, and to guarantee payment of all lawful claims for labor performed and materials furnished in the fulfillment of the contract.

It is anticipated that the Owner will provide written Authorization to Proceed within 30 days after the award of the contract.

The work called for in this Contract shall commence on the date indicated in the SAWS written Authorization to Proceed Under no circumstances shall the work commence prior to the date provided for in the SAWS issued, written Authorization to Proceed. Work shall be substantially completed within **280 consecutive calendar days** and all work completed within **515 consecutive calendar days**.

The undersigned further acknowledges compliance with “Wage and Labor Standard Provisions” of this contract and the use of the Blue Book rental rates for establishment of equipment rental rates whether owned or leased during the course of this Contract.

In completing the work contained in this proposal, the undersigned certifies that Bidder's practices and policies do not discriminate on the grounds of race, color, religion, sex or national origin and that the Bidder will affirmatively cooperate in the implementation of these policies and practices.

Signed: ____________________________________

Company Representative

____

Company Name

____

____

Address

Please return Bidder's check to: ____________________________________

Company Name

____

____

Address

SECTION 01025

MEASUREMENT AND PAYMENT

PART 1 GENERAL

1.01 DESCRIPTION OF WORK

A. This section defines the method that will be used to determine the quantities of Work performed or materials supplied and establish the basis upon which payment will be made.

1.02 ADMINISTRATIVE SUBMITTALS

A. Schedule of Values: Submit schedule on CONTRACTOR's standard form. Refer to Paragraph 1.05 of this Section and Section 01300 – Submittals for additional requirements.

B. Schedule of Estimated Progress Payments (refer to Paragraph 1.06 of this Section for additional requirements):

1. Submit with initially acceptable Schedule of Values.
2. Submit adjustments thereto with Application for Payment.

C. Application for Payment.

D. Final Application for Payment.

1.03 RELATED WORK

A. Section 01300 – Submittals.

1.04 PRICE

A. Required items of Work and incidentals necessary for the satisfactory completion of the Project shall be considered incidental to the specified Work required under this contract and shall be considered as included in the unit prices for the various proposal items. CONTRACTOR shall prepare his Bid accordingly to allow for such items:

1. Not specifically listed in the Bid Proposal.
2. Not specified in this section to be measured or to be included in one of the items listed in the Bid Proposal.
3. To include CONTRACTOR's overhead and profit.

B. Work includes the furnishing of all labor, materials, equipment, tools, and related items for performing all operations required to complete the Project satisfactorily in place, as specified by the Contract Documents.

1.05 SCHEDULE OF VALUES

A. Prepare a separate Schedule of Values for each phase of Work under the Agreement.

B. Use line items in the proposal as line items in the Schedule of Values. Provide adequate detail to allow easy determination of the percentage of work completed for each item.

C. Lump Sum Work

1. Reflect Schedule of Values format included in conformed Bid Proposal Form, specified allowances, and equipment selected by OWNER, as applicable.

2. List bonds and insurance premiums, mobilization, demobilization, facility startup, and contract closeout separately.

3. Separate product costs and installation costs. Break down by Divisions 2 through 16 for each of the Project facilities.

a. Product costs include cost for product, delivery and unloading, royalties and patent fees, taxes, and other cost paid directly to the supplier or vendor.

b. Installation costs include cost for the supervision, labor and supervision, labor and equipment for field fabrication, erection, installation, start-up, initial operation and CONTRACTOR's overhead and profit.

4. Divide principal subcontract amounts into an adequate number of line items to allow determination of the percentage of work completed for each item. These line items may be used to establish the value of work to be added or deleted from the project.

D. An unbalanced or front-end loaded schedule will not be acceptable.

E. Summation of the complete Schedule of Values representing all Work shall equal the Contract Price.

1.06 SCHEDULE OF ESTIMATED PROGRESS PAYMENTS

A. Show estimated payment requests throughout Contract Times aggregating the initial Contract Price.

B. Base estimated progress payments on initially acceptable progress schedule. Adjust to reflect subsequent adjustments in progress schedule and Contract Price as reflected by modifications to the Contract Documents.

1.07 APPLICATION FOR PAYMENT

A. Reference Article VII Contract Payments of the Contract General Conditions.

B. Preparation:

1. Round values to nearest dollar.
2. List each Change Order and Written Amendment executed prior to date of submission as separate line item. Totals to equal those shown on the Transmittal Summary Form for each schedule as applicable.
3. Submit Application for Payment, including a Transmittal Summary Form and detailed Application for Payment Form(s) for each schedule as applicable, a listing of materials on hand for each schedule as applicable and such supporting data as may be requested by OWNER.

C. Include accepted Schedule of Values for each schedule or portion of Work, the unit price breakdown for Work to be paid on unit price basis, a listing of OWNER-selected equipment if applicable, and allowances, as appropriate.

1.08 MEASUREMENT – GENERAL

A. Weighing, measuring, and metering devices used to measure quantity of materials for Work shall be suitable for purpose intended and conform to tolerances and specifications as specified in National Institute of Standards and Technology, Handbook 44.

B. Whenever pay quantities of material are determined by weight, the material shall be weighed on scales furnished by CONTRACTOR and certified accurate by the state agency responsible. A weight or load slip shall be obtained from the weigh facility and delivered to the OWNER's representative at the point of delivery of the material.

C. If material is shipped by rail, the car weights will be accepted provided that actual weight of material only will be paid for and not minimum car weight used for assessing freight tariff, and provided further that car weights will not be acceptable for material to be passed through mixing plants.

D. Vehicles used to haul material being paid for by weight shall be weighed empty daily and at such additional times as required by OWNER. Each vehicle shall bear a plainly legible identification mark.

E. All materials that are specified for measurement by the cubic yard measured in the vehicle shall be hauled in vehicles of such type and size that the actual contents may be readily and accurately determined. Unless all vehicles are of uniform capacity, each vehicle must bear a plainly legible identification mark indicating its water level capacity. All vehicles shall be loaded to at least their water level capacity. Loads hauled in vehicles not meeting the above requirements or loads of a quantity less than the capacity of the vehicle, measured after being leveled off as above provided, will be subject to rejection, and no compensation will be allowed for such material.

F. Where measurement of quantities depends on elevation of existing ground, elevations obtained during construction will be compared with those shown on Drawings. Variations of l foot or less will be ignored, and profiles shown on Drawings will be used for determining quantities. Quantities will be based on ground profiles shown.

G. Units of measure shown on the Schedule of Values shall be as follows unless specified otherwise.

Item	**Method of Measurement**
AC	Acre-Field Measure by OWNER
CY	Cubic Yard-Field Measure by OWNER within the limits specified or shown
CY-VM	Cubic Yard-Measured in the Vehicle by Volume
EA	Each-Field Count by OWNER
GAL	Gallon-Field Measure by OWNER
HR	Hour
LB	Pound(s)-Weight Measure by Scale
LF	Linear Foot-Field Measure by OWNER
LS	Lump Sum-Unit is one; no measurement will be made
MFBM	Thousand Foot Board Measure-Delivery Invoice
SF	Square Foot
SY	Square Yard
TON	Ton-Weight Measure by Scale (2,000 pounds)

1.09 PAYMENT

A. Reference Article VII Contract Payments of the General Conditions.

B. General:

1. The date for CONTRACTOR's submission of monthly Application for Payment shall be established at the Pre-construction Conference.

C. Payment for all Work shown or specified in the Contract Documents is included in the Contract Price. No measurement or payment will be made for individual items.

1.10 NONPAYMENT FOR REJECTED OR UNUSED PRODUCTS

A. Payment will not be made for the following:

1. Loading, hauling, and disposing of rejected material.
2. Quantities of material wasted or disposed of in manner not called for under the Contract Documents.
3. Rejected loads of material, including material rejected after it has been placed by reason of failure of CONTRACTOR to conform to provisions of the Contract Documents.
4. Material not unloaded from transporting vehicle.
5. Defective Work not accepted by OWNER.
6. Material remaining on hand after completion of Work.

1.11 PARTIAL PAYMENT FOR STORED MATERIALS AND EQUIPMENT

A. Partial payment for stored materials and equipment shall be in accordance with Article VII, Section 7.2 of the General Conditions of these Contract Documents and any revisions to said General Conditions as documented in the Supplementary Conditions.

1.12 BID PROPOSAL ITEMS

A. Bidder will complete the Work for the following listed Work items for the prices listed on the Bid Proposal:

Item No. 1: Base Bid for the Terminus Tank (Terminus Site)

1. Description
   a. Work items include:
      i. new 10.0 MG prestressed concrete ground storage tank.
      ii. drainage and water supply pipelines.
   b. Site improvement work items include:
      i. site excavation and fill placement.
      ii. all appurtenances and miscellaneous improvements for a complete in-place facility.

2. Measurement – Measurement of Item No. 1 will be by lump sum.

3. Payment of the full lump sum price shall be paid for the work performed and in accordance with the Schedule of Values. Payment shall constitute full compensation to the CONTRACTOR for furnishing all: labor, equipment, tools, and materials; mobilization and demobilization; and for performing all operations required to furnish to the OWNER the project, complete in place, as specified and as indicated on the Contract Drawings and Specifications.

Item No. 2: Permitting Allowance

1. Description – This item shall be for permitting fees associated with the project scope. This shall include furnishing all materials, and incidentals required to obtain all necessary permits including review fees, in accordance with the Contract Documents, complete in place.
2. Measurement – Measurement for the item “Permitting Allowance” will be “by permit” of the actual fees. This allowance shall cover any approved reimbursement of costs related to obtaining permits required to construct the project. Proof of payment of permits fees will be required, and reimbursements will be made on the basis of actual permit fees required by each respective agency paid. The labor associated with obtaining permits is considered incidental to Item No. 1.
3. Payment of the not to exceed allowance price shall be paid for the work. Payment shall constitute full compensation to the CONTRACTOR for obtaining all

necessary permits for the Project. CONTRACTOR shall provide permit receipts to SAWS for reimbursement.

Item No. 3: General Allowance

1. Description – This item shall be an allowance for items unforeseen or not specifically characterized in the Contract Documents, encountered during the course of construction.
2. Measurement – Measurement for the item "General Allowance" will be by time and materials. The usage of the allowance shall meet the requirements of the General Conditions for contract changes and shall be only by written authorization of the OWNER.
3. Payment of the not to exceed allowance price shall be paid for the work. Payment shall constitute full compensation to the CONTRACTOR for any unforeseen items or not specifically characterized in the Contract Documents. CONTRACTOR shall provide a detailed breakdown for furnishing all labor, materials and equipment for payment.

Item No. 4: Mobilization and Demobilization

1. Description – Work item shall include mobilization and demobilization costs associated with the Central Water Integration Pipeline Project Terminus Tank scope. This item shall include project move-in and move-out of personnel and equipment, for all work including furnishing all labor, materials, tools, equipment and incidentals required to mobilize, demobilize, bond and insure the Work for the project in accordance with the Contract Documents, complete in place.
2. Measurement – Measurement of Item No. 4 will be by lump sum as the work progresses. If the Lump Sum price for Item 4 exceeds the allowable maximum stated for Mobilization and Demobilization, SAWS reserves the right to cap the amount at 5% and adjust the extension of the bid item accordingly.
3. Payment – Partial payments of the lump sum bid for mobilization will be as follows:
   a. When 1% of the adjusted contract amount for construction items (which is defined as the total contract amount less the lump sum proposal for mobilization) is earned, 50% of the mobilization lump sum proposal will be paid. Insurance and Bonds will be paid on the initial request for payment under a sub-heading to mobilization entitled "Insurance and Bonds". The amount paid for Insurance and Bonds will not exceed 3% of the total contract amount for construction items. Receipts or other proof of payment for the full amount of compensation requested under the sub-heading of "Insurance and Bonds" shall be provided to the OWNER with the request for payment.
   b. When 5% of the adjusted contract amount for construction items is earned, 75% of the mobilization lump sum proposal will be paid.
   c. Upon completion of all Work under this contract, payment for the remainder of the lump sum proposal for mobilization will be made.

Item No. 5: Roadway Work

1. Description – The Roadway Work shall consist of furnishing all labor, equipment, tools and materials as indicated on the Drawings and in the Contract Documents. The Roadway Work shall provide for a temporary all-weather access roadway that will be maintained throughout the duration of construction. The roadway will be maintained by the CONTRACTOR and will be available for use by all other contractors, OWNER, ENGINEER, or others requiring access to the site including areas that the CONTRACTOR is utilizing and not utilizing.

2. Measurement – Measurement of Item No. 5 will be by unit cost based on the number of square yards. The Schedule of Values shall provide a unit cost in square yards. The unit cost in the Schedule of Values shall be utilized to adjust for changes in the location, length and width of the roadway including both decreases and increases.

3. Payment of the full lump sum price shall be paid for the work performed and in accordance with the Schedule of Values. Payment shall constitute full compensation to the CONTRACTOR for furnishing all: labor, equipment, tools, and materials; and for performing all operations required as indicated on the Contract Drawings and Specifications.

Item No. 6: Select Fill Material

1. Description – The Select Fill Material allowance shall cover any overages on the select fill quantity required to grade in accordance with the drawings. The base bid quantity in Item No. 1 shall include the select fill volume required based on the estimated grade of the limestone layer shown in the drawings. This item includes import, placement, and compaction of the select fill material with payment by the compacted cubic yard as specified.

2. Measurement – Measurement of Item No. 6 will be by unit cost based on the number of compacted cubic yards of select fill material.

3. Payment of the unit cost price shall be paid for the work performed as measured based on the unit cost for materials and the number of cubic yards of material. Payment shall constitute full compensation to the CONTRACTOR for furnishing all labor, equipment, tools and materials, and for performing all operations required as indicated on the Contract Drawings and Specifications. Upon completion of removal of all overburden above the limestone layer (as verified by field inspection by the ENGINEER), CONTRACTOR will be responsible to perform a post-excavation survey of the limestone layer by a registered surveyor. Survey cross-sections shall be taken at 10-ft intervals and the endpoints of each cross-section shall be identified by coordinates. The survey shall establish the basis of the actual limestone layer elevation in comparison to that depicted on the Drawings and the basis for any difference in quantity of material removed. Any removal and replacement beyond the limits, as defined in the Contract Documents or as required to support the CONTRACTOR’s equipment, shall be at the CONTRACTOR's expense.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION – NOT USED

END OF SECTION

SECTION 03300

CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 SCOPE

A. This section covers procurement of all cast-in-place concrete, including concrete materials, limiting requirements, mixture design, and performance requirements, and delivery to the Site through discharge at the end of the delivery truck chute.

1. Work beyond the end of the delivery truck chute is covered in the Concrete Forming, Concrete Reinforcing, Concrete Joints and Accessories, and Concrete Placing, Finishing, and Curing sections.

2. The requirements specified herein are minimum requirements only and shall not be interpreted as all inclusive. It is the responsibility of the CONTRACTOR to employ the necessary practices based on the referenced ACI Standards to ensure the completion of quality concrete construction, of the strengths specified within the Construction Documents, and relatively free of cracks.

B. Related Work:

1. Section 03100 - Concrete Formwork
2. Section 03200 - Concrete Reinforcement
3. Section 03350 – Concrete Placing, Finishing, and Curing
4. Section 03713 – Shotcrete
5. Section 13207 – Prestressed Concrete Tank

1.02 GENERAL

A. All cast-in-place concrete shall conform to the limiting requirements of this specification including Tables 1A and 1B.

B. Concrete Classifications.

1. Concrete classifications shall be defined and used as indicated for the following classes:

2. Concrete Classifications

Class	Class Description
A.	Structural Concrete

Class	Class Description

A1. Concrete for Liquid-Containing Structures. Concrete for liquid-containing environmental structures, liquid-containing tanks, interior suspended slabs in high humidity areas, headwalls, and all other concrete not otherwise indicated.

A2. Small Aggregate Concrete; Congested Areas. Structural small aggregate concrete shall be used in all areas where the clear distance between reinforcement, conduit, or embedded items is less than the largest dimension of coarse aggregate particles in the structural concrete.

A3. Concrete for Non-Liquid-Containing Structures. Concrete for footings, foundations, manholes, catch basins, pan-formed joists, equipment pads, and all other structural concrete other than for liquid-containing structures.

B. Exterior Flatwork Concrete. Concrete for exterior slabs on grade (mow strip).

1.03 REFERENCES

ACI 117	Specification for Tolerances for Concrete Construction and Materials
ACI 301	Specifications for Structural Concrete
ACI 318	Building Code Requirements for Structural Concrete and Commentary
ACI 347	Guide to Formwork for Concrete
ACI 350	Code Requirements for Environmental Engineering Concrete Structures and Commentary

1.04 SUBMITTALS

A. Drawings and Data.

1. All submittals of drawings; manufacturers' certificates of compliance, recommendations, and test data; reports; catalog data sheets; and other data shall be in accordance with the Submittals Procedures section, unless otherwise specified herein.

   a. Submittals required for each Class of concrete shall be as indicated in Tables 2A and 2B.

2. Prepare mix designs and prove with laboratory 7-day, 14-day and, 28-day compressive test, or submit test reports of 7-day, 14-day, and 28-day compressive tests of the mix where the same mix has been used on two previous projects. A mix design and trial batch testing shall also be performed for the cement rich mix required at the base of water containment structure walls. The materials used in any mix design submitted for review shall be from the same source as those that will be actually furnished for this project (i.e., cement manufacturer, aggregates, admixtures, etc.) Submit mix design and test reports in writing for review by the ENGINEER at least 15 days before placing of any concrete.

3. Reports and certifications on proposed materials and mixture proportions for each concrete mixture design shall be submitted for review within 30 days after the preconstruction conference and prior to conducting the laboratory trial batches for each mixture design.

B. Manufacturer's Certificate of Compliance.

C. A manufacturer's certificate of compliance, which includes copies of independent test results confirming compliance with specified requirements, shall be submitted to ENGINEER for the following materials when used:

Cement.

Admixtures.

Fly Ash.

Slag Cement.

1.05 STORAGE AND HANDLING

A. Cement, slag cement and fly ash shall be stored in suitable moisture-proof enclosures. Cement, slag cement and fly ash which have become caked or lumpy shall not be used.

1. Aggregates shall be stored so that segregation and the inclusion of foreign materials are prevented. The bottom 6 inches of aggregate piles in contact with the ground shall not be used.

PART 2 PRODUCTS

2.01 LIMITING REQUIREMENTS

A. Unless otherwise specified, each concrete mixture shall be designed and controlled, within the following limits, to provide a dense, durable concrete suitable for the expected service conditions.

1. Concrete shall be proportioned to provide an average compressive strength (f'_{cr}) as prescribed in Chapter 5 of ACI 318.

2. Concrete materials shall be selected and concrete shall be proportioned, batched, mixed, and delivered in a manner that will minimize shrinkage and cracking as specified herein, and in accordance with Chapters 3 and 8 of ACI 224R. Concrete temperatures shall be controlled before and until delivery at the end of the delivery truck chute to minimize cracking. Any rise in concrete temperature caused by environmental conditions that will be conducive to excessive shrinkage shall be controlled.

3. For each class of concrete, each concrete mixture shall be designed and concrete shall be controlled within the limits in the specification and in Tables 1A and 1B.

B. Cementitious Material Content Limits. The minimum quantity of Portland cement in the concrete shall be as indicated in Tables 1A and 1B.

1. The cementitious material content shall not be increased beyond the Tables 1A and 1B values more than necessary to achieve the required f'_{cr}.

2. CONTRACTOR may substitute fly ash for Portland cement within the percentage ranges indicated in Tables 1A and 1B, on the basis of 1.0 lbs of fly ash added for each lb of Portland cement reduction. Fly ash shall comprise a maximum of 20 percent of total cementitious material.

3. CONTRACTOR may substitute slag cement for Portland cement within the percentage ranges indicated in Tables 1A and 1B on the basis of 1.0 lbs of slag cement added for each lb of Portland cement reduction.

4. Mixtures using slag cement in combination with fly ash will not be acceptable.

C. Maximum Water-Cementitious Material Ratio.

1. The maximum water-cementitious material ratio shall be on a cement mass basis, or, if fly ash or slag cement is used, the combined mass of cement plus fly ash or slag cement shall be used to determine the water-cementitious materials ratio. Limiting maximum water-cementitious material ratios are indicated in Tables 1A and 1B.

D. Aggregates

1. Aggregates shall comply with ASTM C33 except as specified herein. Fine aggregate shall be clean natural sand. Artificial or manufactured sand shall not be used unless acceptable to ENGINEER. Coarse aggregate shall be crushed rock, washed gravel, or other inert granular material, meeting Class 4S requirements, except that clay and shale particles shall not exceed values indicated in Tables 1A and 1B.

2. Gradation of coarse aggregate shall conform to maximum nominal size grading requirements of ASTM C33. When a combination of two or more sizes is used, the combined gradation shall meet ASTM C33 requirements.

3. Aggregates used in concrete shall have a combined aggregate distribution similar to the aggregates used in the concrete trial mixtures. Reports of individual aggregates shall include sieve sizes 1-1/2-inch, 1 inch, 3/4 inch, 1/2-inch, 3/8-inch, No. 4, No. 8, No. 16, No. 30, and No. 50 in accordance with ASTM E11.

4. Specified sand equivalent for fine aggregate shall be not less than indicated in Tables 1A and 1B for an average of 3 samples tested in accordance with ASTM D2419.

5. To comply with the specified concrete shrinkage test requirements, the clay and shale content of the aggregates may need to be reduced by washing the aggregate.

E. Ratio of Fine to Total Aggregates

1. The ratio of fine to total aggregates, based on solid volumes (not weights), shall be as follows:

Maximum Nominal Coarse Aggregate Size	Minimum Ratio	Maximum Ratio
3/8 inch	0.45	0.60
1/2 inch	0.40	0.55
3/4 inch	0.35	0.50
1 inch	0.30	0.46
1-1/2 inch	0.25	0.40

F. Slump

1. Concrete slump shall be kept as low as possible, consistent with proper handling and thorough consolidation. Prior to the addition of admixtures, slump shall be at least 2 inches and shall not exceed the maximum slump as indicated in Tables 1A and 1B.

2. When superplasticizer is dispensed at the ready-mix plant, the concrete mixture design shall be based on a maximum slump as indicated in Tables 1A and 1B. When superplasticizer is dispensed at the Site, the slump of the concrete delivered shall not exceed the maximum slump as indicated in Tables 1A and 1B before superplasticizer is added.

G. Initial Set

1. The initial set, as determined by ASTM C403, shall be attained 5-1/2 hours ±1 hour after the water and cementitious materials are added to the aggregates for each concrete mixture. The quantity of retarding admixture shall be adjusted to compensate for variations in temperature and job conditions.

H. Total Air Content

1. The total volumetric air content of concrete after placement shall be as indicated in Tables 1A and 1B, and within ±1.5 percent.

I. Admixtures

1. Only approved or specified admixtures shall be used.

2. Unless otherwise acceptable to ENGINEER, all admixtures shall be from one manufacturer and shall be compatible. Admixtures that are compatible with other admixtures and concrete materials shall not have an adverse effect on the required properties of the concrete nor the specified limiting requirements. The admixture content, batching method, and time of introduction to the mixture shall comply with these specifications and with the manufacturer's recommendations for minimum shrinkage. The admixture manufacturer shall provide qualified field services as necessary, at no additional cost to OWNER.

3. Admixtures used in the concrete shall be reviewed and accepted by ENGINEER prior to conducting the laboratory trial concrete mixture testing and the shrinkage testing. No calcium chloride nor admixture containing chloride from sources other than residual impurities in admixture ingredients will be permitted. Admixtures containing unrefined or raw lignosulfonic acids ("lignins") or their salts, calcium chloride, or triethanolamine will not be acceptable.

4. Combination of admixtures which cause premature or local dehydration or post-compaction settlement of the concrete surface shall not be used. If any such undesirable characteristics are observed, the use of the mixture shall be discontinued and an alternate mixture design used.

5. All liquid-containing (Class A1) concrete, and small aggregate (Class A2) concrete that is placed in liquid-containing structures, shall include a high-range water reducing admixture (superplasticizer).

6. Superplasticizer may be dispensed into the concrete at the plant or on the Site and shall be mixed in accordance with the admixture manufacturer's recommendations. Each superplasticizer dose, when dispensed at the Site, shall be easily verifiable and recorded on the delivery ticket. The superplasticizer for each load shall be accurately proportioned into a separate container prior to dispensing the admixture into the concrete. When truck-mounted dispensers are used, the system shall not be flushed or cleaned with water until after the entire load of concrete has been discharged. Redosing of concrete with superplasticizer will not be allowed.

7. A shrinkage reducing admixture may be added to Class A1 concrete. It shall replace an equal volume of mixing water or as otherwise recommended by the admixture manufacturer. The quantity of air entrainment admixture shall be adjusted as required by the admixture manufacturer to keep mixture air content within specified limits.

J. Strength

1. In addition to the other limiting requirements to achieve durability and minimize shrinkage, the minimum acceptable compressive strengths of concrete tested at the end of the delivery truck chute, as determined by ASTM C39, shall be as indicated in Tables 1A and 1B.

2. Adequate test cylinders taken at the point of placement shall also be made to verify that CONTRACTOR's concreting procedures comply with applicable industry standard procedures.

K. Pumped Concrete

1. Coarse aggregate size for pumped concrete mixtures shall be limited to a nominal maximum of 1-1/2 inch.

2. The slump of concrete that is discharged into a pump may exceed the specified maximum slump value by the amount of slump loss in the pumping system, up to a maximum of 1 inch. The slump loss shall be determined by tests made at each end of the pumping system, with the pump boom oriented in the expected worst-case position during placement.

L. Water-Soluble Chloride

1. Maximum water-soluble chloride ion concentrations in hardened concrete at an age of 28 days shall not exceed the limits expressed as a percentage of mass of cementitious materials as indicated in Tables 1A and 1B.

2. Test results shall be reported as the percentage of water-soluble chloride ions in the concrete and as a percentage of chloride ion relative to the mass of cementitious materials in the concrete.

3. Testing of the concrete components for water-soluble chloride ions may be done at the discretion of CONTRACTOR. Copies of the reports on such tests shall be furnished to ENGINEER.

4. The hardened concrete and each gradation of aggregate used in the concrete shall be tested each time a chloride ion test is conducted on a concrete mixture.

M. Laboratory Shrinkage Limits

1. Based on the modified ASTM C157 test procedures as specified herein, the shrinkage limits of concrete shall be the average drying shrinkage of each set of three test specimens cast in the laboratory from a trial batch as measured at the 21 days drying age, and shall not exceed the values in Tables 1A and 1B.

N. Cold Weather Concrete

1. Except as modified herein, cold weather concrete shall comply with ACI 306.1. The temperature of concrete at the point of delivery at the end of the delivery truck chute shall be not less than that indicated in ACI 306.1 for corresponding outdoor temperature (in shade) at the time of placement.

   a. When delivered, heated concrete shall be not warmer than 80°F.

O. Hot Weather Concrete

1. Except as modified herein, hot weather concrete shall comply with ACI 305R-10. Hot weather is defined as any one of, or combination of, jobsite conditions that accelerate the rate of moisture loss or rate of cement hydration of freshly mixed concrete, including air temperature 80 degrees F or more, relative humidity 60% or less, and/or wind velocity of 10 miles per hour or more. The temperature of the concrete at the time of delivery at the end of the delivery truck chute shall be as indicated in ACI 305R-10.

2.02 MATERIALS

Cement	ASTM C 150, Type II. Low Alkali. Tricalcium aluminate content shall not exceed 8.0 percent.
Fly Ash	ASTM C618, Class F, except that loss on ignition shall not exceed 4 percent.
Slag Cement	ASTM C989, Grade 100 or Grade 120.
Aggregates, Fine and Coarse	As specified in Limiting Requirements paragraph.
Water	Potable.
Admixtures	
Water Reducing/Normal Set	ASTM C494, Type A, except as otherwise specified herein.

Water Reducing/Retarding	ASTM C494, Type D, except as otherwise specified herein.
Air-Entraining	ASTM C260.
High Range Water Reducing/Normal Set	ASTM C494, Type F, extended slump life type, except as otherwise specified herein.
High Range Water Reducing/Retarding	ASTM C494, Type G, extended slump life type, except as otherwise specified herein.
Shrinkage Reducing Admixture	Grace “Eclipse 4500”, or Euclid “Eucon SRA”.

2.03 PROPORTIONING

A. Mixture Design

1. Using concrete materials acceptable to ENGINEER, a tentative concrete mixture shall be designed and tested in the laboratory for each size and combined gradation of aggregates and for each consistency as indicated and intended for use on the work and as specified.

2. Concrete proportions shall be established based on laboratory trial mixtures that meet the following requirements:

   a. The combination of materials shall be as proposed for use in the work.

   b. Mixtures shall conform with the limiting requirements specified herein.

   c. The required average compressive strength, f'_{cr}, of the trial mixture shall exceed the specified minimum acceptable compressive strength, f'_{cr}, as required in Tables 1A and 1B.

   d. Trial mixtures of the proportions and consistencies specified for the work shall be prepared. When a three-point curve is required by Tables 2A and 2B, the three concrete trial mixtures shall reflect the cement content proposed for the Project and for the indicated concrete class at three water-cementitious material ratio contents at or lower than indicated in Tables 1A and 1B. The compressive strength of the cylinders made from the three trial mixtures shall produce a range of compressive strengths exceeding or encompassing the f'cr required for the work.

   e. For each proposed concrete mixture that is required to be tested as indicated in Tables 2A and 2B, compressive strength test cylinders shall be made for each testing age. Each change in the water-cementitious materials ratio shall be considered a new concrete mixture. Each mixture shall be tested at the ages of 7 days and 28 days.

   f. When a three-point curve is required in Table 2A or 2B, the results of the cylinder tests for each water-cementitious materials ratio at each age shall be plotted as a curve showing the relationship between compressive strength (along y-axis) and the water-cementitious materials ratio (along x-axis). The water-cementitious materials ratio and the associated average compressive strength for the Project concrete mixture shall be selected from the 28-day curve. The maximum water-cementitious materials ratio specified in the limiting requirements shall still apply even if the curve indicates that the concrete strength would be adequate at a higher ratio. The cement content and mixture proportions to be used shall be such that the selected water-cementitious materials ratio will not be exceeded at specified maximum slump. These concrete mixture proportions shall be submitted for review in accordance with the Submittals Procedures section.

g. When a shrinkage reducing admixture is proposed, trial batches shall be prepared with and without the shrinkage reducing admixture.

3. If acceptable in Table 2A or 2B, concrete mixtures may utilize prior field test data in lieu of laboratory trial mixtures. Field test data records shall be from the production facility being used on current Project and shall have been performed in the past 12 months. Field test data records shall represent a single group of at least 10 consecutive strength tests for one mixture, using the same materials, under the same conditions, and encompassing a period of not less than 60 days.

4. Mixtures shall be adjusted in the field as necessary, within the limits specified, to meet the requirements of these specifications.

B. Preliminary Review

1. Reports covering the source and quality of concrete materials and the concrete proportions proposed for the work shall be submitted to ENGINEER for review before performing the required trial mixture designs and before concrete work is started. The reports required shall be as indicated in Tables 2A and 2B. Review of these reports will be for general acceptability only, and continued compliance with all contract provisions will be required.

2. Aggregate Reports

a. Reports on aggregates shall include the information listed in Tables 2A and 2B. Aggregate reports shall be project specific and shall be no more than 90 days old at time of submittal.

3. Mixture Design Report

a. Design quantities and test results on each mixture shall be submitted for review and shall be acceptable to ENGINEER before concrete work is started. The report on each tentative concrete mixture and on the proposed concrete mixture shall contain the information in Tables 2A and 2B, and shall be submitted to ENGINEER.

4. Mixture Design Testing

a. As stipulated in the Quality Control section, all tests and reports required for preliminary review shall both be made by an independent testing laboratory at the expense of CONTRACTOR specifically for this Project. All materials shall be tested in accordance with the specified test methods and reports for these tests shall be prepared specifically for this Project. If the source of any concrete materials is changed during the contract, the materials and the new mixture design shall be tested in accordance with the specified preliminary review requirements and reports shall be submitted for review.

b. Aggregates shall be sampled and tested in accordance with ASTM C33. In addition, the bulk specific gravity of each aggregate shall be determined in accordance with ASTM C127 and ASTM C128.

c. Concrete test specimens shall be made, cured, and stored in accordance with ASTM C192 and tested in accordance with ASTM C39.

d. Cylinders shall be 6 inches diameter by 12 inches high. A strength test shall be the average compressive strength of two cylinders from the same sample of concrete.

e. Slump shall be determined in accordance with ASTM C143. Total air content shall be determined in accordance with ASTM C231 and verified in accordance with ASTM C138. Concrete temperature shall be determined in accordance with ASTM C1064 and unit weight (mass) shall be determined in accordance with ASTM C138. Water-soluble chloride ion shall be determined in accordance with ASTM C1218.

f. Initial set tests shall be made at ambient temperatures of 70°F and 90°F to determine compliance with the specified time for initial set. The test at 70°F shall be made using concrete containing the specified normal set/water-reducing admixture and, when required, air-entraining admixture. The test at 90°F shall be made using concrete containing the specified retarding/water-reducing admixture and, when required, air-entraining admixture. Initial set shall be determined in accordance with ASTM C403.

g. A preliminary test on a trial batch shall be conducted at the Site, using the proposed superplasticizer in the accepted mixture design to determine the correct dosage. When superplasticizer is not included in the trial mixture, the trial batch tested at the Site shall be used to determine compatibility of the superplasticizer with the other materials used in the concrete, including the other admixtures.

h. A drying shrinkage test shall be conducted on the preliminary trial batch with the maximum water-cementitious materials ratio used to qualify each proposed concrete mixture design using the concrete materials, including admixtures that are proposed for the Project. Three test specimens shall be prepared for each test. Drying shrinkage specimens shall be 4-inch by 4-inch by 11-inch prisms with an effective gauge length of 10 inches, fabricated, cured, dried, and measured in accordance with ASTM C157, except with the following modifications:

(i) Specimens shall be removed from the molds at an age of 23 hours ±1 hour after trial batching, shall be placed immediately in water at 73°F ±3°F for at least 30 minutes, and shall be measured within 30 minutes thereafter to determine original length and then submerged in lime-saturated water as specified in ASTM C157. Measurement to determine expansion expressed as a percentage of original length shall be taken at age 7 days. The length at 7 days shall be the base length for drying shrinkage calculations ("zero" days drying age). Specimens then shall be stored immediately in a humidity controlled room maintained at 73°F ±3°F and 50 percent ±4 percent relative humidity for the remainder of the test. Measurements to determine shrinkage expressed as a percentage of the base length shall be reported separately for 7, 14, and 21 days ±4 hours of drying from "zero" days after 7 days of moist curing for a total of 28 days from the date of casting.

ii) Drying shrinkage deformation for each specimen shall be computed as the difference between the base length (at "zero" days drying age) and the length after drying at each test age. Results of the shrinkage test shall be reported to the nearest 0.001 percent. If drying shrinkage of any specimen deviates from the average for that test age by more than 0.004 percent, the results for that specimen shall be disregarded.

(iii) The average drying shrinkage of each set of 4-inch by 4-inch by 11-inch test specimens made in the laboratory from a trial batch shall not exceed the values required in Tables 1A and 1B. Drying shrinkage tests will only be required for concrete mixtures indicated in Tables 1A, 1B, 2A, and 2B.

(iv) Alkali-aggregate reactivity potential shall be determined by one of the following procedures:

1 Test fine and coarse aggregates in accordance with both ASTM C289 and ASTM C295. Aggregates which do not indicate a potential for alkali reactivity may be used without further testing. Aggregates which indicate a potential for alkali reactivity shall be further tested in accordance with ASTM C227 or C1105 (as appropriate), using a cement containing less than 0.6 percent alkalies.

2 Test fine and coarse aggregates in accordance with ASTM C1260. Aggregates which do not indicate a potential for alkali reactivity may be used without further testing. Aggregates which indicate a potential for alkali reactivity shall be further tested in accordance with ASTM C227 or C1105 (as appropriate), using a cement containing less than 0.6 percent alkalies.

3 Test fine and coarse aggregates in accordance with ASTM C1567, using a single aggregate with all cementitious materials selected for the Project. The fine and coarse aggregates shall not be combined and used in a single test. This test may only be used for mixtures that contain slag cement or fly ash, and those products shall not have an alkali content greater than 4.0 percent sodium oxide equivalent. Combinations of cementitious materials and aggregate which do not indicate a potential for alkali reactivity may be used without further testing. Mixture combinations which indicate a potential for alkali reactivity shall have the ingredients and/or proportions modified and then the test shall be repeated.

4 At the discretion of ENGINEER, testing in addition to that indicated herein or in Appendix X1 of ASTM C33 may be performed on potentially reactive aggregates. Nonreactive aggregates shall be imported if, in the opinion of ENGINEER, local aggregates exhibit unacceptable potential reactivity.

2.04 BATCHING AND MIXING

A. Concrete shall conform to ASTM C94 and shall be furnished by an acceptable ready-mixed concrete supplier.

B. Consistency

1. The consistency of concrete shall be suitable for the placement conditions. Aggregates shall flow uniformly throughout the mass, and the concrete shall flow sluggishly when vibrated or spaded. The slump shall be kept uniform.

C. Delivery Tickets

1. A delivery ticket shall be prepared for each load of ready-mixed concrete and a copy of the ticket shall be handed to ENGINEER by the truck operator at the time of delivery. Tickets shall indicate the name and location of CONTRACTOR, the project name, the mixture identification, the quantity of concrete delivered, the quantity of each material in the batch, the outdoor temperature in the shade, the time at which the cementitious materials were added, and the numerical sequence of the delivery.

PART 3 EXECUTION

3.01 CONTRACTOR'S ONGOING MATERIAL CONTROL TESTING

A. The following tests and test reports are required during the progress of the work and shall be made at the expense of CONTRACTOR. The frequency specified herein for each field control test is approximate and subject to change as determined by ENGINEER.

B. Aggregate Gradation

1. Each 200 tons of fine aggregate and each 400 tons of coarse aggregate shall be sampled and tested in accordance with ASTM D75 and C136, for verification that the gradations continue to meet ASTM C33 requirements. If lesser quantities of aggregates are used, the sampling and testing shall occur at least once every 6 months.

C. Sand Equivalent

1. The sand equivalent test shall be conducted each time the sand gradation tests are conducted.

D. Fly Ash

1. Each 400 tons of fly ash shall be sampled and tested in accordance with ASTM C618 and C311. CONTRACTOR shall supply ENGINEER with certified copies of supplier's (source) test reports showing chemical composition and physical analysis for each shipment delivered to CONTRACTOR and certifying that the fly ash complies with the specifications. The certificate shall be signed by the fly ash supplier.

E. Cement

1. Each 1500 tons of cement shall be sampled and tested in accordance with ASTM C150. CONTRACTOR shall supply ENGINEER with certified copies of supplier's (source) test

reports showing chemical composition and physical analysis, and certifying that the cement complies with ASTM C150 and these specifications. The certificate shall be signed by the cement manufacturer.

F. Slag Cement

1. Each 800 tons of slag cement shall be sampled and tested in accordance with ASTM C989. CONTRACTOR shall supply ENGINEER with certified copies of supplier's (source) test reports showing chemical composition and physical analysis, and certifying that the slag cement complies with ASTM C989 and these specifications. The certificate shall be signed by the slag cement manufacturer.

3.02 CONTRACTOR'S FIELD CONTROL TESTING

A. Field control tests, including slump, air content, and making compression test cylinders, shall be performed by ENGINEER or CONTRACTOR's testing laboratory personnel, at the expense of CONTRACTOR. CONTRACTOR shall provide access to all facilities and the services of one or more employees as necessary to assist with the field control testing.

B. The frequency specified herein for each field control test is approximate and subject to change as determined by ENGINEER.

C. ENGINEER may require field testing prior to the addition of superplasticizer at the Site to determine compliance with the specifications. Field testing after the addition of superplasticizer shall be conducted as specified and as needed to determine that the concrete is in compliance with the specifications. Air content tests shall be conducted whenever field tests are conducted.

D. Slump

1. A slump test shall be made for each 50 cubic yards of concrete. Slump shall be determined in accordance with ASTM C143.

E. Air Content

1. An air content test shall be made on concrete from one of the first three batches mixed each day and on concrete from each batch of concrete from which concrete compression test cylinders are made. Air content shall be determined in accordance with ASTM C231 and verified in accordance with ASTM C138.

F. Unit Weight

1. A unit weight test shall be made on concrete from each batch of concrete from which concrete compression test cylinders are made. Unit weight shall be determined in accordance with ASTM C138.

G. Concrete Temperature

1. A concrete temperature test shall be made on concrete from the first batch of concrete mixed each day and on concrete from each batch of concrete from which concrete compression test cylinders are made. Concrete temperature shall be determined in accordance with ASTM C1064.

H. Water-Soluble Chloride Ion

1. Water-soluble chloride ion testing shall be performed once for each 1,000 cubic yards of concrete in accordance with ASTM C1218.

I. Compression Tests

1. For each class of concrete, four (4) concrete compression test cylinders shall be made for each 100 cubic yards of concrete, not less than once for each 5000 square feet of surface area for slabs or walls, nor less than once each day concrete is placed. One (1) cylinder of each set shall be tested at an age of 7 days and two (2) cylinders shall be tested at an age of 28 days.

2. Test cylinders shall be made, cured, stored, and delivered to the laboratory in accordance with ASTM C31 and tested in accordance with ASTM C39.

3. Cylinders shall be 6 inches diameter by 12 inches high. The compressive strength shall be determined from the average strength of two cylinders from the same sample of concrete.

4. Each set of compression test cylinders shall be marked or tagged with the date and time of day the cylinders were made, the location in the work where the concrete represented by the cylinders was placed, the number of the delivery truck or batch, the air content, the slump, the unit weight, and the concrete temperature.

J. Shrinkage Tests

1. Concrete shrinkage tests shall be performed once for each 1,000 cubic yards of concrete with controlled shrinkage that is placed and shall be made on concrete from a batch of concrete from which concrete compression test cylinders are made. Shrinkage testing shall be conducted as specified for the preliminary trial mixes.

2. The average drying shrinkage of each set of test specimens cast in the field from concrete delivered to the Site and sampled at the end of the delivery truck chute, as measured at the 21 days drying age, shall not exceed the values indicated in Tables 1A and 1B.

K. Test Reports

1. Five copies of each test report shall be prepared and distributed by the testing laboratory to the OWNER, Resident Project Representative (two copies), ENGINEER, and CONTRACTOR, in accordance with the quality control section.

2. CONTRACTOR to coordinate testing schedule with OWNER. CONTRACTOR shall provide OWNER with 48-hour minimum advance notice prior to placements and activities requiring testing/observation.

3.03 EVALUATION AND ACCEPTANCE OF CONCRETE

A. Concrete will be evaluated for compliance with all requirements of the specifications. Concrete strength will be only one of the criteria used for evaluation and acceptance of the concrete. The results of all tests performed on the concrete and other data and information concerning the procedures for handling, placing, and curing concrete will be used to evaluate the concrete for compliance with the specified requirements.

B. Compression tests will be evaluated in accordance with ACI 318 and as specified herein. A strength test shall be the average of the compressive strengths of two 6-inch diameter cylinders, made from the same concrete sample tested at 28 days.

C. Compression Test Evaluation

1. Compressive strength test results will be evaluated for compliance with the specified strength requirements. The strength level of the concrete will be considered satisfactory when the averages of all sets of three consecutive strength tests equal or exceed the specified compressive strength, *f*'c, and no individual strength test result falls below the specified compressive strength by more than 500 psi.

D. Inspection of Concrete Supplier

1. Both scheduled and unscheduled visits by inspectors on days of concrete pours shall be accommodated. Inspectors shall be allowed access to delivery tickets and mixture proportions.

	Concrete Classification	A					B
	Concrete Class	A1	A2	A3			
1.							
	Maximum Nominal Aggregate Size, ASTM C33 aggregate						
A	Size No. 467 (1-1/2")	---	---	489			464
B	Size No. 57 (1")	536	---	514			489
C	Size No. 67 (3/4")	564	---	526			514
D	Size No. 7 (1/2")	584	601	555			526
E	Size No. 8 (3/8")	601	636	564			555
F	Fine Aggregate, (Sand)	---	---	---			---
2.							
A	Field, 7 days;	3,375	3,375	3,375			3,000
B	Field, 28 days; f'_c	4,000	4,000	4,000			4,000
C	Laboratory, 28 days; f'_{cr}	5,700	5,700	5,700			5,200
3.	Maximum water-cementitious material ratio	0.42	0.42	0.42			0.45
4.	Maximum nominal coarse aggregate size.	1	1/2	1-1/2			1-1/2
5.							
A	Slump before super-plasticizer added	3	3	4			4
B	Slump after adding superplasticizer	8	8	8			8
6.	Total air content, percent, (± 1.5 %)	0	0	6			6
7.	Fly ash replacement, percent	Range 15-20	Range 15-20	Range 15-20			Range 15-20
8.	Slag cement replacement, percent	0	0	Range 25-50			Range 25-30
9							
A	Sand equivalent, min. percent	75	75	75			75
B	Chloride ion, max. percent	0.10	0.10	0.10			0.15

	Concrete Classification	A					B
	Concrete Class	A1	A2	A3			
			C				
	Laboratory	0.036	0.036	0.048			0.048
	Field	0.048	0.048	0.064			0.064
D	Coarse Aggregate: Clay and shale combined particles shall not exceed, max. percent	1	1	1			3
			10				
A	Temperature at time of delivery, max.	85	85	90			95
B	Temperature at time of placement, max.	85	85	90			95
C	Laboratory, 28 days; f'_{cr}	3,200	5,200 2,800	---			5,200
3.	Maximum water-cementitious material ratio	0.65	0.45	---			0.42
4.	Maximum nominal coarse aggregate size; inches.	1"	1-1/2"	---			3/4"
			5.				
A	Slump before superplasticizer added	5	6	---			4
B	Slump after adding superplasticizer	8	9	---			8
6.	Total air content, percent (± 1.5%)	---	---	---			6
7.	Fly ash replacement, percent	Range 15-20	Range 15-20	---			Range 15-20
8.	Slag cement replacement, percent	Range 25-50	0	---			Range 25-50
			9				
A	Sand equivalent, min.	---	75	---			75
B	Chloride ion, max. percent	0.30	0.30	---			0.15
			C				
	Laboratory	---	0.048	---			0.048
	Field	---	0.064	---			0.064

	Concrete Classification	A					B
	Concrete Class	A1	A2	A3			
D	Coarse Aggregate: Clay and shale combined particles shall not exceed, max. percent	10	1	---			2
			10				
A	Temperature at time of delivery	95	95	---			85
B	Temperature at time of placement	95	95	---			85

	Concrete Class	A1	A2	A3			B
1							
A	Fine aggregate						
	Source and type	X	X	X			X
	Gradation	X	X	X			X
	Deleterious materials	X	X	X			X
	Fineness modulus	X	X	X			X
	Alkali-aggregate reactivity	X	X	X			X
	Sand equivalent	X	X	X			X
B	Coarse aggregate						
	Source and type	X	X	X			X
	Gradation	X	X	X			X
	Deleterious materials	X	X	X			X
	Abrasion loss	X	X	X			X
	Soundness test	X	X	X			X
	Alkali-aggregate reactivity	X	X	X			X
C	Combined aggregate gradation	X	X	X			X
2	Cement, mill report	X	X	X			X
3	Cementitious material, type, data sheet, and test report (fly ash, slag cement)	X	X	X			X
4							
A	Data sheets and certifications for each required	X	X	X			X
B	Manufacturer's approval letter required	X	X	X			X
5							
A	Mixture proportions report using field test data (prior experience) acceptable	---	---	---			---
B	Job-specific laboratory trial mix required	X	X	X			X
C	Three-point curves required	X	X	X			---
D	Compressive strength at 7 and 28 days	X	X	X			X
E	Mixture proportions report	X	X	X			X
	Slump	X	X	X			X
	Water content	X	X	X			X
	Water-cementitious materials ratio	X	X	X			X
	Brand, type, composition, and quantity of cement	X	X	X			X
	Brand, type, composition, and quantity of fly ash	X	X	X			X
	Specific gravity of each aggregate	X	X	X			X
	Ratio of fine to total aggregates	X	X	X			X

	Concrete Class	A1	A2	A3			B
	Air content	X	X	X			X
	Temperature	X	X	X			X
	Unit weight	X	X	X			X
	Time of initial set at 70°F and 90°F.	X	X	X			X
6	Water-soluble chloride ion, report	X	X	X			X
7	Shrinkage, report	X	X	X			X
8	NSF 61 compliance evaluations	X	X	---			---
9	Field compression test evaluation reports taken at end of delivery truck chute	X	X	X			X

END OF SECTION

SECTION 03713

SHOTCRETE

PART 1 GENERAL

1.01 SUMMARY

A. Related Documents:

1. Drawings and general provisions of the contract apply to this Section.
2. Review these documents for coordination with additional requirements and information that apply to work under this Section.

B. Section Includes: Pneumatically applied concrete.

C. Related Work:

1. Section 03100 – Concrete Formwork
2. Section 03200 – Concrete Reinforcement
3. Section 03300 – Cast-in-Place Concrete
4. Section 13207 – Wire-Wound, Prestressed Concrete Tank with Steel Diaphragm

1.02 REFERENCES

A. General:

1. The following documents form part of the Specifications to the extent stated. Where differences exist between codes and standards, the one affording the greatest protection shall apply.
2. Unless otherwise noted, the referenced standard edition is the current one at the time of commencement of the Work.
3. Refer to General Conditions and Supplementary Conditions for references to applicable regulatory requirements.

B. ACI – American Concrete Institute:

1. ACI 506R Guide to Shotcrete
2. ACI 506.2 Specifications for Shotcrete

C. ASTM International:

1. ASTM C33 Standard Specification for Concrete Aggregates
2. ASTM C150 Standard Specification for Portland Cement
3. ASTM C1140 Standard Practice for Preparing and Testing Specimens from Shotcrete Test Panels
4. ASTM C1141 Standard Specification for Admixtures for Shotcrete

1.03 SUBMITTALS

A. Submit under provisions of Section 01300 – Submittals.

B. Qualifications of shotcrete applicator and personnel performing the work.

C. Mix designs including compressive test data used to establish proportions. Material certificates for shotcrete materials, including cements, aggregates and admixtures. Submit to Testing Laboratory for record purposes.

D. Submit batch tickets to Testing Laboratory for each batch of shotcrete, indicating weight of cement, aggregate, water and admixtures.

E. Samples as requested by the Testing Laboratory.

1.04 QUALITY ASSURANCE

A. Perform shotcrete work in accordance with the requirements of ACI 506.2, "Specifications for Materials, Proportioning, and Application of Shotcrete".

B. Shotcrete Mix Design: Testing laboratory shall, under direction of a Registered Engineer, design shotcrete mixes. Each mix shall bear the signature and registration number of the responsible engineer.

C. Test Panels: Prepare preconstruction test panels at least 21 days prior to job placement, using the mix and equipment proposed for the project.

1. Each proposed nozzleman shall prepare a panel demonstrating each shooting orientation.
2. Fabricate test panels in accordance with ASTM C1140 and as approved by the ENGINEER's representative.
3. Notify Testing Laboratory to observe placement of panels. Maintain panels at point of fabrication for seven (7) days and until Testing Laboratory has taken cores.
4. Samples taken from test panel shall achieve a mean core grade of 2.0, in accordance with Section 1.7 of ACI 506.2, "Shotcrete Core Grades". In the event of failure, nozzleman shall be permitted one retest. Any nozzleman failing the second test shall not be permitted on the project.

D. Certificates of Compliance: Acceptability of the following materials will be based upon documentation furnished by the manufacturer identifying each batch of material and certifying compliance with the requirements specified.

1. Portland cement
2. Fly Ash
3. Admixtures

E. Certified laboratory test reports: Before delivery of materials, certified copies of the reports of all tests required in referenced publications or otherwise specified here shall be submitted. Certified test reports are required for the following:

1. Cement
2. Aggregates
3. Admixtures

1.05 ENVIRONMENTAL REQUIREMENTS

A. Placement of shotcrete shall comply with the weather restrictions listed in AWWA D110.

PART 2 PRODUCTS

2.01 MATERIALS

A. Concrete materials shall conform to the appropriate requirements of Section 03200 - Concrete Reinforcement and Section 03300 - Cast-in-Place Concrete, ACI 506R and ACI 506.2 except as specified herein for adjustment of aggregate and mix for placing.

B. Add mixtures: ASTM C1141.

C. Aggregate: ASTM C33, combined Gradation No. 2 as specified in ACI 506.R.

D. Pre-approved Products

1. MASTER EMACO S 211SP SHOTCRETE
2. MASTER EMACO S 210SP
3. SIKA REPAIR 224
4. SIKA REPAIR SHB
5. ENGINEER-approved equivalent substitution

2.02 SHOTCRETE MIX

A. Proportion shotcrete mix in accordance with ACI 506.2.to achieve 4,500 psi compressive strength at 28 days.

B. Provide a mix that is plastic enough to give good compaction and low percentage of rebound, but stiff enough not to sag.

C. Measure and mix shotcrete in accordance with requirements of Section 03300 - Cast-in-Place Concrete.

2.03 EQUIPMENT

A. Equipment: Equipment of design and size which has given good results in similar work; pneumatic feed type; capable of maintaining continuous placement.

B. Air Supply: Clean, dry air adequate for maintaining sufficient nozzle velocity, uniformly steady for work while simultaneously operating blow pipe for cleaning away rebound.

C. Delivery Equipment: Capable of discharging aggregate-cement-water mixture accurately, uniformly, and continuously through the delivery hose.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive work.

B. Verify fabricated forms are true to line and dimension, adequately braced against deflection and vibration, and constructed to permit escape of air and rebound during gunning operations.

C. Ensure correct placement of reinforcement. Ensure sufficient clearance around reinforcement to permit complete encasement.

D. Ensure easy access to shotcrete surfaces for screening and finishing, to permit uninterrupted application.

E. Beginning of installation means the Subcontractor accepts that the existing conditions meet the above criteria.

3.02 PREPARATION

A. Prepare surfaces by high pressure washing. Minimize abrupt changes in thickness of repair. Remove square external corners from substrate by radiating the edge.

B. Ensure that forms are true to line and dimension, adequately braced against deflection and vibration, and constructed to permit escape of air and rebound during gunning operations.

C. Do not place shotcrete on any surface which is frozen, spongy or where there is standing water.

D. Shotcrete placed against existing concrete or masonry - Remove unsound material before applying shotcrete. Chip or scarify any area to be repaired to remove off-sets which would cause an abrupt change in thickness without suitable reinforcement. Taper edges to leave no square shoulders at the perimeter of a cavity. Remove loose material from areas receiving shotcrete. Wet the surface until it is damp, but without visible free water. Remove paint, oil, grease and other contaminants and apply bonding agent to provide a surface for proper bonding of the shotcrete.

3.03 ALIGNMENT CONTROL

A. Provide alignment wires to establish thickness and plane of required surfaces.

B. Install alignment wires at corners and offsets not established by forms.

C. Tighten alignment wires true to line. Position adjustment devices to permit additional tightening.

3.04 APPLICATION

A. Ensure sufficient clearance around reinforcement to permit complete encasement.

B. Allow easy access to shotcrete surfaces for screening and finishing to permit uninterrupted application.

C. Establish, and adhere to, operating procedures for placement in close quarters, at extended distances or around unusual obstructions where placement velocities and mix consistency must be adjusted.

D. When shotcreting walls, begin the application at the bottom and work upwards. Ensure that the work does not sag.

E. Direct nozzle perpendicular to surface to ensure maximum compaction with minimum rebound.

F. Build up thickness by layers, in multiple passes of the nozzle over the work area. Follow a routing that will fill and completely encase reinforcement, using maximum layer thickness.

G. Allow each layer to take initial set before applying succeeding layers.

H. After initial set, remove excess material outside of forms and alignment lines.

I. Remove laitance that has taken final set by sandblasting. Clean with air-water jet.

J. Sound work with hammer for voids. Cut out voids and replace with new shotcrete layers.

K. Remove trapped rebound at construction and expansion joints.

L. Remove rebound material which does not fall clear of the work. Discard salvaged rebound.

M. Keep rebound and other loose or porous material out of new construction.

N. Provide a natural gun finish for the final layer of shotcrete . Do not scrape or cut to remove high spots until the shotcrete has become stiff enough to withstand pull of the cutting device.

O. Remove and replace all shotcrete which exhibits sags or sloughs, segregation, honeycombing, sand pockets or other obvious defects. Repair defective areas.

3.05 CURING

A. Keep completed surfaces wet for a minimum of seven (7) days. Immediately after placement, protect shotcrete from premature drying, excessively hot or cold temperatures, and mechanical injury. The contractor’s means and methods shall provide an apparatus (such as a sprinkling system) to maintain wetting of the vertical surfaces.

B. Protect shotcrete repair work from frost action or heavy water flow.

3.06 FIELD QUALITY CONTROL

A. Inspection and Testing will be performed under the direction and expense of the contractor consistent with the provisions of Section 03300 – Cast-in-Place Concrete.

B. Testing Laboratory will:

1. Test and inspect materials as required to ensure compliance with specifications.
2. Collect and review tickets for each batch of shotcrete delivered. Annotate water added subsequent to batching.
3. Observe placement of preconstruction test panels. Take six (6) cores from each panel; three (3) with reinforcement and three (3) non-reinforced. Visually inspect and grade in accordance with "Quality Assurance" article. Test non-reinforced cores for compressive strength at seven (7) days.
4. Special Inspect shotcrete placement, as required, for conformance with the Contract Documents.
5. Take 3-inch (75 mm) core specimens from field test panels and test for compressive strength.
6. Take 3-inch (75 mm) core specimens from in place work to examine for structural soundness. In lieu of extracting specimens from the in-place work of the tank walls, the contractor may provide temporary construction test panels adjacent to the final work to be prepared simultaneous with the in-place work. These panels will be utilized for testing purposes and shall be removed after specimens have been tested and reviewed by the EOR and owner.

C. The Subcontractor shall:

1. Pay Testing Laboratory for investigating low-strength compressive test results.

END OF SECTION

SECTION 13207

WIRE-WOUND, PRESTRESSED CONCRETE TANK WITH STEEL DIAPHRAGM

PART 1 – GENERAL

1.01 SCOPE

A. This section covers the design and construction of a 10.0 million gallon, prestressed concrete, wire-wound or strand wrapped circular tank with steel diaphragm complete; including site work, excavation, reinforcing, concrete work, appurtenances, disinfection, testing, and backfill directly related to the tank as specified on the construction plans. Tank shall be in accordance with AWWA D110-13, Type III requirements.

B. The tank shall consist of a cast-in-place reinforced concrete floor, a precast wire-wound prestressed concrete wall with a continuous mechanically bonded steel diaphragm, and a precast or cast-in-place prestressed clear span concrete dome with no interior columns.

C. The tank shall be as designed and constructed by Preload, Inc. or DN Tanks, Inc. **No other manufacturers will be acceptable.**

D. The ground storage tank foundation design, including, but not limited to, excavation, backfill, concrete ring footing, and membrane slab floor shall meet all requirements specified herein and in the project Geotechnical Report.

1.02 GOVERNING STANDARDS

A. References identified refer to the latest revision available. In the case of conflicting criteria within the standards, the most stringent condition shall apply.

1. American Water Works Association (AWWA)

   a. AWWA D110 - Wire- and Strand-Wound, Circular, Prestressed Concrete Water Tanks

   b. AWWA C652 - Standard for Disinfection of Water-Storage Facilities

2. American Concrete Institute (ACI)

   a. ACI 301 - Specifications for Structural Concrete

   b. ACI 305R - Hot Weather Concreting

   c. ACI 306R - Cold Weather Concreting

   d. ACI 318 - Building Code Requirements for Structural Concrete

   e. ACI 350 - Code Requirements for Environmental Engineering Concrete Structures and Commentary

f. ACI 350.3 - Seismic Designs of Liquid-Containing Concrete Structures

g. ACI 372R - Design and Construction of Circular Wire- and Strand Wrapped Prestressed Concrete Structures

h. ACI 506R - Guide to Shotcrete

3. American Society for Testing and Materials (ASTM)

a. ASTM A185 - Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete

b. ASTM A416 - Standard Specification for Steel Strand, Uncoated Seven-Wire for Prestressed Concrete

c. ASTM A475 - Standard Specification for Zinc-Coated Steel Wire Strand

d. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement

e. ASTM A821 - Standard Specification for Steel Wire, Hard Drawn for Prestressing Concrete Tanks

f. ASTM A1008 - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low Alloy with Improved Formability

g. ASTM C31 - Standard Practice for Making and Curing Concrete Test Specimens in the Field

h. ASTM C33 - Standard Specification for Concrete Aggregates

i. ASTM C39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

j. ASTM C618 - Type F Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete

k. ASTM C920 - Standard Specification for Elastomeric Joint Sealants

l. ASTM D1056 - Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber

m. ASTM D1556 - Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method

n. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 Ft. – lbf/ft3) 2700 KN-M/M3)

o. ASTM D1752 - Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction

p. ASTM D2000 - Standard Classification System for Rubber Products in Automotive Applications

4. American Society of Civil Engineers (ASCE)

a. ASCE 7-05 Minimum Design Loads for Buildings and Other Structures

5. U.S. Army Corps of Engineers Specification

a. CRD - C572 - Specification for PVC Waterstop

1.03 SUBMITTALS

A. Shall be in accordance with Section 01300 – Submittals and as outlined herein. Detailed drawings and complete specifications for all materials shall be submitted in accordance with the submittals sections. Drawings and data shall show full information as to the design criteria and construction, including amount, type and placement of all reinforcement details of all construction joints, erection of steel work, and all accessories. A listing of the design criteria used for the design shall be submitted.

B. Design calculations and shop drawings, showing details and procedures of construction, shall be submitted to the ENGINEER for approval. After approval by the ENGINEER, one set of the drawings and calculations will be returned to the CONTRACTOR, and any changes found necessary by the ENGINEER shall be made by the CONTRACTOR. Approval by the ENGINEER of the drawings and calculations submitted by the CONTRACTOR will not in any way relieve the CONTRACTOR of full responsibility for the accuracy and completeness of the drawings and calculations. Design calculations and shop drawings shall be stamped by a Professional Engineer experienced in the design of AWWA D110, Type III wire-wound, prestressed concrete tanks and registered in the State of Texas.

C. Drawings and Calculations to be provided include but are not limited to foundation design calculations, precast wall and prestressing design, structural dome calculations, grating and support beam calculations, rebar placement drawings, wire wrapping details, penetration and reinforcement drawings.

D. Certified mill reports and typical stress-strain curves on the prestressed reinforcement shall be submitted. Reports shall indicate the ultimate strength, the modulus of elasticity, and percent elongation at rupture. These values shall conform to the latest revisions of pertinent ASTM specifications.

E. Written records of stress readings on the prestressed reinforcement shall be submitted, including location and layer of each reading.

F. Design proportions for all concrete and shotcrete. Concrete strengths of trial mixes. Reference Section 03300 – Cast-in-Place Concrete, and Section 03713 – Shotcrete for additional information and requirements.

G. Admixtures to be used in the concrete or shotcrete and their purpose. Reference Section 03300 – Cast-in-Place Concrete, and Section 03713 – Shotcrete for additional information and requirements.

H. Neat cubic yardage of concrete required for the tank foundation.

I. Reinforcing steel shop drawings showing fabrication and placement.

J. Catalog cuts or shop drawings of all appurtenances (i.e., hatches, vent, ladders, waterstops, gauges, and miscellaneous items).

1.04 QUALITY ASSURANCE

A. Contractor Qualifications. The tank shall be designed and constructed by a CONTRACTOR who shall be a specialist in the design and construction of circular, prestressed concrete tanks of the continuous wire or strand-wound type AWWA D110, Type III; shall have furnished at least 20 circular, prestressed concrete tanks with an AWWA D110 Type III core wall within the last 10 years in their own name or under one of its divisions in which 10 have been in successful operation for at least five (5) years; and shall have a record of experience and quality of work in the design and construction of circular prestressed concrete tanks that is satisfactory to the ENGINEER.

B. The design of the prestressed concrete tank, the application of shotcrete and prestressed reinforcement, and the supervision of all tank construction under this contract shall be the responsibility of the CONTRACTOR and shall not be subcontracted or otherwise assigned. The design for the tank shall be prepared by a professional engineer licensed in the State of Texas who has designed at least five (5) circular prestressed concrete tanks within the last 10 years, with an AWWA D110 Type III core wall and which have been in successful operation for at least five (5) years.

C. Workers, including the CONTRACTOR’s superintendent and foreman, shall be fully qualified to perform the work. CONTRACTOR’s superintendent and foreman shall have had experience on at least two (2) AWWA D110 Type III tanks of comparable size within the last 10 years.

D. At the time of bid, the qualified CONTRACTOR shall have at least two (2) operational systems for prestressing strand or wire with the capability of wrapping prestressed reinforcement on the tank meeting these specifications. The prestressing equipment system shall be of a design and size that has given satisfactory results on similar work in the last five (5) years.

E. Professional Liability Insurance. Insurance shall be per the contract general conditions. Please submit insurance as required.

F. Delivery, Storage, and Handling. Materials shall be delivered, stored and handled as specified in Section 01600 and the respective material specifications.

G. During field handling and storage, prestressed reinforcement shall be fully protected from physical damage and corrosion before, during, and after placement. Protection shall include enclosed, ventilated temporary storage facilities. Material shall not be stored on the ground or covered with polyethylene or other membrane cover that would permit condensation to form on the steel.

H. Rubber and plastic materials shall be stored in a cool place and shall not be exposed to direct sunlight.

PART 2 – PRODUCTS

2.01 GENERAL DESCRIPTION

A. The tank shall be constructed complete with all materials and accessories as required and as specified herein. All materials in contact with potable water shall comply with the requirements of the Safe Drinking Water Act and other Federal, State, local, and provincial requirements.

B. The tank shall conform to the details indicated on the Drawings and to the following requirements:

Minimum capacity, measured below the high water level	10,000,000 gal
Inside diameter, approx.	145.5 ft
Tank floor	998.5-ft
Overflow weir level	1079.1-ft
Maximum water level	1079.0-ft
Inlet diameter (2)	60-inch
Outlet diameter	60-inch
Overflow diameter	36-inch
Total overflow rate at maximum water level	54 MGD
Backfill elevation, at wall	998.00-ft
Net allowable soil bearing pressure	7,500 psf (see Geotechnical Report)
(for tank ring footing)	
Net allowable soil bearing pressure	5,600 psf (see Geotechnical Report)
(for tank slab)	
Rise to diameter ratio of dome	1:10 – 1:12 with final design by tank manufacturer (as per AWWA D110-13)

2.02 DESIGN REQUIREMENTS

A. Tank design shall be based on elastic analysis methods and shall take into account effects of all loads and prestressing forces during and after tensioning. The foundation design shall be in accordance with the criteria described herein and in accordance with AWWA D110, Type III tank. Refer to the Geotechnical Report as an additional guide to subsurface conditions.

1. Floor and Wall Footing. The tank floor shall be cast-in-place concrete slab-on-grade. The floor may be considered as a membrane type designed to transmit loads to the subbase directly through the slab and <u>the membrane slab floor thickness shall be no less than 6-inches</u>. If required, footings shall be provided under pipe supports on top of the floor slab to distribute loads. No construction joints will be allowed in the floor slab, unless otherwise approved by the ENGINEER.

2. A continuous reinforced concrete ring footing shall be provided to distribute the vertical loads at the base of the wall to the underlying foundation material. The ring footing shall be designed to produce an average bearing pressure approximately equal to the average pressure produced by the fully loaded tank. The ring footing shall have a minimum depth of 3.5-ft and a minimum width of at least 4-ft.

3. Walls. Circumferential prestressed steel reinforcement shall be provided to resist all forces due to internal loads, after accounting for all stress losses and for residual compression. The minimum horizontal core wall compression stresses for fixed base wall construction shall be provided as if the base were free to move radially.

4. The design wall thickness shall be determined using the design steel area requirements, the initial steel stress and concrete stress immediately after pulling and the final steel stress and concrete stress after all losses. The maximum final prestress in the core wall shall be 45% of the concrete or shotcrete specified 28-day strength. The wall thickness shall be adequate to support the increased circumferential compressive force due to banding of prestressed reinforcement adjacent to openings.

5. Non-prestressed reinforcement bar size shall be not greater than ¾-inch (#6), and bar spacing shall not exceed 12 inches.

6. Wall joint details at the floor shall be of the bearing pad type with embedded seismic cables. Seismic cables shall be installed per tank manufacturer, **when required by design**.

7. Dome Roof. The dome roof shall be reinforced cast-in-place or precast concrete with a circular prestressed dome ring. The dome shall have a rise-to diameter ratio as specified. The underside of the dome ring shall be provided with a ¾-inch continuous perimeter “drip” groove or equivalent. In the edge regions, additional reinforcement shall be used as recommended by ACI 372R.

8. Tank Design. Tank design shall include the following loads that act upon the structure:

   a. Full hydrostatic load.
   b. No hydrostatic load.
   c. Vertical loads from the roof system and wall system.
   d. Roof live load of 20 psf minimum, unreducible, not simultaneous with snow.
   e. Wind loads shall be based on ASCE 7 procedures. Reference Structural sheets for additional information.
   f. Seismic loads shall be based on ACI 350.3 and ASCE 7. Reference Structural sheets for additional information.
   g. Vehicle load GVWR 14,000 pounds on the backfill.
   h. Construction loads.
   i. Temperature and moisture gradients.

9. Additionally, the wall design shall provide for the effects on the wall from the following stresses:

   a. The tank shall be designed for a maximum temperature differential through the wall of 50 deg F.
   b. Losses from shrinkage, plastic flow, wire creep, and allowance residual compression in shotcrete. In no case shall the losses used for design (exclusive of residual compression requirements) be less than 25,000 psi, regardless of calculations.
   c. Edge restraint at the wall junction with the floor and roof.
   d. Prestressing during and after tensioning.
   e. Differential drying stresses. Calculations shall determine differential stresses and required reinforcement.
   f. Overflow pipe supports and wall penetrations.

10. The stresses for concrete and shotcrete shall not exceed stresses indicated in ACI 372R and AWWA D110 unless otherwise specified herein and in these Contract Documents.

11. The minimum horizontal compressive stresses, after losses in the core wall when the tank is empty, shall be 240 psi.

12. The maximum flexural tension, with tank either full or empty, shall be resisted entirely by tensile reinforcing steel.

13. Non-prestressed reinforcement shall meet the requirements of ACI 350 and shall not be credited for resisting any portion of primary circumferential tension resulting from fluid pressure.

2.03 MATERIALS

A.	Concrete	ACI 301, Portland cement Type I or II; floor and footing minimum 28-day strength of 4,000 psi; wall and roof construction shall minimum 28-day strength of 4,000 psi. Reference Section 03300 – Cast-in-Place Concrete for additional requirements.
B.	Admixtures	ACI 301.
C.	Concrete Aggregate	Reference Section 03300.
D.	Fibers	Polypropylene fibrillated fibers – Grace Fibers, polypropylene monofilament fibers – Grace MicroFiber, Fibermesh 150 by Propex, or equal.
E.	Shotcrete	ACI Standard 506. Reference Section 03713 – Shotcrete for additional requirements.
F.	Geotextile Fabric	Non-woven; 6 mil polyethylene vapor barrier.
G.	Steel Shapes	ASTM A36. See Section 05120 – Structural Steel Framing.
H.	Prestressed Reinforcement	ASTM A 227; ASTM A 416; ASTM A 421; ASTM A 648, Classes l, ll, or lll; or ASTM A 821. Minimum ultimate tensile strength of 210,000 psi.
I.	Non-prestressed Reinforcement	ACI 318. new billet steel Grade 60, meeting the requirements of ASTM A615. Welded wire fabric shall conform to ASTM A185. free from loose rust, scale, and contaminants.
J.	Rebar Chair Supports	Steel or Plastic or Dobie Bricks.
K.	Sheet Steel Diaphragm	ASTM A 1008, not less than 26 gauge (0.017 inch) vertically ribbed with adjacent and opposing channels.
L.	Seismic Restraint Cable	ASTM A 416, minimum Grade 250 prior to

		galvanizing; ASTM A 586, Table 4, Class A or ASTM A603, galvanized. Or: ASTM A 416, min Grade 250 with fusion-bonded, grit impregnated, epoxy coating per ASTM A 822. **(Seismic cable to be installed when required by design as per tank manufacturer).**
M.	Waterstops	NSF 61 certified, U.S. Army Corps of Engineers CRD-C-572, PVC type; 11 inches wide, 3/8-inch thick, ribbed or serrated "O" bulb closed center section. Shore hardness 70 – 85. Tear resistance 300 lb/in (min).
N.	Elastomeric Bearing Pads	Neoprene. ASTM D 2000 line call-out M2BC410A14B14 or 2BC415A14B14. Minimum tensile strength 1,500 psi; min elongation 500%; a maximum compressive set of 50 percent; durometer 40 – 50. Or: Natural Rubber. ASTM D 2000 line call-out M4AA414A13. Virgin natural polyisoprene.
O.	Sponge Filler	Preformed closed cell neoprene or rubber; ASTM D 1752, Type I; or ASTM D 1056, Grade 2A1 through 2A4.
P.	Diaphragm Joint Sealant	Elastomeric caulking and sealing compound, polysulfide liquid polymer or moisture insensitive two-component epoxies of a 100 percent solids constituency. Sealant shall be suitable for submerged service. ASTM C920, type M.
Q.	Epoxy Adhesive	Moisture insensitive two-component epoxy with 100 percent solids.
R.	Brackets, Bolts and Nuts	Type 316 stainless steel anchors.

S. Mortar Fill and Non-Shrink Grout - minimum compressive strength of 4,000 psi at 28 days.

T. Excavation and Backfill. Excavation, preparation of subgrades, backfilling, construction of fills, surfacing and grading, and other appurtenant work shall be performed in accordance with the applicable requirements of Section 02200 – Earthwork and as specified herein. Excavation and backfill shall be in accordance with the foundation design provided and shall be in accordance with requirements given herein and recommendations provided in the project Geotechnical Report.

U. Cast-in-Place Concrete. All work in connection with cast-in-place and precast concrete, including reinforcing steel, forms, finishing, curing, and other appurtenant work, shall conform to applicable requirements of Section 03300, except as modified herein.

V. Shotcrete. All work in conjunction with shotcrete shall comply with Section 03713.

2.04 CONSTRUCTION

A. Site Preparation. The minimum acceptable site preparation shall be as indicated on the plans and as specified within the Contract Documents. The tank manufacturer shall increase the site preparation as necessary to be compatible with his foundation design. Additional reference information can be found in the Geotechnical Report.

B. Tank Pad and Foundation. The ring footing should be supported on at least 3-ft of crushed limestone select fill to provide a uniform cushion beneath the footing. The foundation design should be for the specific soil conditions at this site and should be founded in at least 3-ft of compacted, engineered select fill.

1. The minimum depth of the ring footing shall be 3.5-ft and its minimum width should be at least 4-ft to facilitate the bearing capacity.

2. The bearing surface should be dry and competent and should not contain any loose debris, soft/loose soils or wet soils.

3. The foundation bearing level shall be free of loose soil, ponded water or debris. Prior to placing fills, this shall be observed by the Geotechnical Engineer or his representative.

C. Subgrade Preparation. The subgrade shall be prepared in accordance with the requirements of these specifications and Drawings. Additional reference information is available in the Geotechnical Report. CONTRACTOR shall excavate to such depths and widths to provide adequate room for tank construction.

1. Excavation shall be completed to the design subgrade level (i.e., exposed limestone bedrock).

2. Existing soils above the limestone bedrock should be removed from an area consisting of the tank pad, 15-ft setback and front slope areas (as discussed and defined below). Excavated on-site soils shall not be used as fill within these areas.

3. A loaded dump truck, weighing at least 20 tons, shall be used to proof-roll resulting subgrade areas for a minimum of 15 passes.

4. Should undercuts be required, they shall be replaced with similar soils compacted as per the requirements described above. Loose lift thickness shall be no greater than 8 inches.

5. The undercut zone shall extend to the toe of the slope laterally beyond the perimeter of the exterior edge of the ring footing.

6. A representative of the Geotechnical Engineer shall be present during site preparation operations to ensure that all work performed is in accordance with recommendations given in the Geotechnical Report.

D. Fill Material Requirements. A significant quantity of select fill will be required to achieve final grades. Some fill will be placed against cut slopes and/or could be placed if undercuts are required. New fill shall be placed and compacted into the slope using proper techniques.

1. Select granular fill shall consist of crushed limestone base material meeting all requirements of TxDOT Item 247, Type A, Grade 1 or 2.

2. Select granular fill shall be placed in maximum 8-inch loose lifts and compacted to at least 95% of maximum dry density, as per ASTM D1557 (Modified Proctor), at -2% to +2% of optimum moisture.

3. The suitability of select fill materials shall be approved by the Geotechnical Engineer.

4. Where pavement and concrete mow strips are not placed, an 18-inch thick clay cap should be placed and compacted over select fill. This cap shall not include soil particles larger than 3 inches and shall have a plasticity index (PI) between 15 – 30 and the liquid limit (LL) shall not exceed 45. Material passing the No. 200 sieve shall be at least 50% by weight. It should be placed in maximum 8-inch loose lifts, moisture conditioned at 0% to +4% of optimum and compacted to at least 95% of maximum dry density (as per ASTM D 698). The clay cap should extend at least 5-ft beyond the perimeter of the ring footing.

5. The suitability of clay cap materials shall be approved by the Geotechnical Engineer.

E. Engineered Fill Pad Preparation. A 3:1 (H:V) or flatter slope has been designed around the tank. A 15-ft setback, at a minimum 2% downward slope away from the tank, shall be provided between the tank perimeter and edge of slope to achieve the bearing capacity and reduce the settlement potential of the tank footing. The 15-ft setback is also designed to reduce the failure potential of the 3:1 (H:V) slope. The following earthwork steps shall be undertaken to achieve the required bearing capacity and reduce the potential vertical rise (PVR) to 1-inch or less:

1. Remove all existing overlying soils (to expose the limestone bedrock) in the tank pad area, setback area (i.e., between tank perimeter and edge of front slope) and 3:1 front slope area (i.e., between edge and toe of slope).

2. Proof-roll exposed limestone bedrock with a 20-ton loaded dump truck for a minimum of 15 passes. This work shall be performed under the direction of the Geotechnical Engineer’s representative.

3. Place and compact TxDOT Item 247 crushed limestone in lifts to achieve the finished grade. Up to 12 inches of "Leveling Base" may be substituted above TxDOT Item 247 at the CONTRACTOR's option.

4. Erosion protection measures on side slopes shall be made (as required) to limit the potential for erosion (i.e., material loss) and gullying.

F. Flowable Fill. If the bearing bedrock becomes unsuitable, flowable fill can be used to restore the bearing surface.

1. It can also be used as an alternative to soil backfill in utility trenches and utility plugs.

2. All requirements under TxDOT Item 401 (Flowable Backfill) shall be met.

3. Any future excavation of this material shall meet "excavatable" mix design requirements with a compressive strength of 80 to 200 psi at 28 days (as noted in Table 2 of Item 401).

G. Leveling Base. A leveling base material consisting of a minimum 6-inch thick layer of compacted select fill shall be placed beneath the entire tank foundation. Prior to construction of the floor, a 6 mil polyethylene vapor barrier shall be placed over the granular subbase. Edges of the polyethylene shall be overlapped a minimum of 6 inches.

1. If submitted by the tank manufacturer as an alternative, consideration shall be given to using a uniformly graded ¾-inch minus crushed stone as the leveling base material. The crushed stone shall be ¾-inch sieve size with 100 percent passing the one inch. If uniformly graded crushed stone is used for the leveling base material, compaction performance criteria shall be used to gauge the degree of compaction. Crushed stone shall be placed in layers not exceeding 9 inches and compacted with at least two (2) passes in each direction with vibratory roller compaction equipment. Compaction shall be inspected and verification of compaction effort shall be documented by an approved testing laboratory.

2. The surface elevation of the leveling base shall be fine graded to a tolerance of plus zero inches to minus ½-inch over the entire foundation areas. Fine grading tolerances for floor pipe encasements shall be plus zero inches to minus six inches.

H. Concrete Floor. The concrete slab-on-grade floor shall be cast monolithically with no cold joints. No construction joints will be allowed in the floor slab, unless otherwise approved by the ENGINEER. If joints are acceptable to the ENGINEER, waterstops shall be provided for all construction joints in the concrete floor slab. Reinforcement shall be continuous through construction joints and each joint shall have a keyway. Unformed floor surfaces shall be to the lines and grades indicated on the Drawings and shall be finished as specified. At the option of the CONTRACTOR, fiber concrete may be used for the concrete floor. Dose per manufacturers recommendations at $600g/m^3$.

I. Prior to placement of the floor concrete, all piping that penetrates the floor shall be set and encased in concrete.

J. Curing shall be with water only, in accordance with Section 03350 – Concrete Placing, Finishing, and Curing.

K. Precast Core Wall. The core wall shall be constructed of precast panels and vertical joints filled with shotcrete, mortar or cast-in-place concrete. A continuous watertight steel diaphragm shall be provided throughout and within the tank wall, and shall be located between the stored tank contents and the prestressing wires. The steel diaphragm shall be full length without horizontal joints. Vertical diaphragm joints shall be mechanically seamed except where located between wall panels, in which case joints shall be sealed with polysulfide or other suitable sealant. All vertical diaphragm joints shall be sealed to be fully watertight. Piercing of the diaphragm shall not be permitted except by design. Precast panels shall be fabricated to the curvature of the tank radius. The tolerance in panel wall thickness shall be - 0 to + ¼-inch. Concrete for each panel shall be placed in one continuous operation. After each precast panel has firmed sufficiently, it shall be covered with polyethylene sheet for curing. The interior of precast wall panels shall be given a fine broom finish. The precast panels shall be erected around the circumference of the tank and aligned to proper tolerances.

L. Steel Shell Diaphragm. The steel shell diaphragm shall be vertically ribbed with adjacent and opposing channels, and the base of the channels shall be wider than the throat, providing a mechanical keyway anchorage between the shotcrete and concrete and the diaphragm. The steel shell diaphragm shall be continuous, with no horizontal joints to within 3 inches of the top and bottom of the wall. The steel diaphragm shall extend the full circumference of the tank, including spanning joints between precast panels with a metal plate or diaphragm acceptable to the ENGINEER. No holes, including nail holes, will be permitted except those required for reinforcing bolts, pipe sleeves, temporary construction openings, or special appurtenances acceptable to the ENGINEER. All openings shall be completely edge sealed with polysulfide or polyurethane sealant.

M. Individual sheets within the wall shall be roll seamed or otherwise fastened in a manner acceptable to the ENGINEER which results in a firm mechanical lock. The joints of individual sheets within the wall panel shall be sealed with PVC tape, if roll seam type connection is used, and with polysulfide polymer or epoxy for other type connections.

N. Joints of the diaphragm shall form a continuous watertight diaphragm without voids, holes, or openings. Fasteners acceptable to the ENGINEER shall be used to connect adjacent diaphragm panels at a maximum spacing of 18 inches on center.

O. Wall Joints. Wall joints shall be used between precast concrete core wall panels. Details shall be acceptable to the ENGINEER.

P. Wall Base Joint. A suitable watertight bearing pad joint shall be provided at the bottom of the prestressed wall, consisting of a waterstop, an elastomeric bearing pad, and joint filler. The joint shall be provided around the entire perimeter of the wall, connecting the floor to the wall at the bottom.

Q. Water stops shall be continuous, centered in the joint with equal embedment above and below, and secured by split forms or other means to ensure positive positioning. Water stops shall be spliced in strict conformity with the recommendations of the manufacturer in a manner to ensure imperviousness to water. Water stops shall be coordinated with the diaphragm to provide a watertight joint acceptable to the ENGINEER.

R. Elastomeric bearing pads shall be provided of sufficient size to carry the load placed thereon and to allow the wall to move in and out by deforming the pad.

S. Combined bearing pad/waterstop, where the bearing pad and waterstop are an integral unit, may be submitted for consideration by the ENGINEER, in accordance with the provisions of the submittals section.

T. Joint filler shall be of sufficient size to facilitate placing and to preclude the development of voids between joint filler, bearing pads, and waterstops. For quality control of the specified minimum shotcrete cover over reinforcement, the joint filler shall extend to and establish the extreme edges of the shotcrete.

U. Seismic Restraint Cables. Seismic restraint cables, **when required by design**, shall be installed between the base of the wall and the floor. Sleeves of rubber or other acceptable material shall surround the strands at the grout entry. Seismic cables shall be encased in the exterior half of the tank wall.

V. Dome Roof. The dome roof shall be constructed to proper spherical curvature. Construction joints shall be located and configured to maintain an adequate strength. Dome forms shall be designed to resist all forces acting with respect to its sloped surface. No portion of formwork for domes shall be removed until the concrete has attained sufficient strength, and until the full circumferential prestressing force has been applied to the dome ring. The exterior dome surface shall be given a light broom finish. The dome soffit shall be a form finish. The exterior dome surface shall receive a coat of membrane-forming curing compound immediately after completion of the final finishing operation.

2.05 COATINGS

A. Interior Painting. Interior concrete or shotcrete surfaces of the tank do not require painting.

B. Exterior Coating. All exposed exterior concrete and shotcrete surfaces of the prestressed concrete tank shall be covered with coating materials as specified in Section 09820 - Prestressed Concrete Tank Coating.

2.06 ACCESSORIES (shall comply with SAWS standards at time of bidding)

A. Pipe Connections. Pipe connections shall be oriented, shall extend below the bottom of the tank, and shall terminate with end connections, as indicated on the Drawings. Pipe and fittings shall be as specified in the respective piping sections. Extra reinforcement shall be provided in the floor slab around pipe connections, as indicated on the tank and concrete details drawings.

1. Pipe connections shall be flush with the tank floor unless otherwise indicated on the Drawings. Removable silt stops are required where indicated on the Drawings.

2. Tank inlet penetration (from the future Terminus Facility) shall be a flanged 90 degree fitting to which an inlet fitting shall be connected. CONTRACTOR shall perform computational fluid dynamics (CFD) modeling to determine the type and orientation of inlet fitting that will maximize circulation inside the tank.

B. Overflow. The overflow shall be equipped with a weir cone capable of discharging the specified overflow rate with a maximum water level 12 inches above the weir.

1. The overflow weir cone shall be fabricated from minimum ¼-inch thick AISI Type 316L stainless steel plates and shall be provided with a flanged connection on the bottom.

2. The overflow pipe shall be made of carbon steel if encased in concrete, (conforming to requirements given in Section 15065 – Steel Process Piping) or stainless steel (conforming to requirements given in Section 15067 – Stainless Steel Pipe and Fittings), and shall be as shown on the Drawings.

3. The overflow pipe shall terminate with a 36-inch, Tideflex Series 35 check valve or equal with flange installation. The overflow weir cone and overflow pipe shall be braced to the reservoir wall at not less than six (6) equally spaced locations or by other methods that the CONTRACTOR uses as standard on their tanks. All bracing and bolts shall be AISI Type 316 stainless steel.

4. The tank design shall account for all loads that are imposed on the structure as a result of the method used to support the overflow pipe and weir cone. The design shall also account for all buoyant forces on the weir cone and support structure with the weir empty and water on the outside of the cone to the top of the weir.

C. Roof Hatches. Three (3) hatches shall be provided on the tank roof at the locations indicated on the Drawings. One hatch shall have an opening dimension of 72 inches by 72 inches while the other two (2) hatches shall have dimensions of 36 inches by 42 inches. Each opening shall have a curb at least 4 inches high, and the cover shall have a downward overlap of at least 2 inches. Each cover shall be provided with a neoprene gasket. The roof hatch shall be of aluminum construction and completely watertight. The cover shall be at least 11 gauge, and shall be insulated with 1 inch of rigid insulation protected by a minimum 18 gauge liner plate. The hatch shall be complete with hinges, spring type operators, automatic hold-open arm, hand grip, spring latch with inside and outside operation, and provisions for locking, all of which shall be Type 316 stainless steel. The hatches shall be double leaf, Type D, as manufactured by Bilco Company or equal.

D. Exterior Ladder. An exterior metal ladder shall be provided where indicated on the Drawings. The ladder shall be fabricated from Type 316L stainless steel. The exterior ladder shall begin 1 foot above finished grade, include a security gate with padlock, and side rails shall extend 42 inches above the edge of the roof. The exterior ladder shall include safety rails on top of the tank roof to the access hatch attached to the ladder side rails and anchored to the roof as required.

1. Each ladder shall be designed to be rigid and meet all applicable OSHA standards. Each ladder shall have a fall prevention device consisting of a sliding, locking mechanism and safety belt.

2. Landing platforms (top and intermediate) shall be provided at approximate 40-ft intervals as shown on the Drawings. Anchorages shall be coordinated with the tank designer.

E. Interior Ladders. An interior ladder shall be provided under the roof hatch located adjacent to the tank's exterior ladder. If any wall access manhole invert is more than three (3) feet above the floor, an aluminum grab bar and ladder shall also be provided on the inside of the reservoir, between the level of each access manhole and the floor.

1. Each ladder shall be fabricated from Type 316L stainless steel. Each ladder shall be designed to be rigid and meet all applicable OSHA standards. The ladder under the roof hatch shall have a fall prevention device consisting of a sliding, locking mechanism and safety belt.

F. Wall Access Manholes. Two (2) wall access manholes (shell manways) shall be provided at the locations shown on the Drawings. Each access manhole shall be 36 inches in diameter.

1. The manhole center line shall be located approximately three (3) feet above finished grade. The manway flange shall be Type 316L stainless steel and shall be designed to withstand the weight and pressure of the tank contents. The manhole shall provide a watertight seal. The opening shall be suitably reinforced.

G. Vent. An AST vent screened with 16 x 16 mesh PTFE insect screen shall be provided. The vent shall have a net free area of at least 2,500 square inches and shall have an inlet/exhaust capacity at least equal to the specified overflow rate. At the option of the manufacturer, multiple vents having a combined net free area of at least 2,500 square inches may also be provided. The vent(s) shall be located at the center of the roof, as shown on the Drawings. The vent opening shall be at least 3 feet diameter and shall be provided with a curb at least 4 inches high.

1. The vent should admit air at a flow rate equal to the maximum specified overflow rate at pressure differentials not exceeding 2.0 inch of water column. The exhaust capacity of the vent must be at least equal to the specified overflow rate of the tank.

H. Sample Tap and Water Pressure Transmitter Connection. One water sample tap and one (1) tap for a future water pressure transmitter shall be provided through the wall of the tank, as shown on the Drawings. All tap connections shall be watertight. All fittings, piping and accessories shall be of Type 316L stainless steel.

I. Perimeter Drain. A 4-inch perforated PVC pipe shall be installed along the perimeter of the tank foundation. The PVC pipe shall have perforations along the top sides of the pipe and shall be encased in crushed stone or process gravel per manufacturer's recommendation.

J. Dome Sleeves. Two (2) 4" Type 316L stainless steel dome sleeves with blind flanges shall be provided. Locate dome sleeves as shown on the Drawings.

K. Wall Sleeves. Two (2) 16" Type 316L stainless steel wall sleeves shall be provided for future aeration piping connections. Locate wall sleeves as shown on the Drawings.

L. Tank Plaque. A tank plaque shall be provided and mounted on the exterior tank wall.

PART 3 – EXECUTION

3.01 ERECTION

A. General. The tank shall be constructed as specified and indicated on the Drawings. Erection, inspection and field testing shall be performed in accordance with ACI 350, ACI 372R, AWWA D110, and ACI 318 except as specified herein. The tank, appurtenances, and related structures shall be constructed to the dimensions and configurations indicated on the Drawings and of the materials specified.

B. Steel Shell Diaphragm. Prior to the start of shotcrete and concrete work, the surfaces of the diaphragm face to which shotcrete or concrete is applied shall be thoroughly cleaned and free of dust, oil, and other foreign material.

C. Wall Joints. When precast concrete core wall panels are used, all surfaces of each joint shall be prepared as required for the material used to fill joint. Joint filler material shall be concrete or shotcrete.

D. Circumferential Prestressing. Circumferential prestressed reinforcement shall be continuously and uniformly applied under tension to the core wall in a helix of such pitch to provide an initial predetermined force and unit compressive stresses in the core wall per linear foot of height equivalent to the stress specified.

E. An acceptable calibrated stress recording device, which can easily be recalibrated, shall be used to measure and record reinforcement stress levels throughout the prestressing operation. A written record of the stress readings shall be maintained by the CONTRACTOR and delivered to the ENGINEER at the end of each working day throughout the period of prestressing operations. The records shall show the height and layer of reinforcement for which the stress is recorded. A minimum of one reading for every vertical foot of wall height shall be taken. The recording device shall be calibrated prior to use by an independent laboratory or shall be self-calibrated using a dynamometer calibrated by an independent laboratory, and the stress of the wire or strand in the final position, or between the stressing head and the wall, shall be verified daily by an acceptable alternative method.

F. For openings having a vertical height of 2 feet or less, the band of prestressed reinforcement normally required over the opening shall be displaced into circumferential bands immediately above and below the opening. The total prestressing force shall not be reduced as a result of the opening. Each band shall provide approximately one half of the displaced prestressing force. Minimum clear spacing of reinforcement shall be maintained above and below the opening.

G. Openings greater than 2 feet in vertical height may be accommodated with acceptable special wall designs that provide adequate reinforcement at the opening.

H. Any reinforcement not initially meeting the spacing requirements shall be respaced or removed. Prestressed reinforcement shall be placed no closer than 2 inches from the top of wall or edges of openings or inserts, nor closer than 3 inches from the base of walls where radial movement may occur between the base and floor or footing. The practice of bundling reinforcement will not be acceptable.

I. CONTRACTOR shall supply and make available for the ENGINEER's use special equipment at the jobsite capable of measuring the stress in the reinforcement after it is in place on the wall.

J. Prestressed reinforcement shall be placed in a manner that will minimize temperature increase any time during prestressing operations. If a die-drawn process is used, maximum temperature increase shall be 400°F immediately after leaving the die. Temperature measurement instruments with a contact type sensing probe, or an equivalent method, shall be used to determine the temperature of the wire. The temperature measuring equipment shall be required and used by the CONTRACTOR.

K. Wall Base Joint. Elastomeric bearing pads and joint filler shall be attached to the concrete surface with an acceptable waterproof adhesive material to prevent displacement during construction. Under no condition shall the pad be nailed to the concrete. All voids and cavities occurring between butted ends of pads, between pad and waterstops, and between pad and joint filler shall be filled with a nontoxic sealant compatible with the pad material and the submerged surface.

L. Seismic Restraint Cables. Seismic restraint cables, **when required by design**, shall be installed between the base of the wall and the floor.

M. Wall and Dome Roof. Cables shall be cut to uniform lengths and prebent before being placed in the forms. Care shall be taken in placement to avoid compression of the bearing pad and restraint of radial wall movement. The portion of the cable to be enclosed by sleeves shall be given a suitable coating to prevent corrosion. Cable units may be tied to the non-prestressed wall reinforcing bars.

3.02 FIELD QUALITY CONTROL

A. CONTRACTOR shall provide the ENGINEER certification of the calibration accuracy of equipment used.

B. Grades. CONTRACTOR shall verify all elevations in the field, any discrepancies shall immediately be brought to the attention of the ENGINEER/OWNER.

C. Wall Tolerances. The maximum out-of-round tolerance for concrete and shotcrete core walls shall be based on the ratio of plus or minus ½-inch per 100-foot diameter circle and the circumference shall be a smooth curve. Tolerance in wall thickness shall be plus ¼-inch for concrete walls and plus ½-inch for shotcrete. All transitions shall be gradual and smooth. Walls shall be plumb within a tolerance not exceeding 3/8-inch per 10 feet of vertical dimension.

D. Tightness Testing. At the completion of tank construction, CONTRACTOR shall demobilize from the site. A test for water tightness shall be conducted at a later date. It is anticipated that this work will be completed around the time that construction of the Terminus Facility is substantially complete.

1. ENGINEER shall be responsible for providing CONTRACTOR with written notice at least 21 days in advance of the anticipated time that CONTRACTOR will need to remobilize to complete this work.

2. The tightness test shall be performed by the CONTRACTOR based on maintaining a full tank level for a period of at least 72 hours and then measuring the loss after an additional five (5) days. If the loss exceeds the maximum allowable, the test shall be repeated after corrective measures have been taken. The maximum allowable daily liquid volume loss over the five (5) day period shall not exceed one-twentieth of 1 percent per day.

3. All construction joints shall be watertight and free from leaks. In addition, damp spots on wall areas will not be acceptable. Damp spots are defined as spots where moisture can be picked up on a dry hand.

4. No leakage that results in visible flow from beneath the tank will be permitted. No leakage that includes visible flow through the wall-floor joint will be permitted. Dampness or wet spots on top of the footing shall not be construed as flowing water.

5. CONTRACTOR shall make all necessary repairs if the tank fails the tightness test or is otherwise defective. The method of repair shall be acceptable to the ENGINEER. After repair, the tank shall be retested to the satisfaction of the ENGINEER.

6. The Terminus Facility Contractor shall be responsible for filling the tank under the supervision of the CONTRACTOR.

E. Concrete Testing. Reference Section 03300 – Cast-in-Place Concrete, and Section 03713 – Shotcrete for testing requirements.

1. CONTRACTOR to coordinate testing schedule with OWNER. CONTRACTOR shall provide OWNER with 48-hour minimum advance notice prior to placements and activities requiring testing/observation.

3.03 CLEANING

A. The tank shall be kept clean at all times, and under no circumstances shall body excrement be permitted to come in contact with any interior surfaces of the structure. After the tank has been completed, the CONTRACTOR shall carefully clean out the interior, remove all rubbish, trash, loose material, and other items of a temporary nature, and then thoroughly scrub and hose down all interior floor, ceiling, and wall surfaces and shall keep such surfaces clean until final acceptance by the OWNER. All water remaining in the tank after the scrubbing and hosing operations have been completed shall be removed by and at the expense of the CONTRACTOR.

3.04 DISINFECTION

A. Prior to tightness testing but after other work has been completed, the interior of the reservoir and inlet and outlet lines shall be thoroughly cleaned and disinfected. Prior to starting any disinfection work, the CONTRACTOR shall submit to the ENGINEER a detailed outline of the procedures proposed, the coordination and sequence of operations, and the manner of filling and flushing the reservoir. All procedures shall be acceptable to the ENGINEER. All water used in disinfecting the reservoir, and which is to be wasted, shall be disposed of in a manner acceptable to the OWNER and the appropriate pollution control agency.

1. CONTRACTOR shall coordinate with Terminus Facility Contractor with regards to availability of water for tank disinfection purposes.

B. Disinfection procedures shall be in accordance with either Method 2 (Section 4.3.2) or Method 3 (Section 4.3.3) of AWWA C652-11.

1. <u>Method 2</u> – A solution containing at least 200 mg/L available chlorine shall be applied directly to the surface of all parts of the storage facility that will be in contact with water when the storage facility is full to the overflow elevation. The chlorine solution shall be applied with suitable brushes or spray equipment. This solution shall thoroughly coat all surfaces to be coated – this includes all inlet/outlet piping and separate drain piping with available chlorine of not less than 10 mg/L (when filled with water). Note that overflow piping does not require disinfection. Disinfected surfaces shall remain in contact with this strong chlorine solution for at least 30 minutes. Following this procedure, potable water shall be admitted, drain piping shall be purged of the 10 mg/L chlorinated water, and the storage facility shall be filled to its overflow elevation. Following this procedure and contingent on satisfactory bacteriological testing, appropriate chlorine residual and acceptable aesthetic water quality, the reservoir may be placed into service.

2. <u>Method 3</u> – Water and chlorine shall be added in amounts such that the solution will initially contain at least 50 mg/L available chlorine and will fill approximately 5 percent of the total storage volume. Chlorine shall be added to the disinfecting solution as sodium hypochlorite. The solution shall then be held in the reservoir for a period of not less than 6 hours. The reservoir shall then be filled to the overflow level by flowing potable water into the highly chlorinated water and allowed to stand for a period of not less than 24 hours. If a chlorine residual of at least 2 mg/L remains, the disinfection is satisfactory. If the chlorine residual is less than 2 mg/L, additional sodium hypochlorite shall be added, the reservoir shall be allowed to stand for an additional 24 hours, and the chlorine residual shall be rechecked. After the disinfection is deemed satisfactory, all highly chlorinated water shall be purged from drain piping and

the reservoir may be placed into service.

C. After the chlorination procedure is completed and before the storage facility is placed in service, water from the reservoir shall be sampled and tested for coliform organisms in accordance with the latest edition of Standard Methods for the Examination of Water and Wastewater. If two (2) consecutive samples taken 24 hours apart are negative, the reservoir may be placed in service. If samples show the presence of coliform bacteria, additional samples shall be taken until two (2) consecutive samples are negative, or the disinfection procedure repeated and the water retested.

D. CONTRACTOR shall, at the completion of tank construction, demobilize from the site. CONTRACTOR shall thoroughly clean and disinfect the tank interior at a later date. It is anticipated that this work will be completed around the time that construction of the Terminus Facility is substantially complete.

1. ENGINEER shall be responsible for providing CONTRACTOR with written notice at least 21 days in advance of the anticipated time that CONTRACTOR will need to mobilize to complete this work.

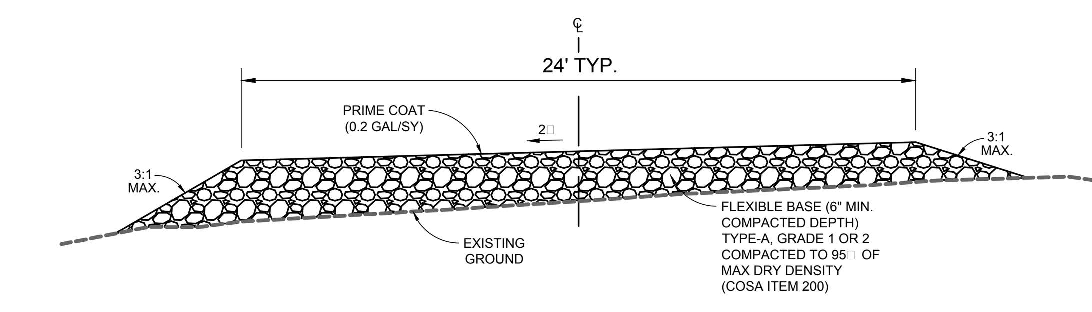
3.05 CLEAN-UP

A. The premises shall be kept clean and orderly at all times during the work. Upon completion of construction, the CONTRACTOR shall remove or otherwise dispose of all rubbish and other materials caused by construction operation. CONTRACTOR shall restore the site to existing or better condition.

END OF SECTION

LEGEND

- EXISTING SANITARY SEWER MANHOLE
- PROPERTY LINES
- EXISTING SEWER MAIN
- EXISTING CHAIN LINK FENCE
- EXISTING CONTOURS
- DIMENSION CONTROL POINT
- PROPOSED ALL-WEATHER ACCESS ROAD
- EXISTING TREE

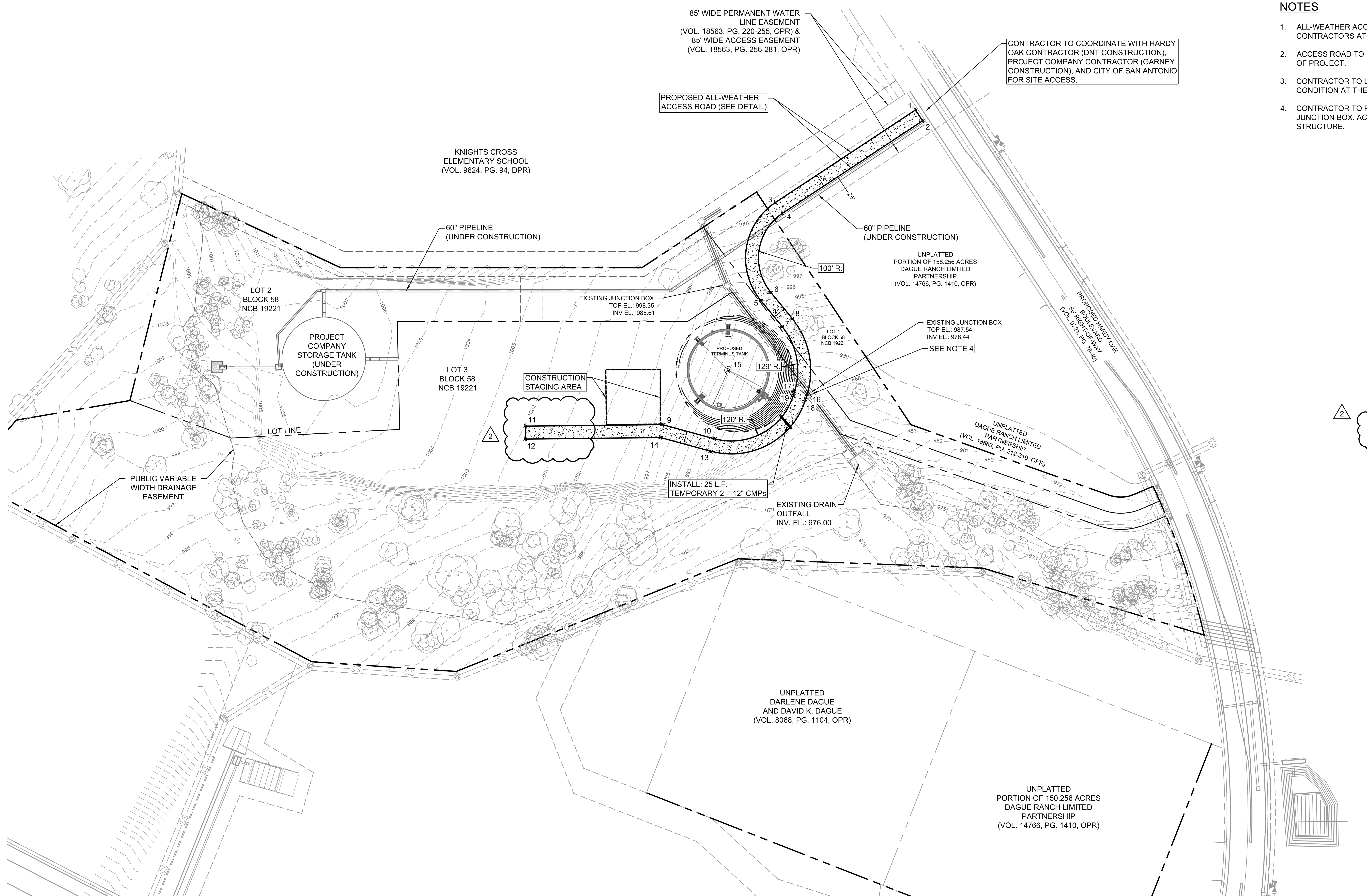


ALL-WEATHER ACCESS ROAD

NOT TO SCALE

NOTES

1. ALL-WEATHER ACCESS ROAD TO BE ACCESSIBLE BY ALL CONTRACTORS AT ALL TIMES.
2. ACCESS ROAD TO BE MAINTAINED BY CONTRACTOR FOR DURATION OF PROJECT.
3. CONTRACTOR TO LEAVE ALL-WEATHER ACCESS ROAD IN GOOD CONDITION AT THE END OF THE PROJECT.
4. CONTRACTOR TO PROVIDE PROTECTION AROUND EXISTING JUNCTION BOX. ACCESS ROAD SHALL BE BUILT AROUND THIS STRUCTURE.



COORDINATES

POINT #	NORTHING	EASTING
1	13779313.07	2134033.98
2	13779297.45	2134052.19
3	13779077.14	2133831.59
4	13779061.51	2133849.80
5	13778894.54	2133855.00
6	13778914.25	2133868.68
7	13778859.03	2133906.15
8	13778878.75	2133919.83
9	13778622.99	2133742.74
10	13778624.17	2133842.82
11	13778550.64	2133499.52
12	13778527.63	2133506.37
13	13778600.17	2133843.10
14	13778599.03	2133746.38
15	13778753.74	2133832.88
16	13778749.73	2133985.56
17	13778750.25	2133961.56
18	13778741.03	2133985.37
19	13778741.55	2133961.37

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BID SET

BAIN MEDINA BAIN, INC.
ENGINEERS & SURVEYORS

SAN ANTONIO WATER SYSTEM

MARK	DATE	DESCRIPTION	BY
1	3/20/18	PER ADDENDUM #2	NR
2	3/22/18	PER ADDENDUM #3	NR

SAN ANTONIO WATER SYSTEM

CENTRAL WATER INTEGRATION PIPELINE

TERMINUS TANK PROJECT

TERMINUS TANK DIMENSION CONTROL AND ACCESS PLAN

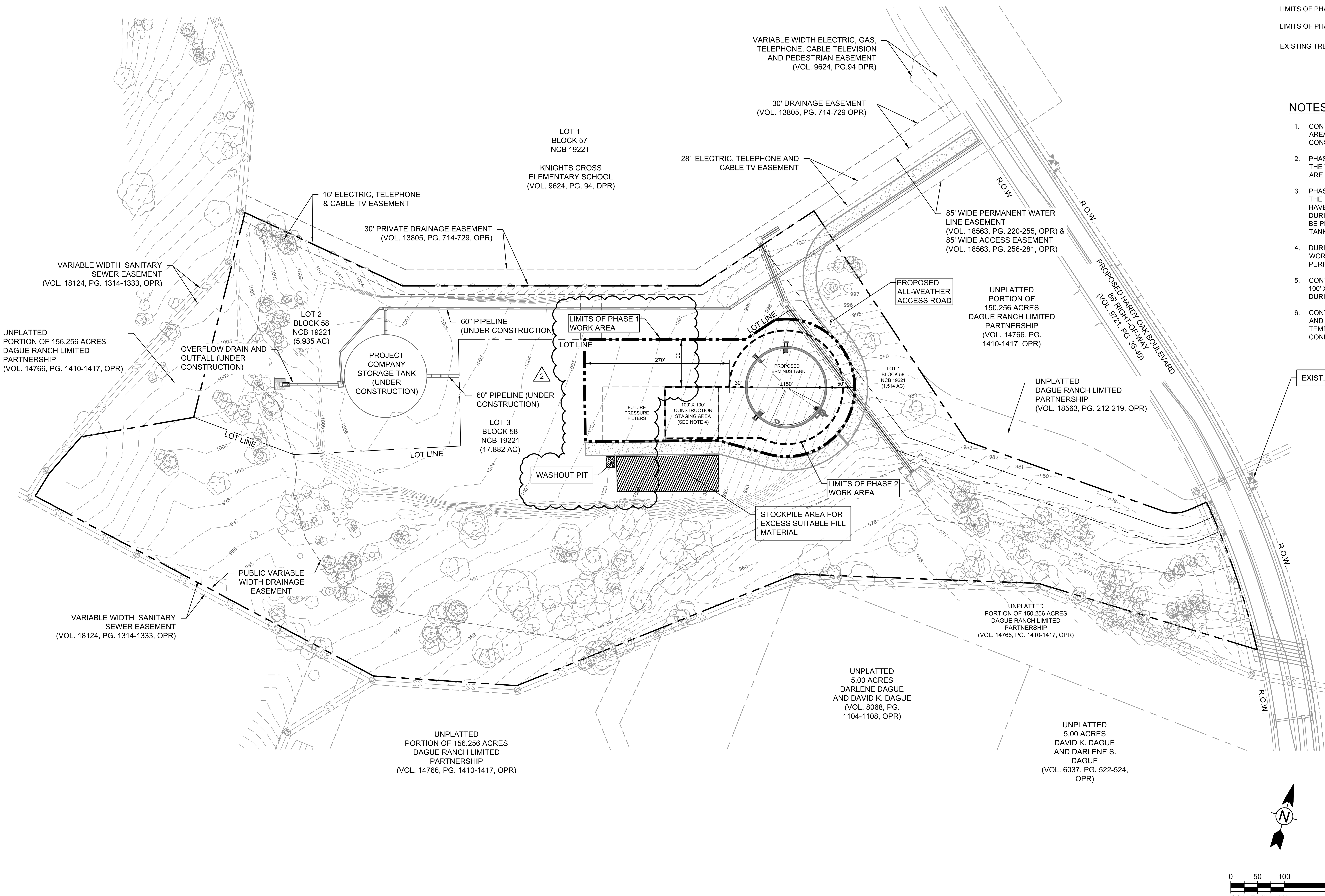
3/22/18

STATE OF TEXAS
NICHOLAS M. RAMONES
117112
LICENSED
PROFESSIONAL ENGINEER

PROJ:	200-09308-18001
DESN:	NR
DRWN:	VS,ML
CHKD:	CB

C-1302

Bar measures 1 inch, otherwise drawing is not to scale



LEGEND

EXISTING SANITARY SEWER MANHOLE	SS
PROPERTY LINES	
EXISTING SEWER MAIN	SS
EXISTING CHAIN LINK FENCE	
EXISTING CONTOURS	1904
LIMITS OF PHASE 1 WORK AREA	
LIMITS OF PHASE 2 WORK AREA	
EXISTING TREE	

NOTES:

1. CONTRACTOR SHALL LIMIT WORK TO THE AREAS INDICATED FOR EACH PHASE OF CONSTRUCTION.
2. PHASE 1 CONSTRUCTION CORRESPONDS TO THE TIME FRAME IN WHICH CASTING BEDS ARE ON THE PROJECT SITE.
3. PHASE 2 CONSTRUCTION CORRESPONDS TO THE PERIOD AFTER WHICH ALL CASTING BEDS HAVE BEEN REMOVED FROM THE JOB SITE. DURING THIS TIME THE CONTRACTOR SHALL BE PROVIDED A 30 FT WIDE RING AROUND THE TANK IN WHICH TO DO THEIR WORK.
4. DURING WIRE-WINDING OPERATIONS, NO WORK UNDER OTHER CONTRACTS WILL BE PERFORMED WITHIN 100 FEET OF THE TANK.
5. CONTRACTOR SHALL HAVE ACCESS TO THE 100' X 100' CONSTRUCTION STAGING AREA DURING ALL PHASES OF CONSTRUCTION.
6. CONTRACTOR TO COORDINATE WITH SAWS AND OBTAIN ALL PERMITS/FEES FOR TEMPORARY FIRE HYDRANT METER CONNECTION AS REQUIRED.

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SAN ANTONIO WATER SYSTEM

MARK	DATE	DESCRIPTION	BY
1	3/20/18	PER ADDENDUM #2	NR
2	3/22/18	PER ADDENDUM #3	NR

SAN ANTONIO WATER SYSTEM
CENTRAL WATER INTEGRATION PIPELINE
TERMINUS TANK PROJECT

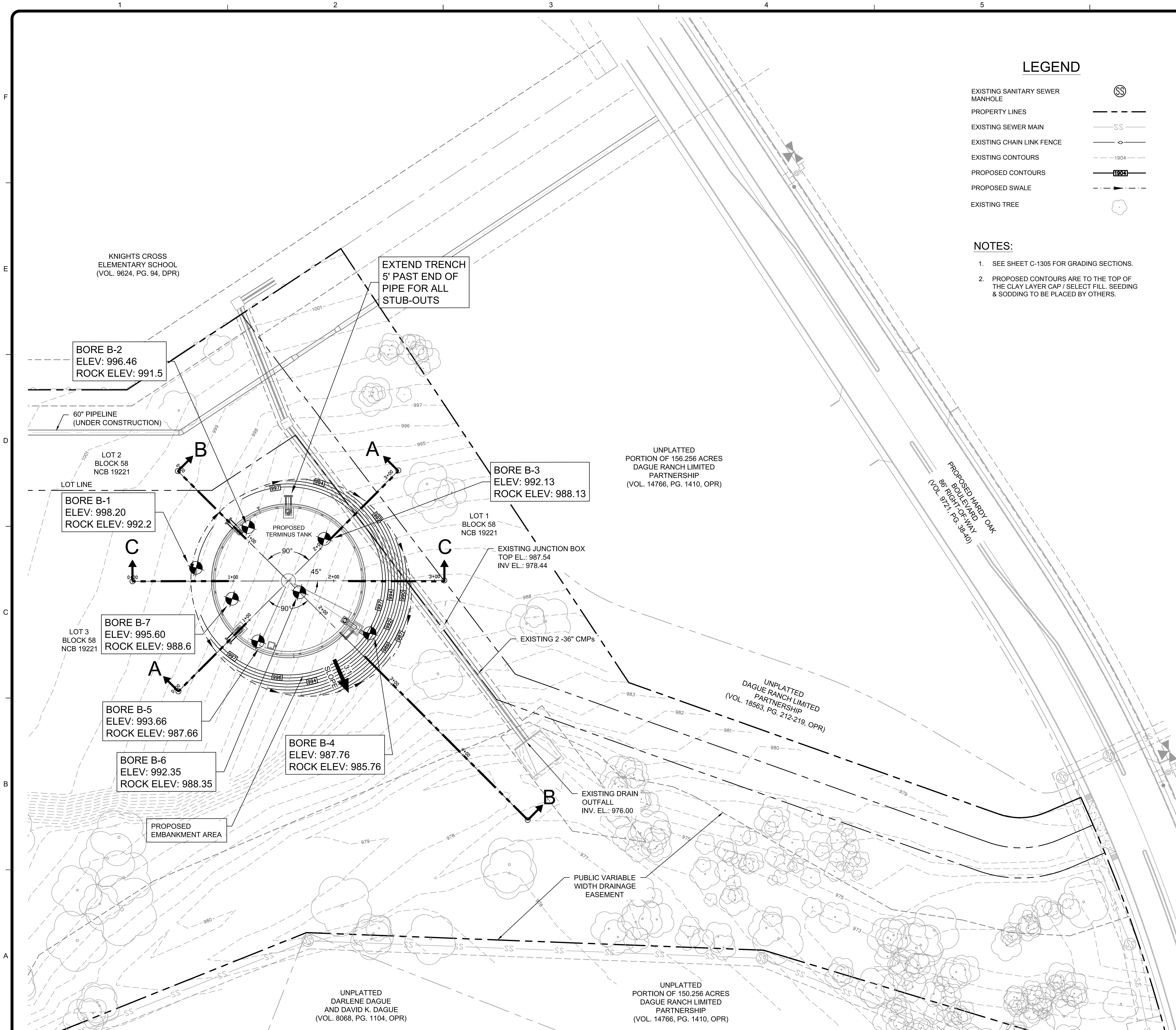
TERMINUS PHASED CONTRACTOR LAYDOWN AREAS

3/22/18
STATE OF TEXAS
NICHOLAS M. RAMONES
117112
LICENSED
PROFESSIONAL ENGINEER
N. Ramones

PROJ:	200-09308-18001
DESN:	NR
DRWN:	VS,ML
CHKD:	CB

C-1303

Bar measures 1 inch, otherwise drawing is not to scale



LEGEND

EXISTING SANITARY SEWER MANHOLE	
PROPERTY LINES	
EXISTING SEWER MAIN	
EXISTING CHAIN LINK FENCE	
EXISTING CONTOURS	
PROPOSED CONTOURS	
PROPOSED SWALE	
EXISTING TREE	

NOTES:

1. SEE SHEET C-1305 FOR GRADING SECTIONS.
2. PROPOSED CONTOURS ARE TO THE TOP OF THE CLAY LAYER CAP / SELECT FILL. SEEDING & SODDING TO BE PLACED BY OTHERS.

GRADING NOTES

SITE PREPARATION
SITE PREPARATION SHALL CONSIST OF ALL CLEARING AND PREPARATION OF LAND TO BE FILLED. EXCAVATION, EMBANKMENT, SPREADING, COMPACTION TESTING INSPECTION OF THE FILL OR CUT AND ALL NECESSARY WORK TO COMPLETE THE GRADING THE SITE TO CONFORM TO THE LINES, GRADES AND SLOPES AS SHOWN ON THE APPROVED PLANS.

SCARIFYING THE AREA
ALL ORGANIC MATTER SHALL BE REMOVED FROM THE SURFACE UPON WHICH THE FILL IS TO BE PLACED. THE SURFACE SHALL BE DISKED OR SCARIFIED TO A MINIMUM DEPTH OF SIX INCHES (6"). ALL SURFACE RUTS OR OTHER UNEVEN FEATURES WILL BE LEVELED PRIOR TO FIELD DENSITY TESTING.

FILL MATERIALS OUTSIDE TANK FOOTPRINT
FILL MATERIALS USED SHALL BE FREE FROM ORGANIC MATTER AND OTHER DELETERIOUS SUBSTANCES SUCH AS TREES, BUSHES, RUBBISH, AND ROCKS OVER 3" IN SIZE.

DEPTH AND MIXING OF FILL MATERIAL OUTSIDE TANK FOOTPRINT
THE FILL MATERIAL SHALL BE PLACED IN LEVEL UNIFORM LAYER WHICH, WHEN COMPACTED SHALL HAVE A DENSITY CONFORMING TO THE COMPACTION REQUIREMENTS ABOVE. EACH LAYER SHALL BE THOROUGHLY MIXED DURING SPREADING TO ENDURE UNIFORMITY OF MATERIAL IN EACH LAYER, COMPACTED LAYER THICKNESS MAY VARY DEPENDING ON THE COMPACTION EQUIPMENT AND DEMONSTRATED CAPABILITY. THE MAX LOOSE DEPTH FOR ANY MATERIAL SHALL NOT EXCEED TWELVE INCHES (12").

ROCK
FILL MATERIAL SHALL NOT INCLUDE ANY ROCK.

COMPACTION OF FILL LAYER
COMPACTION EQUIPMENT SHALL BE CAPABLE OF COMPACTING THE FILL TO THE SPECIFIED DENSITY. COMPACTION SHALL BE ACCOMPLISHED WHILE THE FILL MATERIALS AT OR NEAR THE APPROPRIATE MOISTURE CONTENT. COMPACTION OF WHICH LAYER SHALL BE CONTINUOUS OVER THE ENTIRE STRUCTURAL AREA.

DENSITY TEST (SEE SPECIFICATION AND GEOTECHNICAL REPORT)

EXCAVATED MATERIALS
1. THE CONTRACTOR SHALL LEAVE SEPARATE SPOIL PILES FOR EACH MATERIAL EXCAVATED DURING TANK CONSTRUCTION.
2. EXCLUDING ANY FAT CLAY, TERMINUS CONTRACTOR MAY USE THESE SPOILS AS FILL MATERIAL ON THE TERMINUS SITE.
3. ANY FAT CLAY OBTAINED DURING EXCAVATION SHALL BE PLACED INTO A SEPARATE PILE.
4. NO SPOILS SHALL BE USED AS SUBGRADE MATERIAL FOR THE PROPOSED TANK.

SITE SURVEY
1. CONTRACTOR TO VERIFY EXISTING SITE CONDITIONS PRIOR TO CONSTRUCTION AND NOTIFY ENGINEER OF ANY DISCREPANCIES.
2. TOP OF ROCK ELEVATIONS SHOWN ARE APPROXIMATE, CONTRACTOR TO CONFIRM.
3. UPON COMPLETION OF EXCAVATION ACTIVITIES, CONTRACTOR WILL BE RESPONSIBLE TO PERFORM A SURVEY OF ALL STOCKPILE AREAS TO QUANTIFY THE VOLUME OF MATERIAL EXCAVATED FOR FINAL PLACEMENT BY OTHERS. THE SURVEY METHOD SHALL BE APPROVED BY SAWS. THE PREFERRED METHOD IS UAV LIDAR BUT OTHER METHODS WILL BE CONSIDERED.
4. CONTRACTOR TO COMPLETE POST-CONSTRUCTION AS-BUILT SURVEY AT END OF PROJECT.
5. SURVEYS SHALL BE PROVIDED TO THE ENGINEER IN A DIGITAL FORMAT.

2

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TBPE NO. F-1712 WWW.BMBI.COM

SAN ANTONIO WATER SYSTEM

MARK	DATE	DESCRIPTION	BY
1	3/20/18	PER ADDENDUM #2	NR
2	3/22/18	PER ADDENDUM #3	NR

SAN ANTONIO WATER SYSTEM
CENTRAL WATER INTEGRATION PIPELINE
TERMINUS TANK PROJECT

TERMINUS TANK GRADING PLAN

3/22/18
STATE OF TEXAS
NICHOLAS M. RAMONES
117112
LICENSED
PROFESSIONAL ENGINEER

PROJ:	200-09308-18001
DESN:	NR
DRWN:	VS,ML
CHKD:	CB

C-1304

Bar measures 1 inch, otherwise drawing is not to scale

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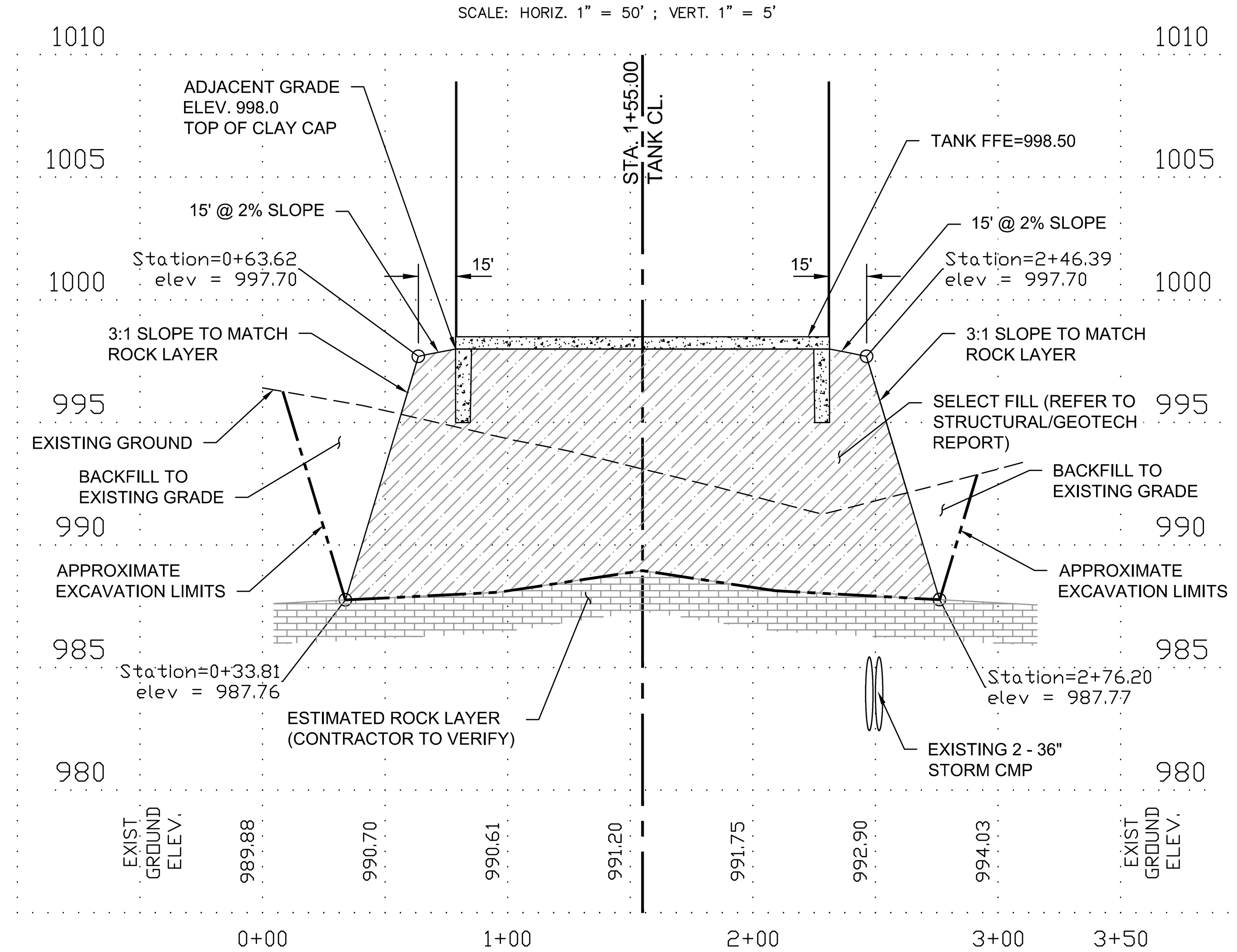
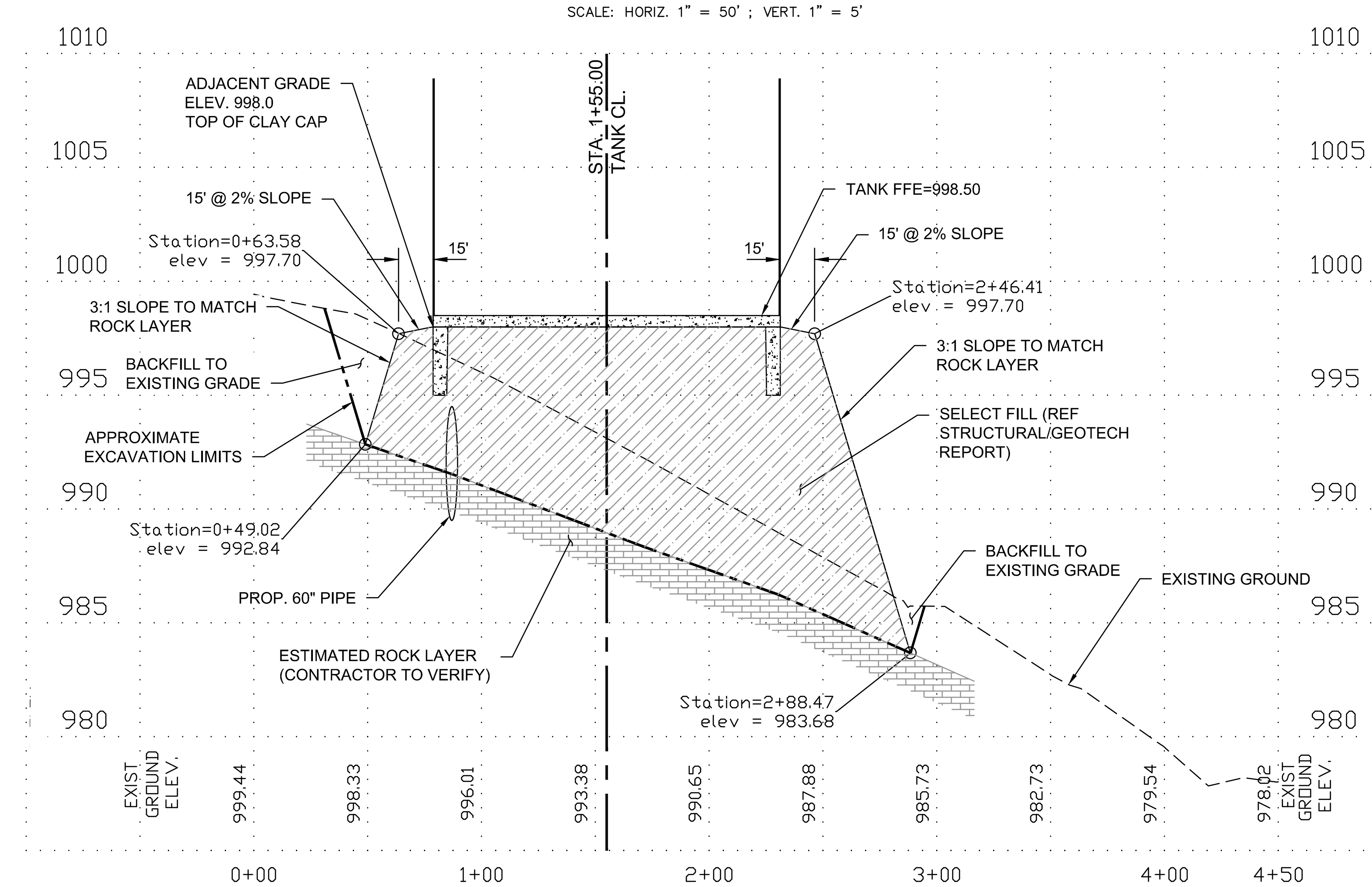
SECTION A–A

SCALE: HORIZ. 1" = 50' ; VERT. 1" = 5'



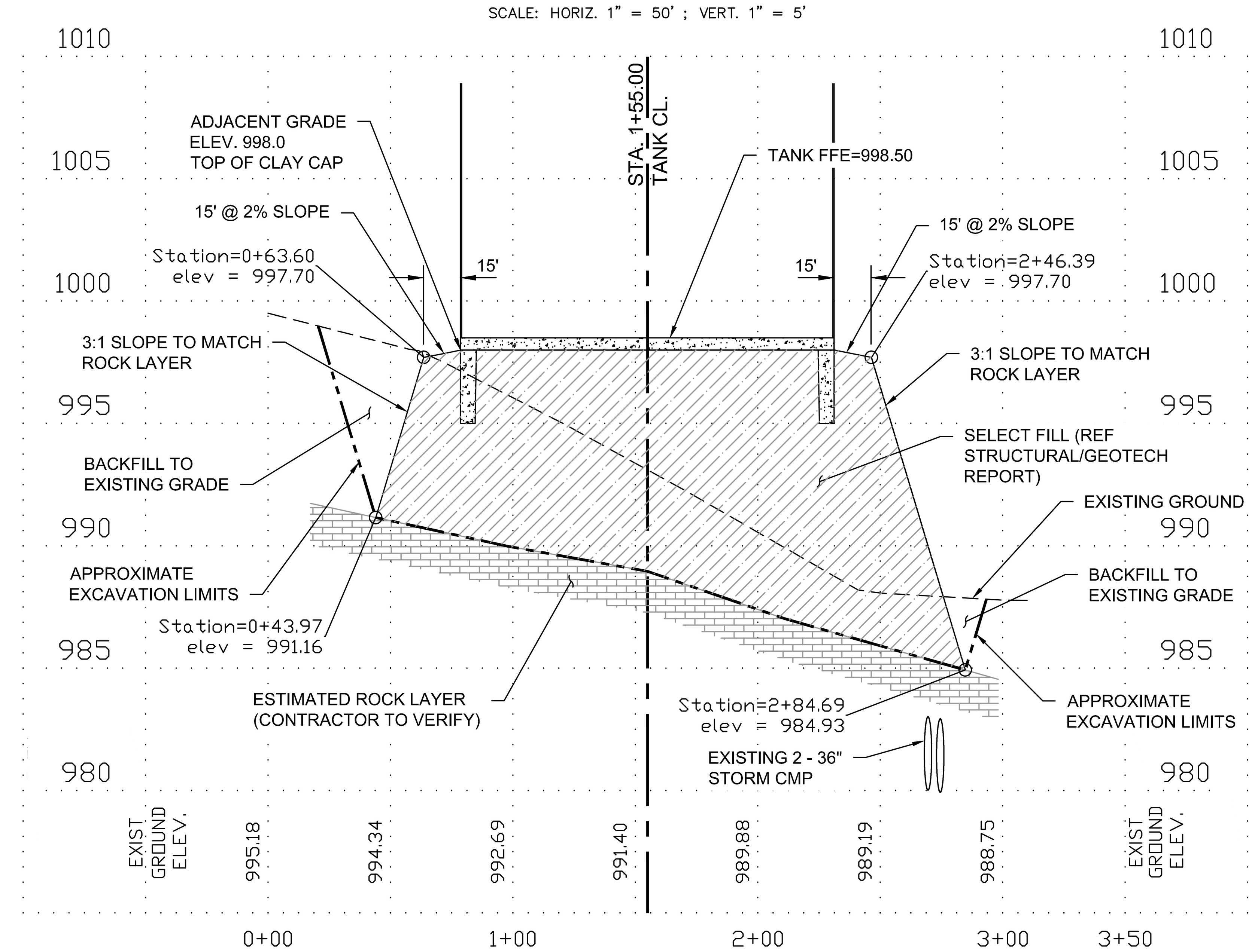
SECTION B–B

SCALE: HORIZ. 1" = 50' ; VERT. 1" = 5'



SECTION C–C

SCALE: HORIZ. 1" = 50' ; VERT. 1" = 5'



2

NOTES:

1. PROPOSED GRADING SHOWN REPRESENTS THE TOP OF THE CLAY LAYER CAP / SELECT FILL. SEEDING & SODDING TO BE PLACED BY OTHERS.
2. REFERENCE GEOTECHNICAL REPORT AND SPECIFICATIONS FOR CLAY CAP AND SELECT FILL REQUIREMENTS.
3. TOP OF ROCK ELEVATIONS SHOWN ARE APPROXIMATE. CONTRACTOR TO VERIFY.

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BID SET

BAIN MEDINA BAIN, INC.
ENGINEERS & SURVEYORS

SAN ANTONIO WATER SYSTEM

MARK	DATE	DESCRIPTION	BY
1	3/20/18	PER ADDENDUM #2	NR
2	3/22/18	PER ADDENDUM #3	NR

SAN ANTONIO WATER SYSTEM
CENTRAL WATER INTEGRATION PIPELINE
TERMINUS TANK PROJECT

TERMINUS TANK GRADING SECTIONS

3/22/18

STATE OF TEXAS
NICHOLAS M. RAMONES
117112
LICENSED
PROFESSIONAL ENGINEER

PROJ:	200-09308-18001
DESN:	NR
DRWN:	VS,ML
CHKD:	CB

C-1305

Bar measures 1 inch, otherwise drawing is not to scale

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GENERAL REQUIREMENTS:

1. THE GENERAL STRUCTURAL NOTES ARE INTENDED TO AUGMENT THE DRAWINGS AND SPECIFICATIONS, SHOULD CONFLICTS EXIST BETWEEN THE DRAWINGS, SPECIFICATIONS AND THE STRUCTURAL NOTES. THE STRICTEST PROVISION SHALL GOVERN.

2. THE STRUCTURES ARE DESIGNED TO BE SELF-SUPPORTING AND STABLE AFTER THE BUILDING IS FULLY COMPLETED. IT IS THE CONTRACTOR'S SOLE RESPONSIBILITY TO DETERMINE ERECTION PROCEDURE AND SEQUENCE, TO INSURE THE SAFETY OF THE BUILDING AND IT'S COMPONENT PARTS DURING ERECTION, AND TO PROVIDE TEMPORARY BRACING, GUYS, OR TIE-DOWNS AS NECESSARY FOR COMPLETION OF THE WORK. SUCH MATERIAL SHALL REMAIN THE CONTRACTOR'S PROPERTY AFTER COMPLETION OF THE WORK.

3. FOLLOW ALL APPLICABLE SAFETY CODES AND REGULATIONS DURING ALL PHASES OF CONSTRUCTION.

4. ALL CONDITIONS AND DIMENSIONS PERTAINING TO EXISTING UTILITIES AND CONSTRUCTION AT THE SITE, SHALL BE VERIFIED BY THE CONTRACTOR BEFORE PROCEEDING WITH THE WORK. THIS ASSESSMENT SHALL BE CONDUCTED SUFFICIENTLY IN ADVANCE OF ANY PHASE OF CONSTRUCTION, TO THE MAXIMUM EXTENT POSSIBLE, TO AVOID DELAYS IN THE WORK.

5. EQUIPMENT WEIGHTS AND STRUCTURAL ITEMS IN ANY WAY RELATED TO THE SUPPORT OF EQUIPMENT OR OPENINGS ARE INDICATED FOR INFORMATIONAL PURPOSES ONLY. VERIFY AND COORDINATE SIZE, LOCATION AND QUANTITY OF OPENINGS AND EQUIPMENT WEIGHTS REQUIRED FOR ARCHITECTURAL, MECHANICAL AND ELECTRICAL TRADES, OBTAIN APPROVAL OF AFFECTED TRADES BEFORE PROCEEDING WITH SUCH PORTION OF THE WORK. CHANGES REQUIRED BY EQUIPMENT IN EXCESS OF THE WEIGHT OR GEOMETRIC ALLOWANCES ARE THE CONTRACTOR'S RESPONSIBILITY.

6. ALL LOADS AND REACTIONS ON DRAWINGS AND IN THESE GENERAL STRUCTURAL NOTES ARE UNFACTORED SERVICE LOADS UNLESS OTHERWISE NOTED, LOAD CASES WHICH INCLUDE COMBINED LOADS SHALL BE CALCULATED IN ACCORDANCE WITH THE MUNICIPAL CODE OF SAN ANTONIO.

7. IN GENERAL, ALL SECTIONS AND DETAILS SHOWN ON THE PLANS ARE INTENDED TO APPLY TO SIMILAR CONDITIONS, UNLESS SPECIFICALLY NOTED.

8. SEE "C" AND "D" DRAWINGS FOR EMBEDDED ITEMS NOT SHOWN HEREIN AND TO VERIFY SIZE AND LOCATION OF ALL OPENINGS.

9. NO CORE DRILLING SHALL BE ALLOWED WITHOUT APPROVAL BY THE ENGINEER, BEFORE CORE DRILLING ANY HOLES, LOCATE THE REINFORCING STEEL IN EXISTING CONCRETE WITH R-METER, RELOCATE THE HOLE TO AVOID CUTTING ANY REBARS OR POST-TENSIONING TENDONS. DO NOT DRILL HOLES THROUGH EXISTING REBARS UNLESS ACCEPTABLE TO THE STRUCTURAL ENGINEER. DO NOT OVERCUT ANY HOLES.

DESIGN LOAD CRITERIA:

1. REFERENCE CODE: INTERNATIONAL BUILDING CODE IBC 2015 ASCE 7-10, MINIMUM DESIGN LOADS FOR BUILDINGS AND OTHER STRUCTURES.

2. RISK CATEGORY III

3. LIVE LOADS:
   - ROOF AREA: 20 PSF

4. DEAD LOADS: THE SELF WEIGHT OF EACH STRUCTURAL ELEMENT AND THE FOLLOWING SUPERIMPOSED LOADS
   - MISCELLANEOUS LOADS (TANK LID AND WALLS: 5 PSF

5. WIND LOADS:
   - BASIC WIND SPEED: 120 MPH
   - WIND IMPORTANCE FACTOR LW: 1.0
   - WIND EXPOSURE FACTOR: C
   - ENCLOSURE CLASSIFICATION: ENCLOSED BUILDING
   - GUST EFFECT FACTOR: .85, RIGID BUILDING

6. SNOW LOADS:
   - IMPORTANCE FACTOR Is: 1.00
   - GROUND SNOW LOAD. Pg: 5 PSF

7. SEISMIC DESIGN CRITERIA:
   - SEISMIC IMPORTANCE FACTOR Is: 1.25
   - MCE ACCELERATIONS, Ss/S1: 0.074/0.030
   - LONG PERIOD TRANSITION PERIOD T: TBD
   - SITE CLASS: B
   - SPECTRAL RESPONSE COEFFICIENTS Sds/Sdf: 0.049/0.020
   - SEISMIC DESIGN CATEGORY: C
   - BASIC SEISMIC FORCE RESISTING SYSTEM: ORDINARY PLANE CONCRETE SHEAR WALLS

DESIGN LOAD CRITERIA (CONTINUED):

8. CONNECTIONS FOR SUPPORTED EQUIPMENT. FACIAL AND OTHER NON-STRUCTURAL ITEMS SHALL BE DESIGNED TO ACCOUNT FOR UNEXPECTED ECCENTRICITIES IN THE LOADED PARTS AND RESULTING PRYING EFFECTS. CONNECTIONS WHICH RELY ON MULTIPLE FASTENERS AT ONE LOCATION SHALL TAKE INTO ACCOUNT THE STIFFNESS OF THE CONNECTED ELEMENTS AND THEIR ABILITY TO REDISTRIBUTE LOADS TO OTHER ANCHORS IN THE EVENT OF FASTENER YIELD OR SLIP.

9. ALL ANCHORS EMBEDDED IN CONCRETE OR MASONRY SHALL BE PROPORTIONED TO EXCEED THE STRENGTH OF THE CONNECTED HARDWARE. ALL ANCHORS SHALL BE SHOWN TO BE IN COMPLIANCE WITH ACI 318 APPENDIX D. MECHANICAL EXPANSION FASTENERS SHALL NOT BE USED IN CONDITIONS WHERE THEY WILL SEE TENSILE LOADS. POWDER DRIVEN ANCHORS SHALL NOT BE USED IN CONCRETE OR MASONRY.

SPECIAL INSPECTION

SPECIAL INSPECTION WILL BE PROVIDED BY THE CONTRACTOR BASED ON THE REQUIREMENTS OF THE 2015 IBC AS SUMMARIZED IN THE TABLE BELOW. THE CONTRACTOR SHALL PROVIDE SUFFICIENT NOTICE AND ACCESS FOR THE SPECIAL INSPECTOR TO PERFORM THESE INSPECTIONS.

SPECIAL INSPECTION PROGRAM(1)

ESTABLISHED PER 2015 IBC CHAPTER 17

ITEM	CONTINUOUS (3)	PERIODIC (3)	COMMENTS
SOILS		X	
GRADING, EXCAVATION &FILL			GEOTECHNICAL ENGINEER
FINAL FOUNDATION PREPARATION			GEOTECHNICAL ENGINEER
CONCRETE			
REINFORCING PLACEMENT		X	
REINFORCING WELDING	X		REF. NOTE 4
REINFORCING COUPLING		X	
ANCHOR BOLTS & INSERTS		X	
PRE-STRESSING STEEL PLACEMENT & GROUTING (IF APPLICABLE)		X	
PRE-STRESSING STEEL STRESSING	X		
MATERIAL VERIFICATION		X	
PREPARATION OF TEST SPECIMENS	X		RECORD SLUMP, AIR CONTENT, & TEMPERATURE
CONCRETE PLACEMENT	X		
EPOXY ANCHOR PLACEMENT	X		
EXPANSION ANCHOR PLACEMENT	X		
CURING		X	
SHOTCRETE			
REQUIRED MIX DESIGN		X	
STRENGTH TEST - IN PLACE WORK		X	
STRENGTH TEST - TEST PANELS		X	
SHOTCRETE PLACEMENT	X		
REINFORCEMENT PLACEMENT	X		
CURING		X	
PREFABRICATED CONSTRUCTION			REF. NOTE 5

1. THE ITEMS CHECKED WITH AN "X" SHALL BE INSPECTED IN ACCORDANCE WITH IBC CHAPTER 17 BY A CERTIFIED SPECIAL INSPECTOR FROM AN ESTABLISHED TESTING AGENCY. FOR MATERIAL SAMPLING AND TESTING REQUIREMENTS, REFER TO THE PROJECT SPECIFICATIONS AND THE SPECIFIC GENERAL NOTES SECTIONS. THE TESTING AGENCY SHALL SEND COPIES OF ALL STRUCTURAL TESTING AND INSPECTION REPORTS DIRECTLY TO THE ARCHITECT, STRUCTURAL ENGINEER, CONTRACTOR AND BUILDING OFFICIAL. ANY MATERIALS WHICH FAIL TO MEET THE PROJECT SPECIFICATIONS SHALL IMMEDIATELY BE BROUGHT TO THE ATTENTION OF THE ENGINEER AND CONTRACTOR. SPECIAL INSPECTION TESTING REQUIREMENTS APPLY EQUALLY TO ALL BIDDER DESIGNED COMPONENTS.
2. SPECIAL INSPECTION IS NOT REQUIRED FOR WORK PERFORMED BY AN APPROVED FABRICATOR PER IBC SECTION 1704.2.2.
3. CONTINUOUS SPECIAL INSPECTION MEANS THAT THE SPECIAL INSPECTOR IS ON THE SITE AT ALL TIMES OBSERVING THE WORK REQUIRING SPECIAL INSPECTION (IBC SECTION 1702). PERIODIC SPECIAL INSPECTION MEANS THAT THE SPECIAL INSPECTOR IS ON SITE AT TIME INTERVALS NECESSARY TO CONFIRM THAT ALL WORK REQUIRING SPECIAL INSPECTION IS IN COMPLIANCE.
4. CONTINUOUS INSPECTION IS REQUIRED FOR WELDING OF REINFORCING THAT RESISTS FLEXURAL AND AXIAL FORCES IN INTERMEDIATE AND SPECIAL MOMENT FRAMES, REINFORCING IN BOUNDARY ELEMENTS OF SPECIAL REINFORCED CONCRETE SHEAR WALLS AND SHEAR REINFORCEMENT. PERIODIC INSPECTION MAY BE USED FOR OTHER WELDED REINFORCING.
5. INSPECTION FOR PREFABRICATED CONSTRUCTION SHALL BE THE SAME AS IF THE MATERIAL USED IN THE CONSTRUCTION TOOK PLACE ON SITE. CONTINUOUS INSPECTION WILL NOT BE REQUIRED DURING PREFABRICATION IF THE APPROVED FABRICATOR CERTIFIES THE CONSTRUCTION AND FURNISHES EVIDENCE OF COMPLIANCE.

FOUNDATION NOTES:

1. FOUNDATIONS SHALL BE DESIGNED IN ACCORDANCE WITH ACI AND THE IBC 2015 ALLOWABLE LOADS LISTED BELOW ARE BASED ON RECOMMENDATIONS PROVIDED IN THE PROJECT SPECIFIC GEOTECHNICAL REPORT BY ARIAS GEOPROFESSIONALS' REPORT NUMBER 2018-53, TITLED PROPOSED GROUND STORAGE TANK TERMINUS SITE, DATED MARCH 6, 2018.

2. THE ALLOWABLE SOIL BEARING PRESSURE BASED ON THE PROJECT SPECIFIC GEOTECHNICAL REPORT BY ARIAS GEOPROFESSIONALS' REPORT NUMBER 2018-53, TITLED PROPOSED GROUND STORAGE TANK TERMINUS SITE, DATED MARCH 6, 2018.
   1. THE ALLOWABLE BEARING PRESSURE FOR THE TANK PAD SHALL BE 5,600 PSF (BASED ON TOTAL LOAD CONDITIONS).
   2. THE ALLOWABLE BEARING PRESSURE FOR THE TANK RING FOOTING SHALL BE 7,500 PSF (BASED ON TOTAL LOAD CONDITIONS).

3. PRIOR TO ANY EXCAVATION OPERATIONS, THE CONTRACTOR IS RESPONSIBLE FOR LOCATING ALL UNDERGROUND UTILITIES OR OTHER SUBSURFACE STRUCTURES WITHIN THE AREA TO BE EXCAVATED.

4. ALL EXCAVATIONS WITHIN 2 FEET OF EXISTING STRUCTURES TO REMAIN SHALL BE REMOVED BY HAND. THE CONTRACTOR IS SOLELY RESPONSIBLE FOR TAKING ADEQUATE PRECAUTIONS NOT TO DAMAGE THE EXISTING INFRASTRUCTURE DURING ALL EXCAVATION, FILL AND COMPACTION OPERATIONS.

5. IN TIGHTLY CONFINED AREAS. A LIGHTWEIGHT VIBRATORY SLED, WEIGHING BETWEEN 500 AND 2000 POUNDS MAY BE SUBSTITUTED FOR THE DRUM ROLLER COMPACTOR. THE DENSIFICATION REQUIREMENTS REMAIN THE SAME.

6. DENSITY TESTING SHALL BE CONDUCTED IN ACCORDANCE WITH THE SPECIFICATIONS.

7. SHOULD PUMPING OR YIELDING OF THE SOIL BE ENCOUNTERED DURING COMPACTION OPERATIONS, COMPACTION EFFORTS SHALL BE CEASED AND THE GEOTECHNICAL ENGINEER SHALL BE NOTIFIED.

8. PROOF ROLL IN ACCORDANCE WITH THE SPECIFICATIONS.

9. STORMWATER SHALL BE DIVERTED FROM OPEN EXCAVATIONS.

TETRA TECH
Texas Registration No. F-3924
www.tetratech.com
700 N. St. Mary's, Suite 300
San Antonio, TX 78205
Ph (210) 299-7900 Fax (210) 226-8497

BID SET

STRUCTURAL ENGINEERING ASSOCIATES INC.
CONSULTING ENGINEERS
TBPE FIRM REG. NO. F-199
SAN ANTONIO, TX 78229
(210) 735-9202 WWW.SEATX.COM

SAN ANTONIO WATER SYSTEM

MARK	DATE	DESCRIPTION	BY
1	3/20/18	PER ADDENDUM #2	
2	3/22/2018	PER ADDENDUM #3	

SAN ANTONIO WATER SYSTEM
CENTRAL WATER INTEGRATION PIPELINE TERMINUS TANK PROJECT

STRUCTURAL GENERAL NOTES

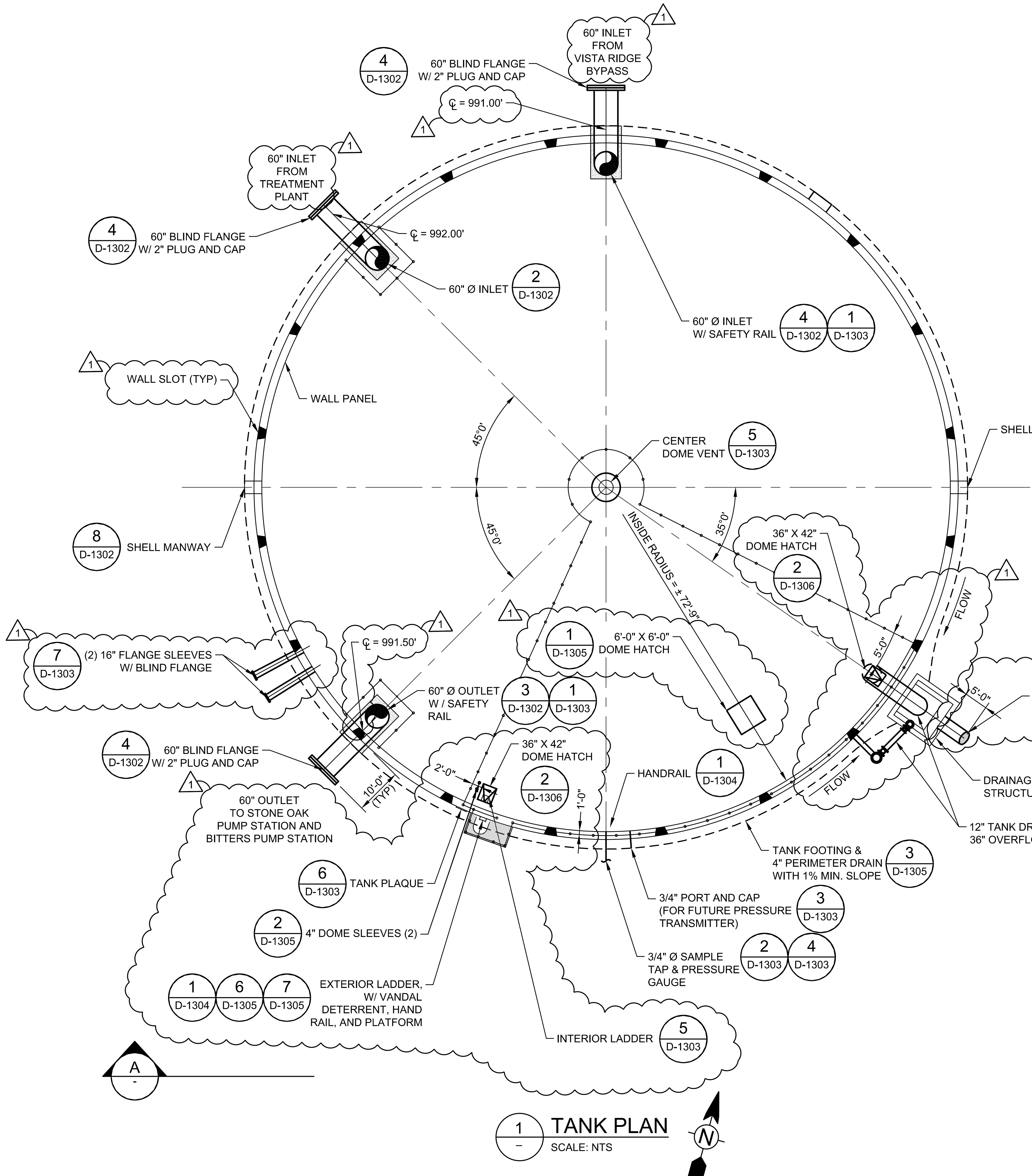
PROJ:	200-09308-18001
DESN:	SD
DRWN:	AGS
CHKD:	EHJ

S-1301

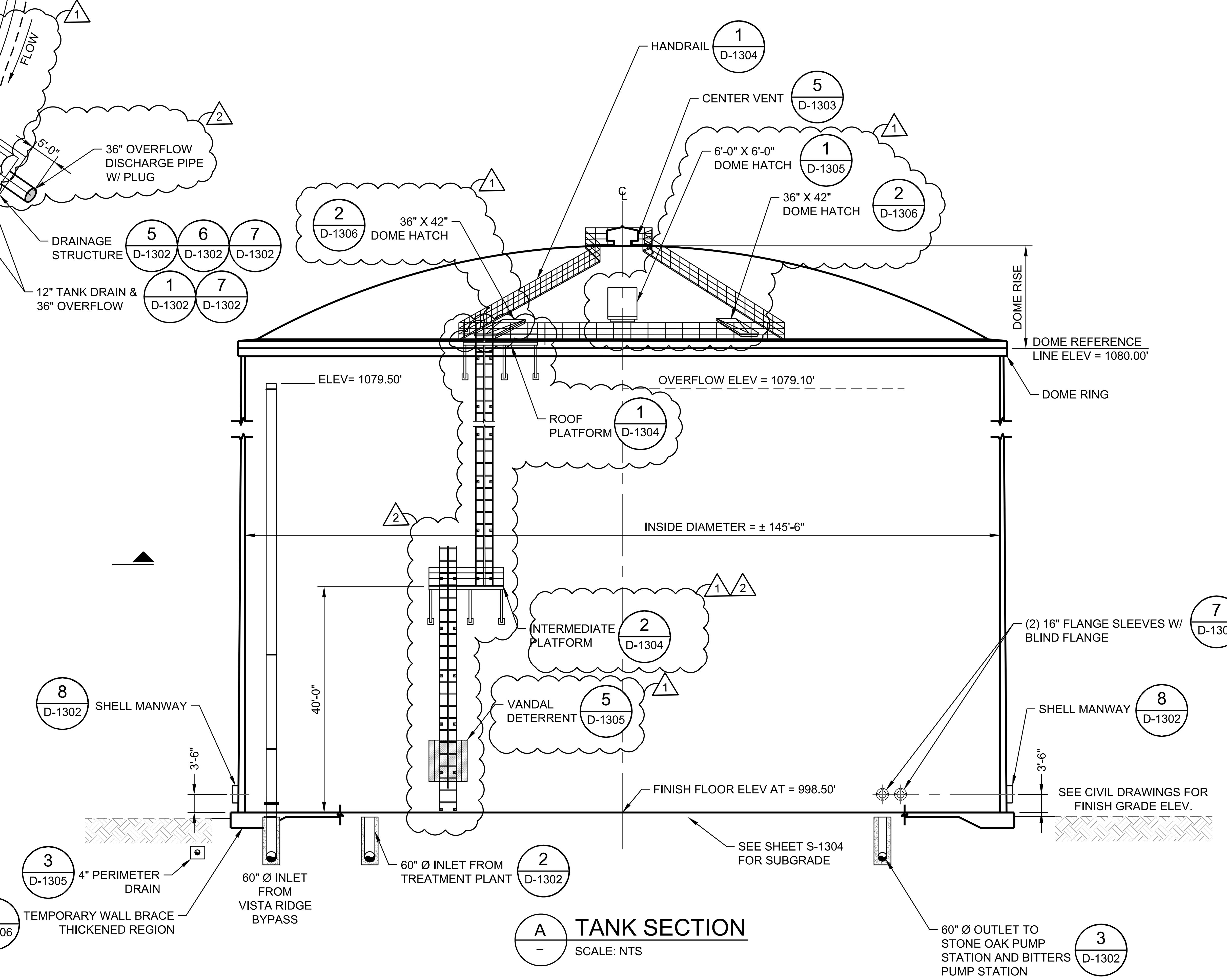
STATE OF TEXAS
ERIC H. JAHELKA
109207
LICENSED PROFESSIONAL ENGINEER
22 MARCH, 2018

3/22/2018 5:35:44 PM A360://200-09308-18001 CWIPP/09308-01-03-GST-S-2017.rvt

Bar measures 1 inch, otherwise drawing is not to scale



1 TANK PLAN
SCALE: NTS



A TANK SECTION
SCALE: NTS

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www.tetratech.com
700 N. St Mary's, Suite 300
San Antonio, TX 78205
Ph (210) 299-7900 Fax (210) 226-8497

BID SET

SAN ANTONIO WATER SYSTEM

MARK	DATE	DESCRIPTION	BY
1	03/20/18	PER ADDENDUM #2	LM
2	03/22/18	PER ADDENDUM #3	DA

SAN ANTONIO WATER SYSTEM
CENTRAL WATER INTEGRATION PIPELINE
TERMINUS TANK PROJECT

TERMINUS SITE GROUND STORAGE TANK PLAN & SECTION

STATE OF TEXAS
JAIME R. KYPUROS JR.
93790
LICENSED PROFESSIONAL ENGINEER

Jaime R. Kypuros Jr.
3/22/2018

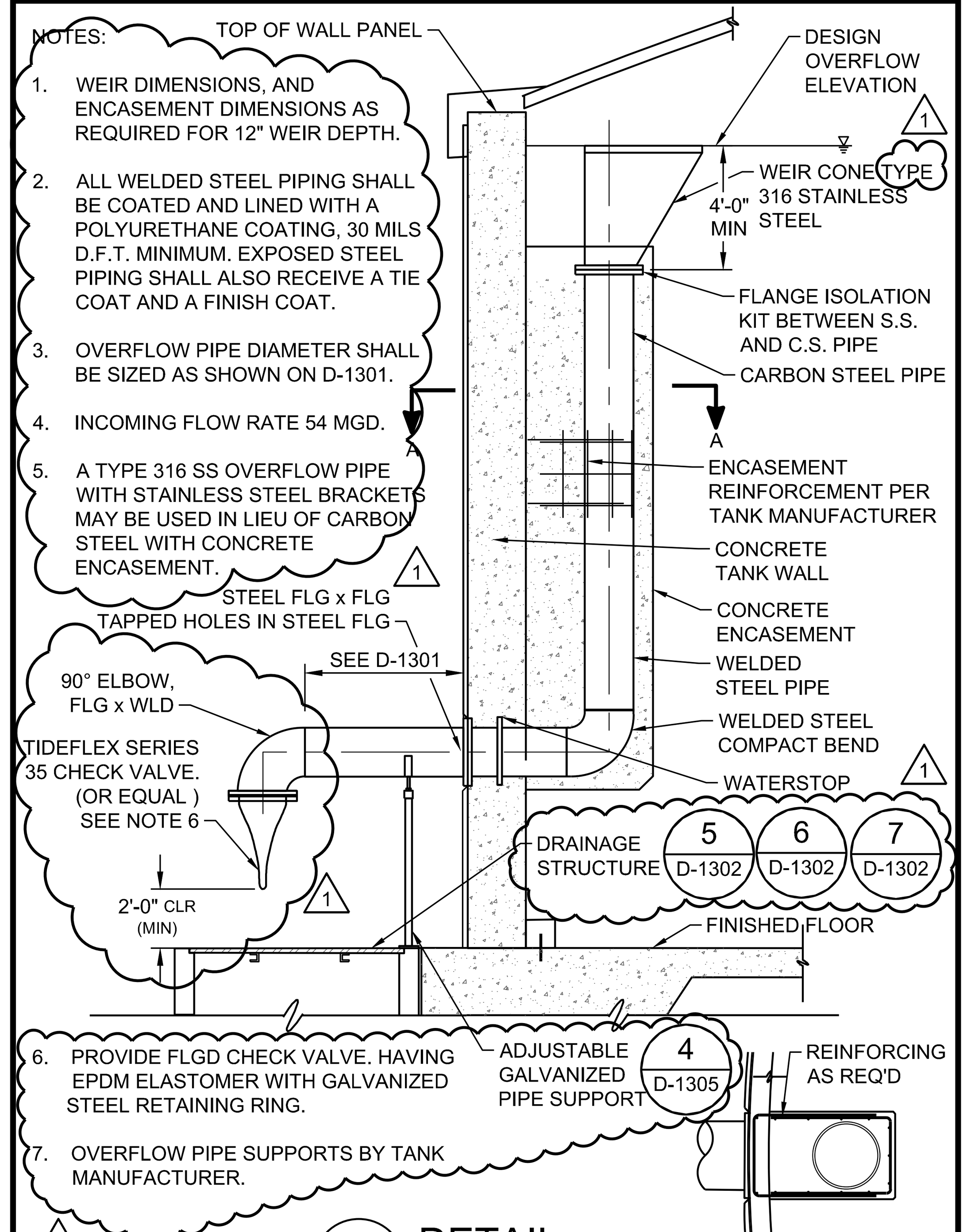
PROJ:	200-09308-18001
DESN:	BM
DRWN:	DA
CHKD:	WX

D-1301

3/22/2018 12:53:54 PM - O:\PROJECTS\ORLANDO\IER\09308\200-09308-18001-B\CAD\SHEETFILES\TERMINUS_TANK\D-1301 GST PLAN & ELEV.DWG - ANDERSON, DEBORAH

Bar measures 1 inch, otherwise drawing is not to scale

OVERFLOW PIPE

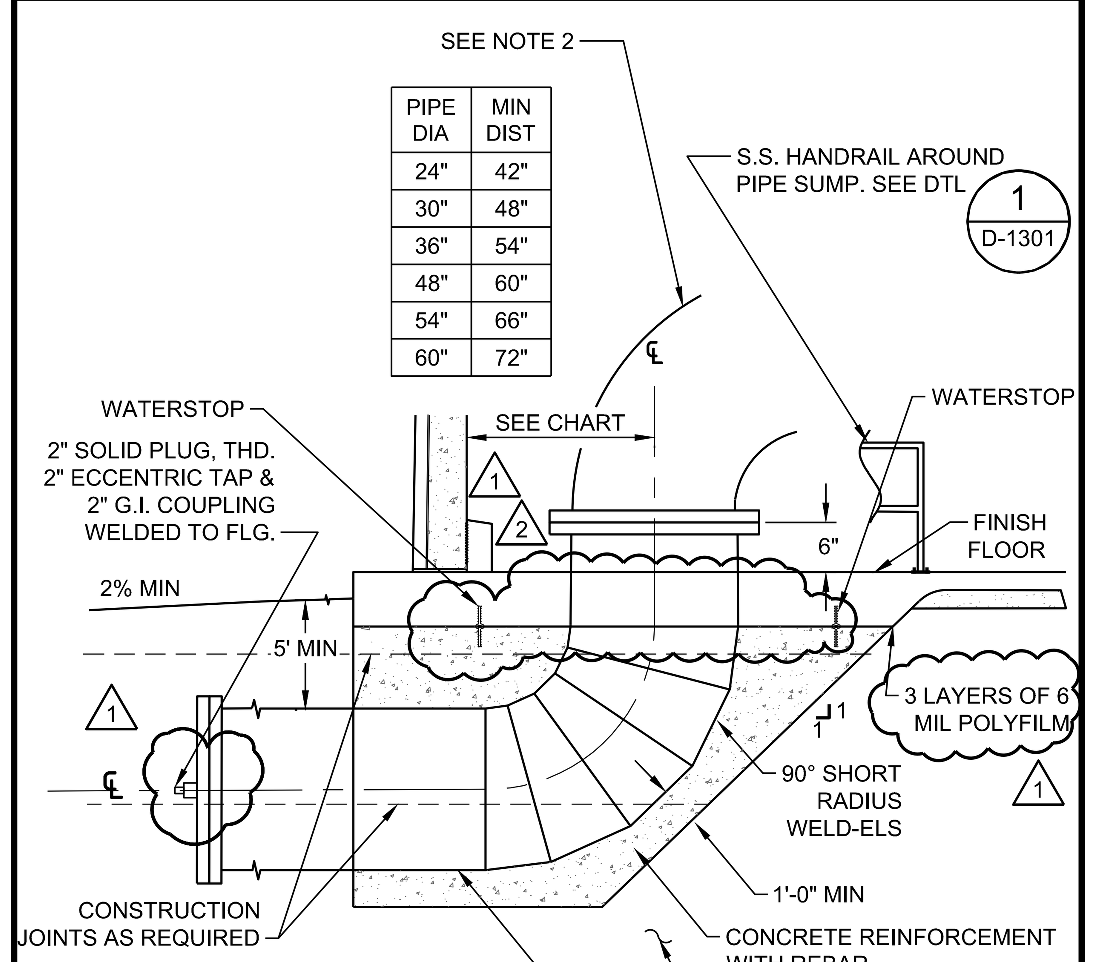


NOTES:

1. WEIR DIMENSIONS, AND ENCASEMENT DIMENSIONS AS REQUIRED FOR 12" WEIR DEPTH.
2. ALL WELDED STEEL PIPING SHALL BE COATED AND LINED WITH A POLYURETHANE COATING, 30 MILS D.F.T. MINIMUM. EXPOSED STEEL PIPING SHALL ALSO RECEIVE A TIE COAT AND A FINISH COAT.
3. OVERFLOW PIPE DIAMETER SHALL BE SIZED AS SHOWN ON D-1301.
4. INCOMING FLOW RATE 54 MGD.
5. A TYPE 316 SS OVERFLOW PIPE WITH STAINLESS STEEL BRACKETS MAY BE USED IN LIEU OF CARBON STEEL WITH CONCRETE ENCASEMENT.
6. PROVIDE FLGD CHECK VALVE. HAVING EPDM ELASTOMER WITH GALVANIZED STEEL RETAINING RING.
7. OVERFLOW PIPE SUPPORTS BY TANK MANUFACTURER.

1 DETAIL
SCALE: NTS

TANK FLOOR INLET



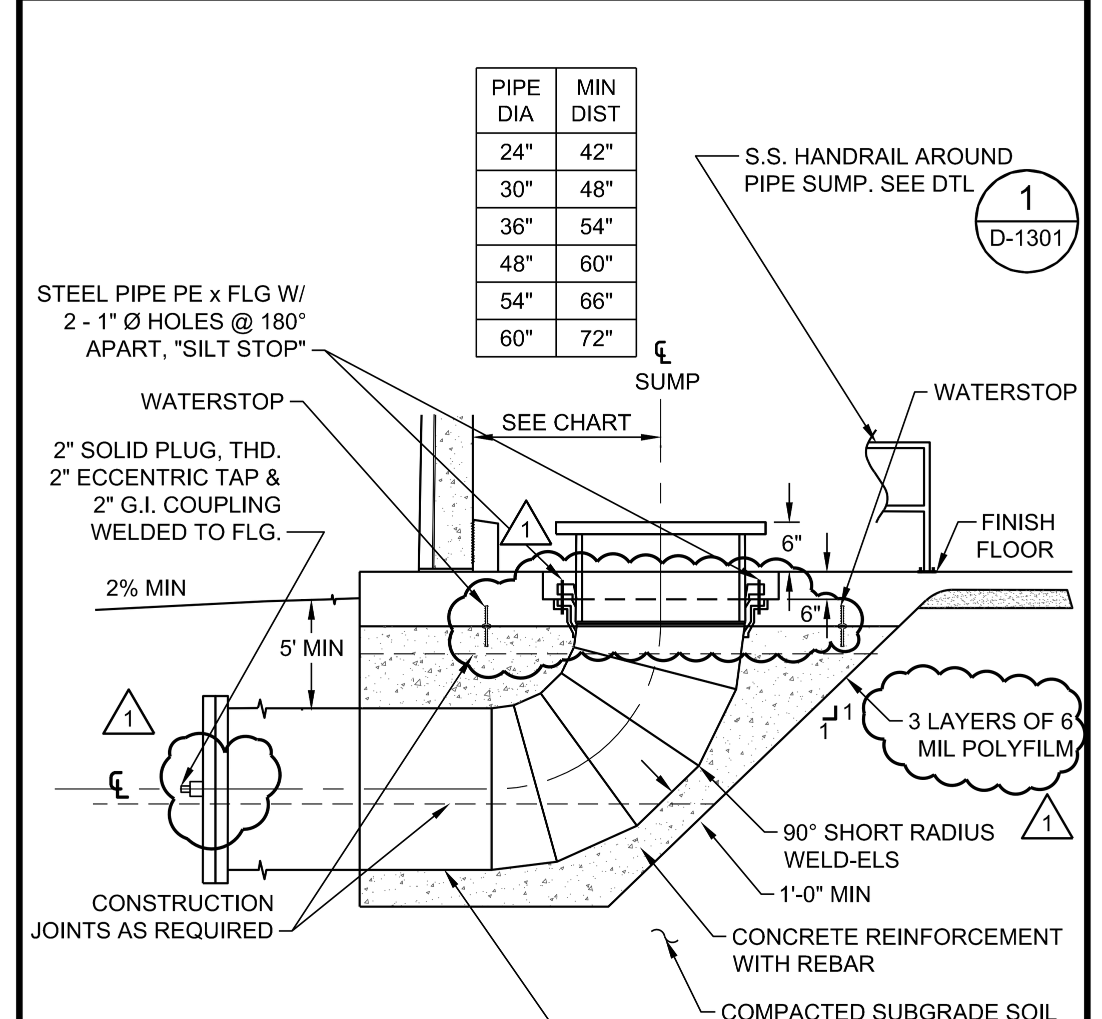
PIPE DIA	MIN DIST
24"	42"
30"	48"
36"	54"
48"	60"
54"	66"
60"	72"

NOTE:

1. ALL PIPING INSIDE THE TANK (THAT IS NOT ENCASED) SHALL BE TYPE 316L STAINLESS STEEL.
2. TO MAXIMIZE CIRCULATION TANK MANUFACTURER SHALL USE COMPUTATIONAL FLUID DYNAMICS (CFD) TO DETERMINE ANGLED FITTING THAT IS REQUIRED. FITTING SHALL BE TYPE 316L SS.
3. PROVIDE TEMPORARY PRESSURE TEST CAP.

2 DETAIL
SCALE: NTS

TANK FLOOR OUTLET



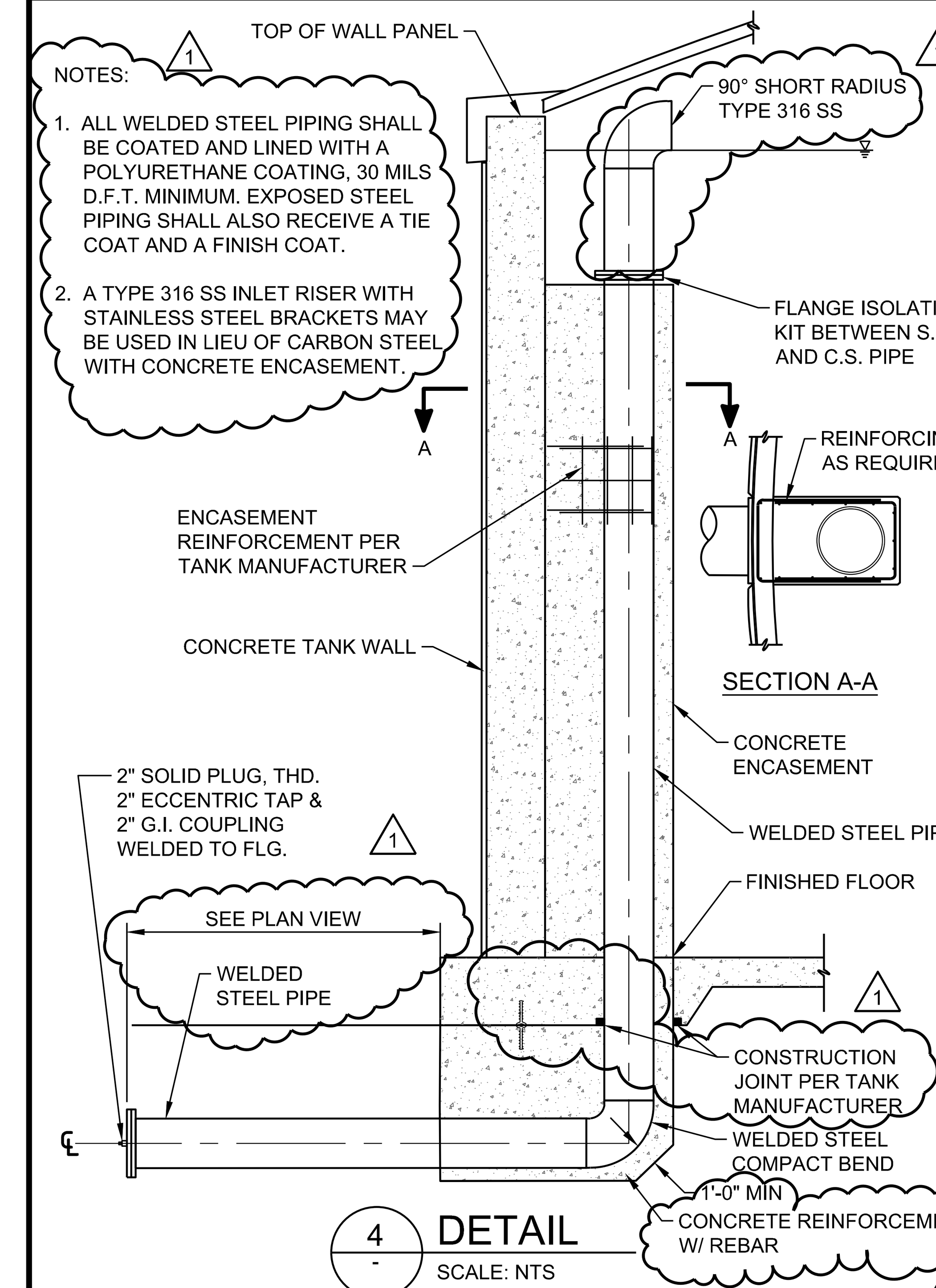
PIPE DIA	MIN DIST
24"	42"
30"	48"
36"	54"
48"	60"
54"	66"
60"	72"

NOTE:

1. ALL PIPING INSIDE THE TANK (THAT IS NOT ENCASED) SHALL BE TYPE 316L STAINLESS STEEL.
2. PROVIDE TEMPORARY PRESSURE TEST CAP.

3 DETAIL
SCALE: NTS

VISTA RIDGE BY-PASS INLET

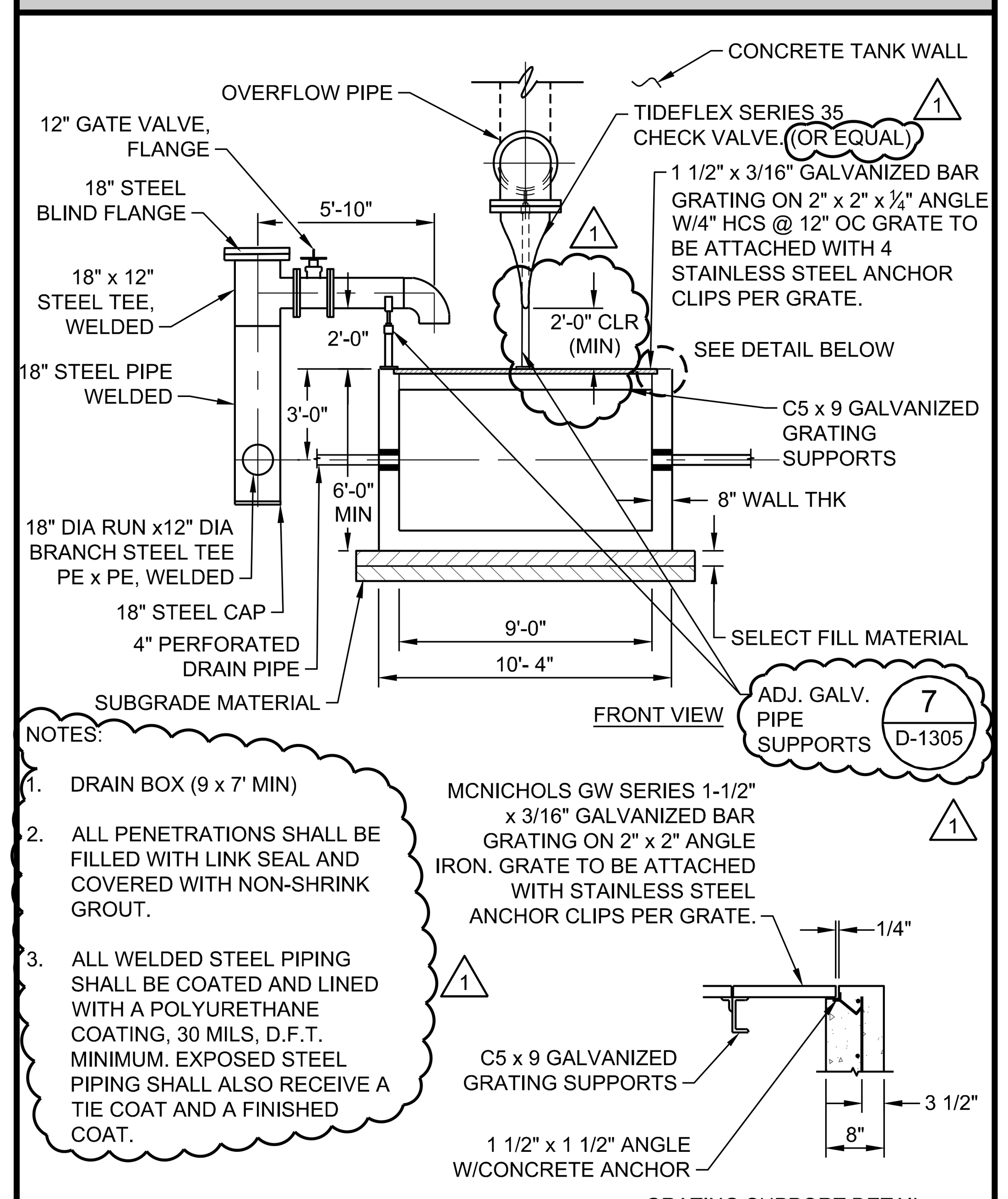


NOTES:

1. ALL WELDED STEEL PIPING SHALL BE COATED AND LINED WITH A POLYURETHANE COATING, 30 MILS D.F.T. MINIMUM. EXPOSED STEEL PIPING SHALL ALSO RECEIVE A TIE COAT AND A FINISH COAT.
2. A TYPE 316 SS INLET RISER WITH STAINLESS STEEL BRACKETS MAY BE USED IN LIEU OF CARBON STEEL WITH CONCRETE ENCASEMENT.

4 DETAIL
SCALE: NTS

DRAINAGE STRUCTURE - FRONT VIEW

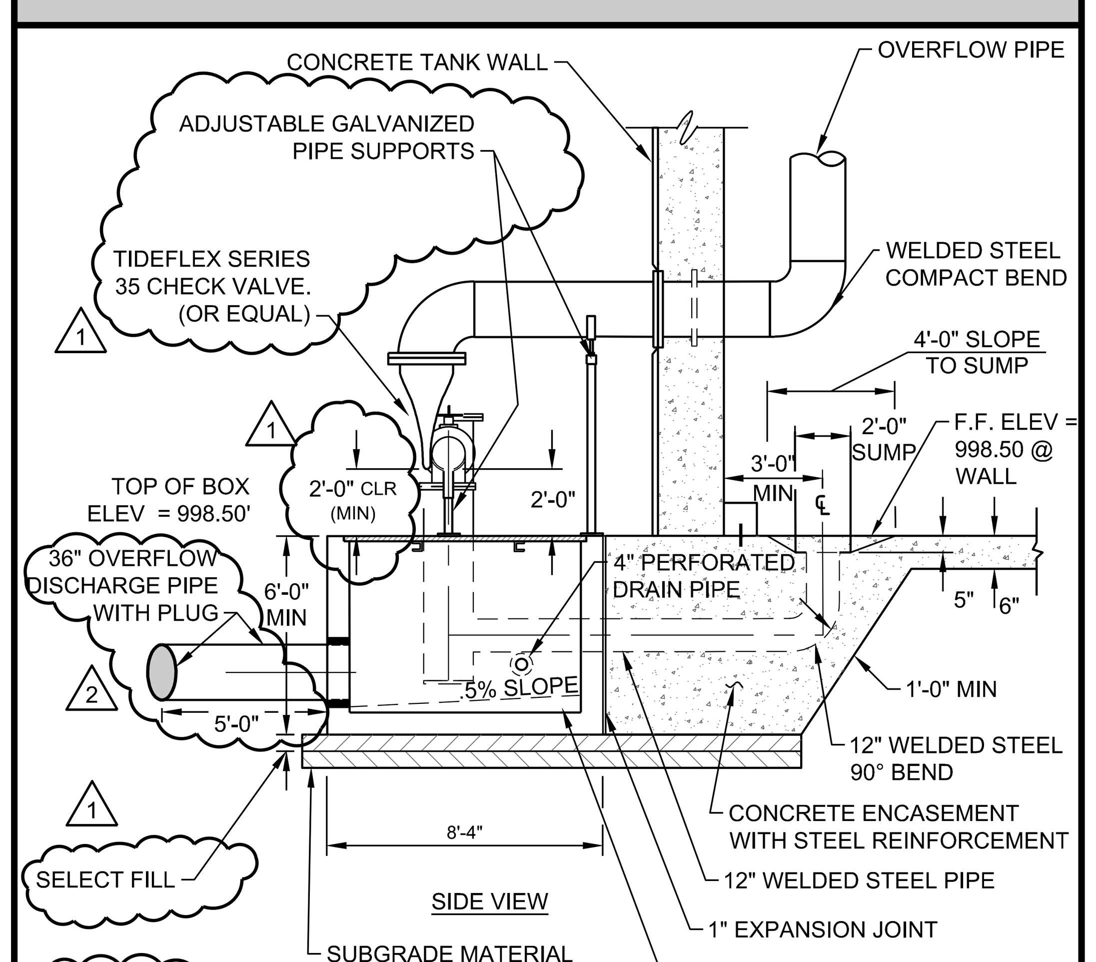


NOTES:

1. DRAIN BOX (9 x 7' MIN)
2. ALL PENETRATIONS SHALL BE FILLED WITH LINK SEAL AND COVERED WITH NON-SHRINK GROUT.
3. ALL WELDED STEEL PIPING SHALL BE COATED AND LINED WITH A POLYURETHANE COATING, 30 MILS, D.F.T. MINIMUM. EXPOSED STEEL PIPING SHALL ALSO RECEIVE A TIE COAT AND A FINISHED COAT.

5 DETAIL
SCALE: NTS

DRAINAGE STRUCTURE - SIDE VIEW

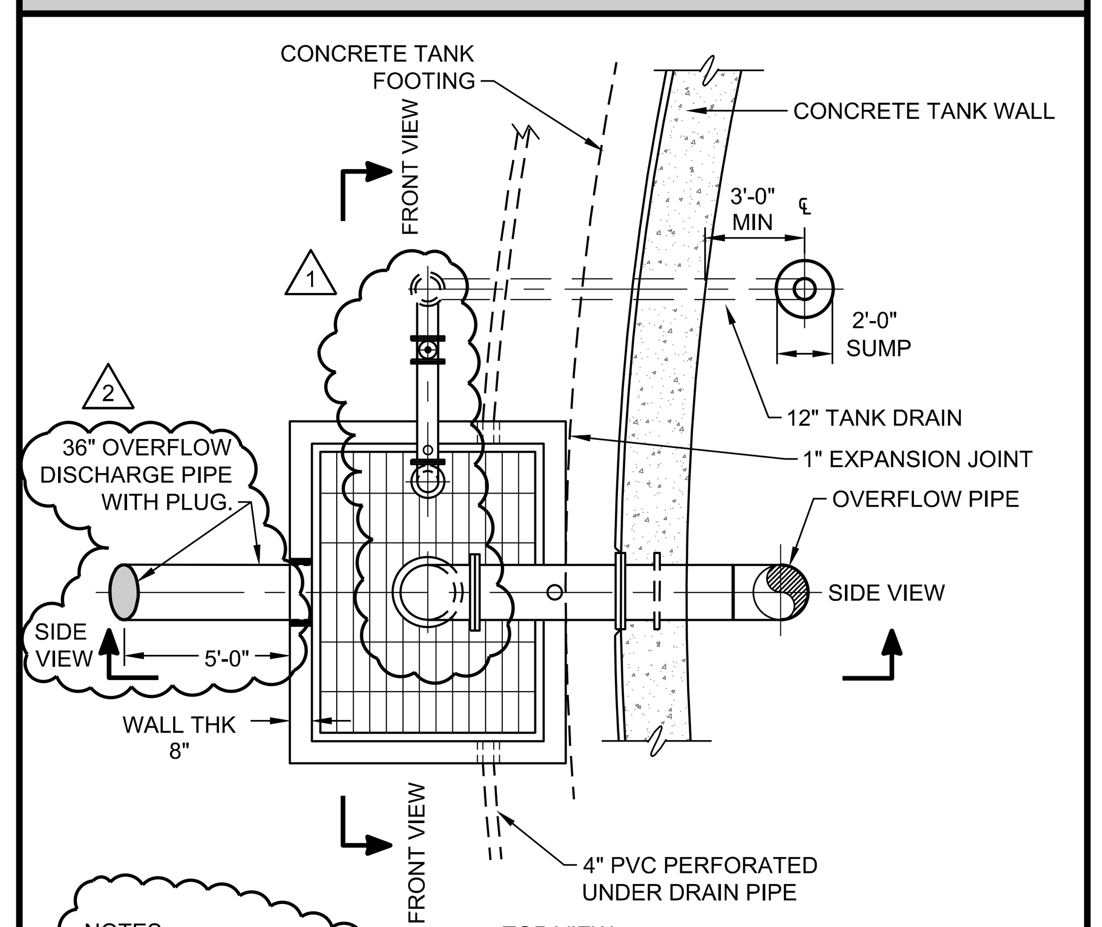


NOTES:

1. DRAIN BOX (9 x 7' MIN)
2. DRAINAGE BOX STRUCTURE SIZED AS PER INFLOW AND OUTFLOW CAPACITY CALCULATIONS
3. ALL PENETRATIONS SHALL BE FILLED WITH LINK SEAL AND COVERED WITH NON-SHRINK GROUT.
4. ALL WELDED STEEL PIPING SHALL BE COATED AND LINED WITH A POLYURETHANE COATING, 30 MILS, D.F.T. MINIMUM. EXPOSED STEEL PIPING SHALL ALSO RECEIVE A TIE COAT AND A FINISHED COAT.
5. ALL EXPOSED PIPING SHALL BE TYPE 316L STAINLESS STEEL. ALL PIPE ENCASED IN CONCRETE SHALL BE CARBON STEEL.

6 DETAIL
SCALE: NTS

DRAINAGE STRUCTURE - PLAN VIEW

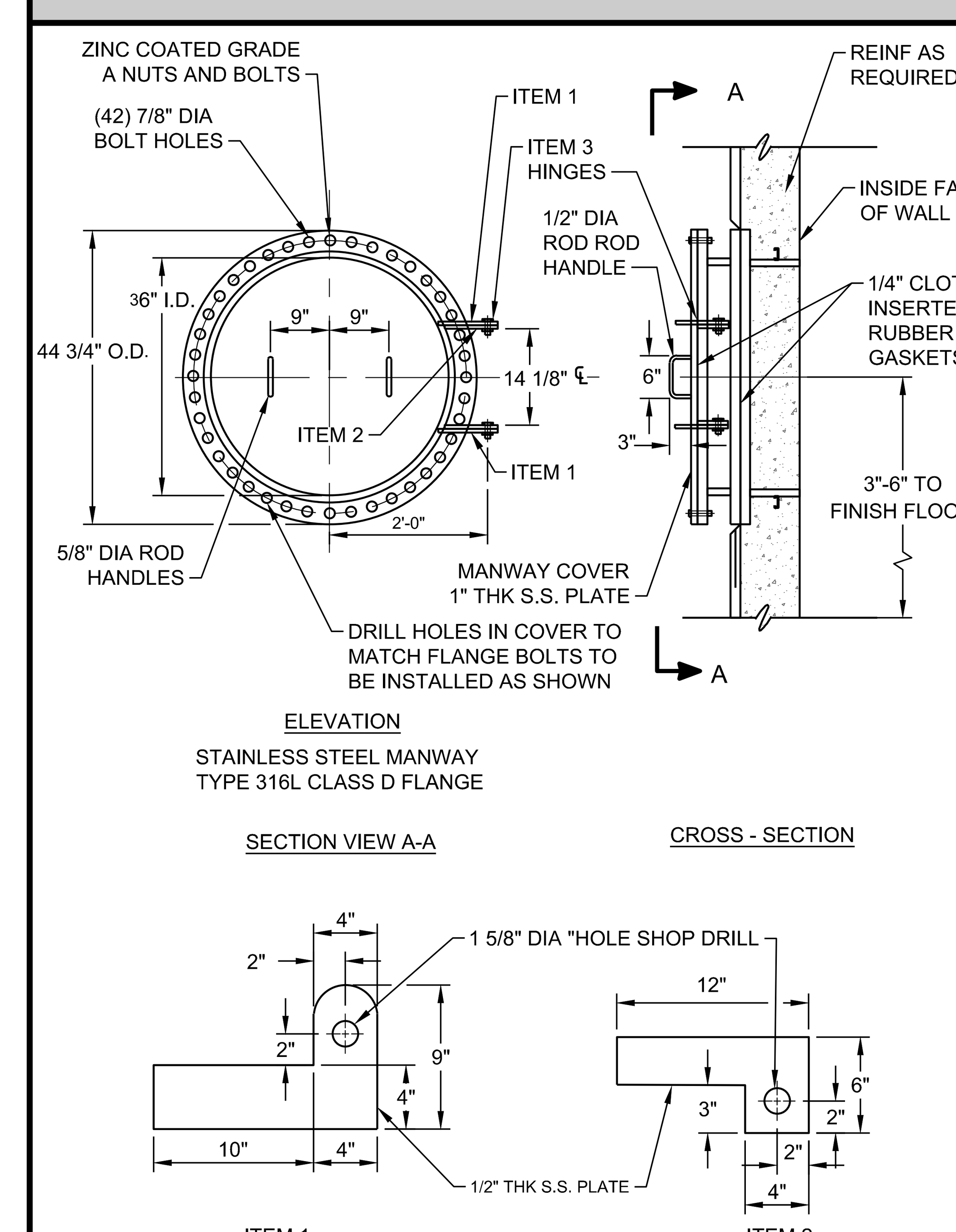


NOTES:

1. DRAIN BOX (9' x 7' MIN)
2. ALL PENETRATIONS SHALL BE FILLED WITH LINK SEAL AND COVERED WITH NON-SHRINK GROUT.
3. ALL WELDED STEEL PIPING SHALL BE COATED AND LINED WITH A POLYURETHANE COATING, 30 MILS D.F.T. MINIMUM. EXPOSED STEEL PIPING SHALL ALSO RECEIVE A TIE COAT AND A FINISHED COAT.

7 DETAIL
SCALE: NTS

36" SHELL MANWAY



8 DETAIL
SCALE: NTS

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BID SET

SAN ANTONIO WATER SYSTEM

MARK	DATE	DESCRIPTION	BY
1	03/20/18	PER ADDENDUM # 2	LM
2	03/22/18	PER ADDENDUM # 3	LM

SAN ANTONIO WATER SYSTEM
CENTRAL WATER INTEGRATION PIPELINE
TERMINUS TANK PROJECT
TERMINUS SITE
GROUND STORAGE TANK
DETAILS I

STATE OF TEXAS
JAIME R. KYPUROS JR.
93790
LICENSED PROFESSIONAL ENGINEER
3/22/2018

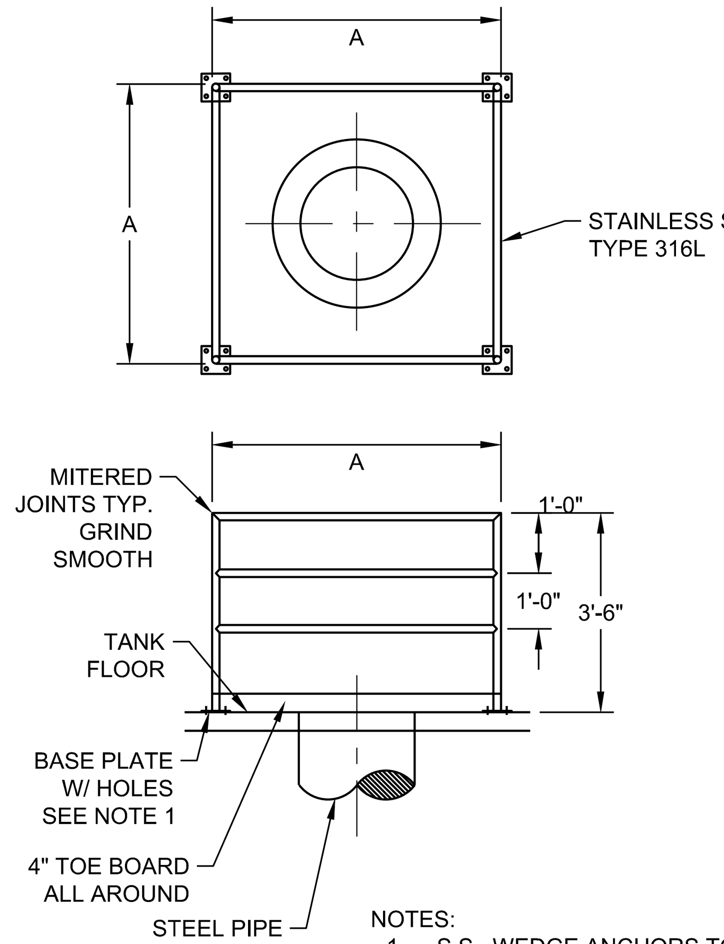
PROJ:	200-09308-18001
DESN:	BM
DRWN:	DA
CHKD:	WX

D-1302

Bar measures 1 inch, otherwise drawing is not to scale

3/22/2018 5:28:57 PM - O:\PROJECTS\ORLANDO\IER\09308\200-09308-18001-B\CAD\SHEETFILES\TERMINUS_TANK\D-1302 GST DETAILS I.DWG - MARTINEZ, LORENZO

PIPE SAFETY RAILING

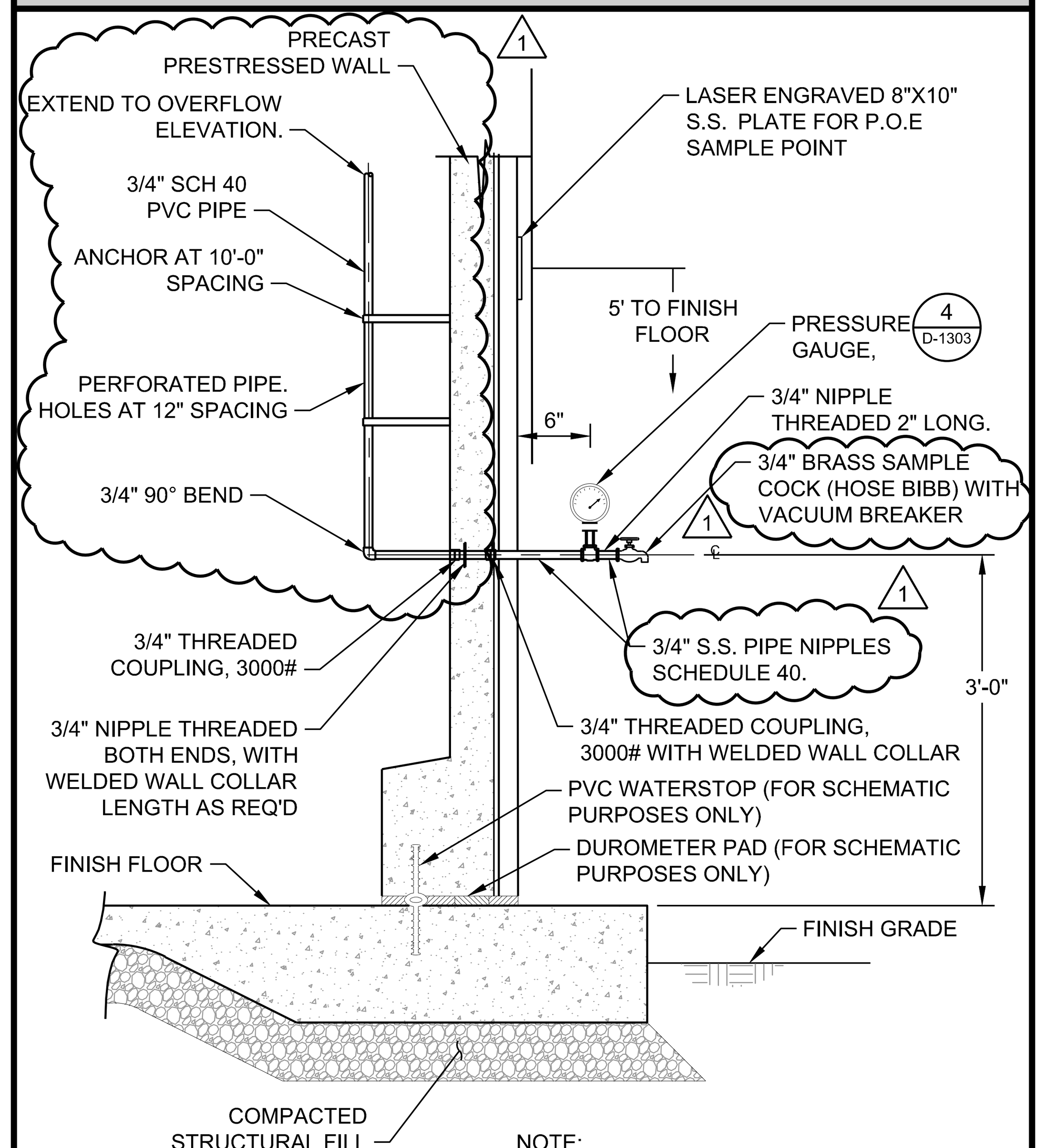


PIPE DIA.	A
20"	42"
24"	48"
30"	54"
36"	60"
42"	66"
48"	72"
54"	78"
60"	84"

NOTES:
1. S.S. WEDGE ANCHORS TO BE USED TO CONNECT HANDRAIL BASE PLATES TO THE TANK FLOOR.
2. ALL S.S. TO BE ISOLATED FROM CONCRETE USING NEOPRENE GASKETS.
3. TOE BOARD TO BE PROVIDED ON ALL SIDES OF PIPE.
4. REMOVABLE RAILING. ONE SIDE OF RAILING SHALL BE REMOVABLE FOR MAINTENANCE.

1 DETAIL
SCALE: NTS

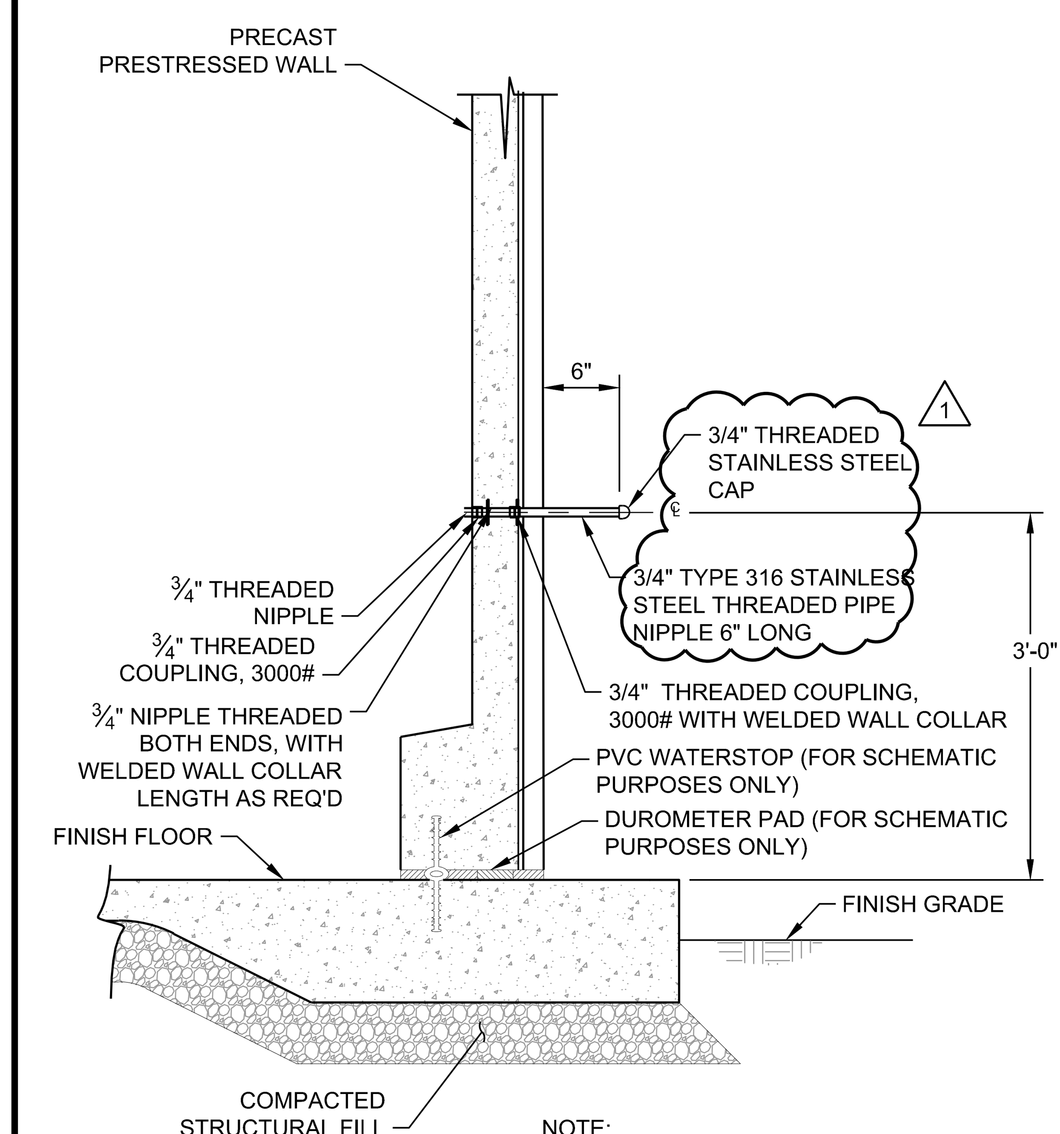
WATER SAMPLE LINE



NOTE:
PROVIDE PIPING INSULATION

2 DETAIL
SCALE: NTS

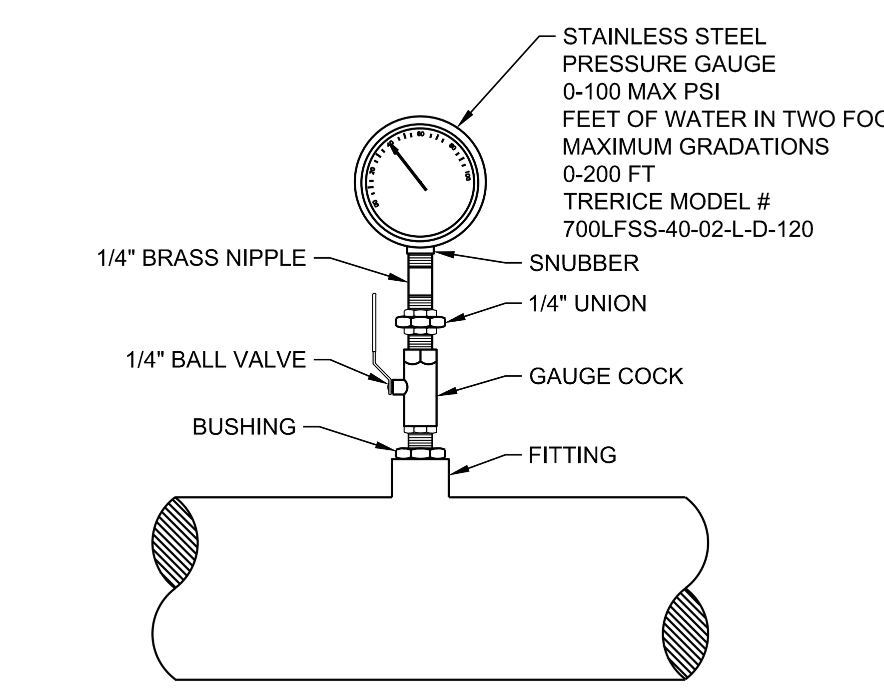
3/4" PORT AND CAP



NOTE:
PROVIDE PIPING INSULATION

3 DETAIL
SCALE: NTS

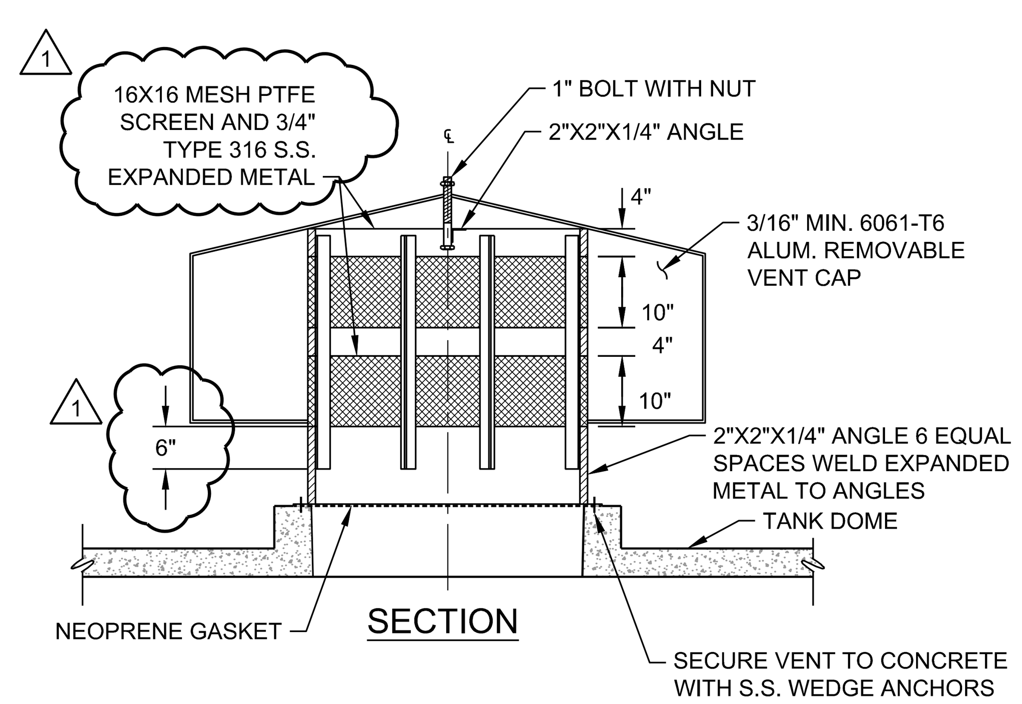
PRESSURE GAUGE

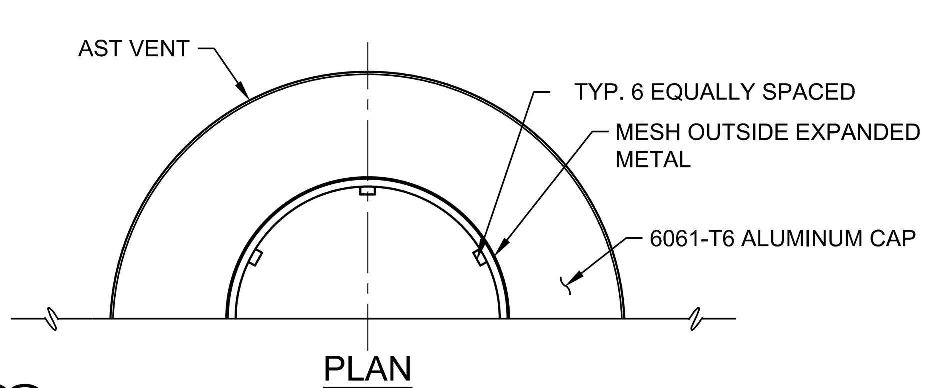


NOTES:
1. ALL GAUGES TO BE GLYCOL FILLED AT A 4" MIN.
2. ALL GAUGES MUST READ PRESSURE IN POUNDS PER SQUARE INCH (PSI) AND FEET OF WATER.

4 DETAIL
SCALE: NTS

CENTER VENT

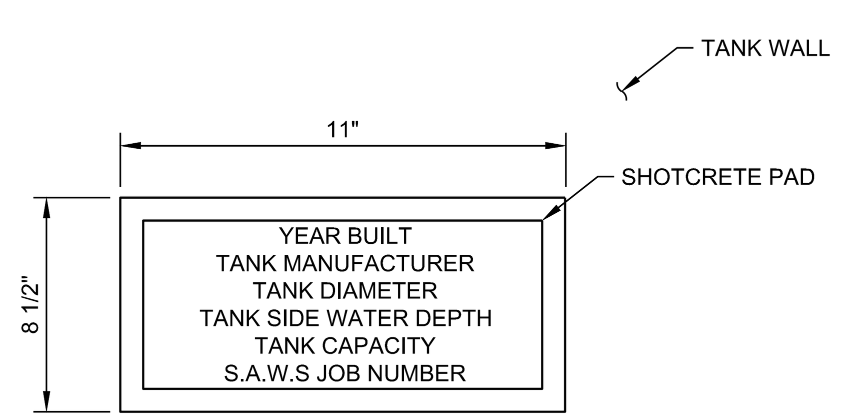




NOTE:
VENT SIZE AS REQUIRED BY DESIGN. AST VENT ONLY. (ALWAYS SAFE TANK VENT)

5 DETAIL
SCALE: NTS

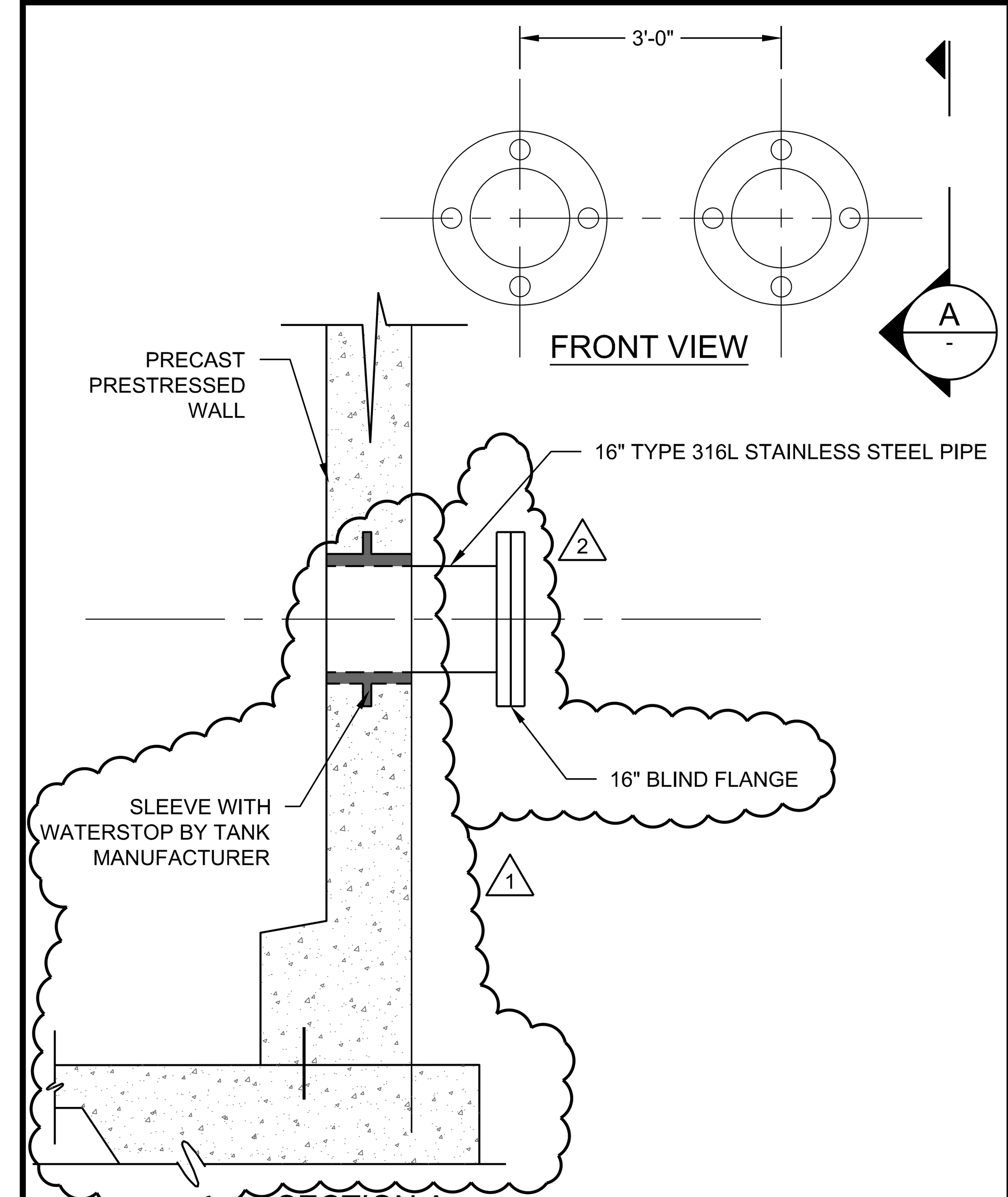
TANK PLAQUE



NOTES:
1. PLAQUE MOUNTED TO SHOTCRETE PAD LOCATED ADJACENT TO EXTERIOR LADDER OR MANWAY.
2. PLAQUE MUST BE 24 GAUGE BRONZE WITH RAISED LETTERS.

6 DETAIL
SCALE: NTS

16" FLANGED SLEEVE W/ BLIND FLANGE



7 DETAIL
SCALE: NTS

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BID SET

SAN ANTONIO WATER SYSTEM

MARK	DATE	DESCRIPTION	BY
1	03/20/18	PER ADDENDUM # 2	LM
2	03/22/18	PER ADDENDUM # 3	LM

SAN ANTONIO WATER SYSTEM
CENTRAL WATER INTEGRATION PIPELINE
TERMINUS TANK PROJECT
TERMINUS SITE
GROUND STORAGE TANK
DETAILS II

PROJ:	200-09308-18001
DESN:	BM
DRWN:	DA
CHKD:	WX

STATE OF TEXAS
JAIME R. KYPUROS JR.
93790
LICENSED
PROFESSIONAL ENGINEER
3/22/2018

D-1303

Bar measures 1 inch, otherwise drawing is not to scale

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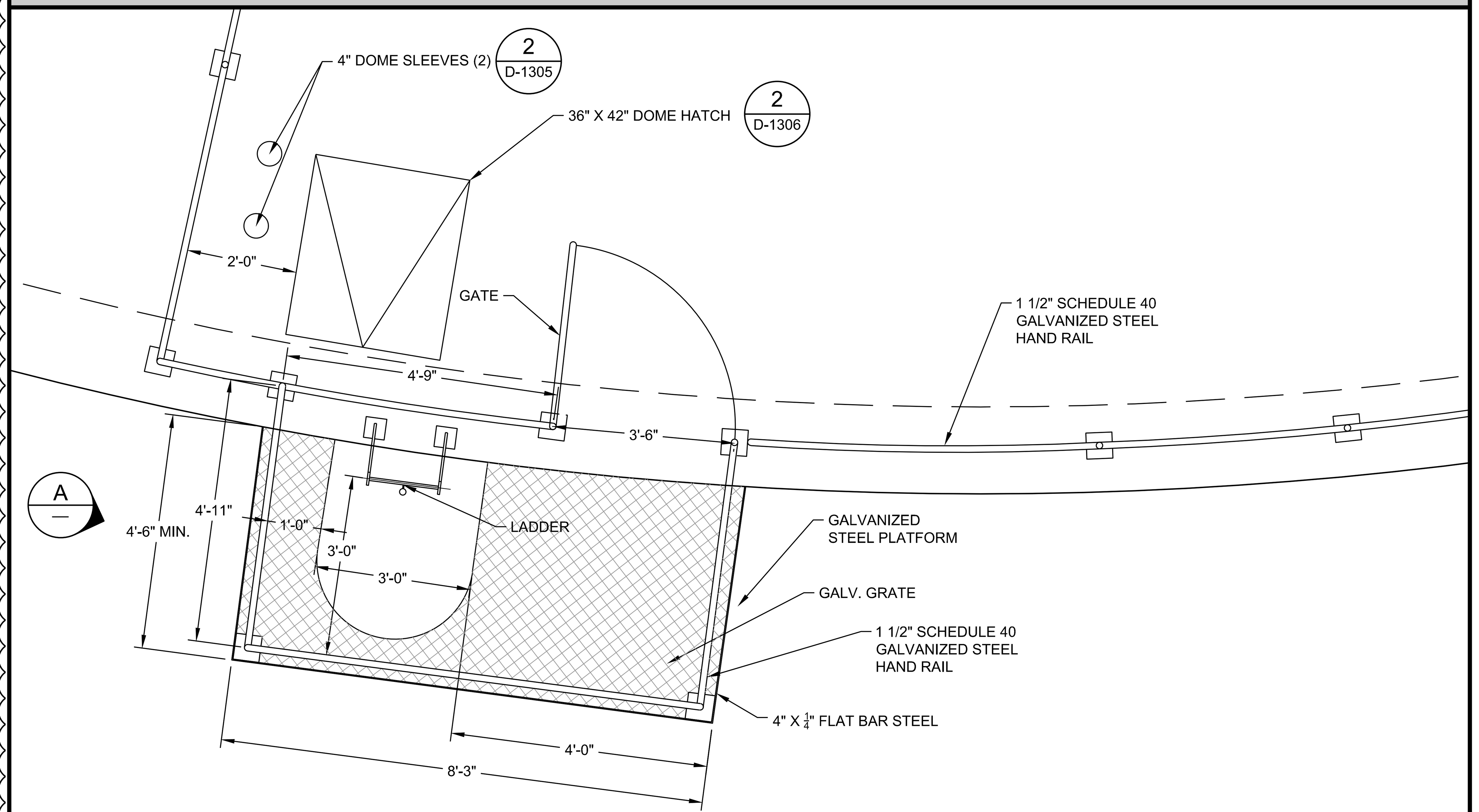
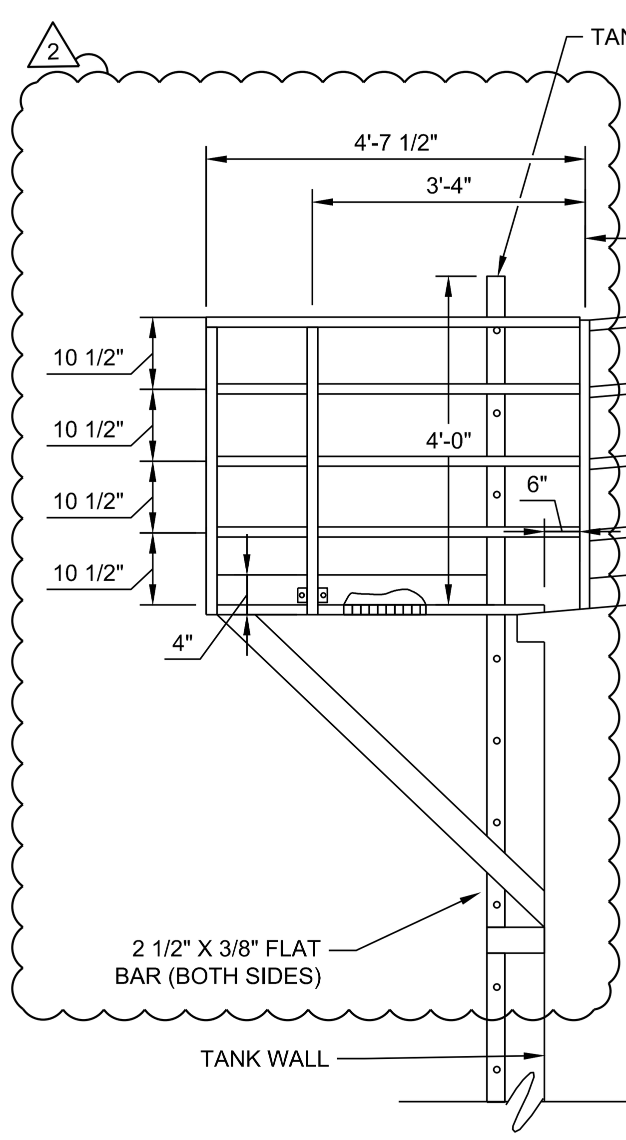
ROOF PLATFORM



PLAN VIEW

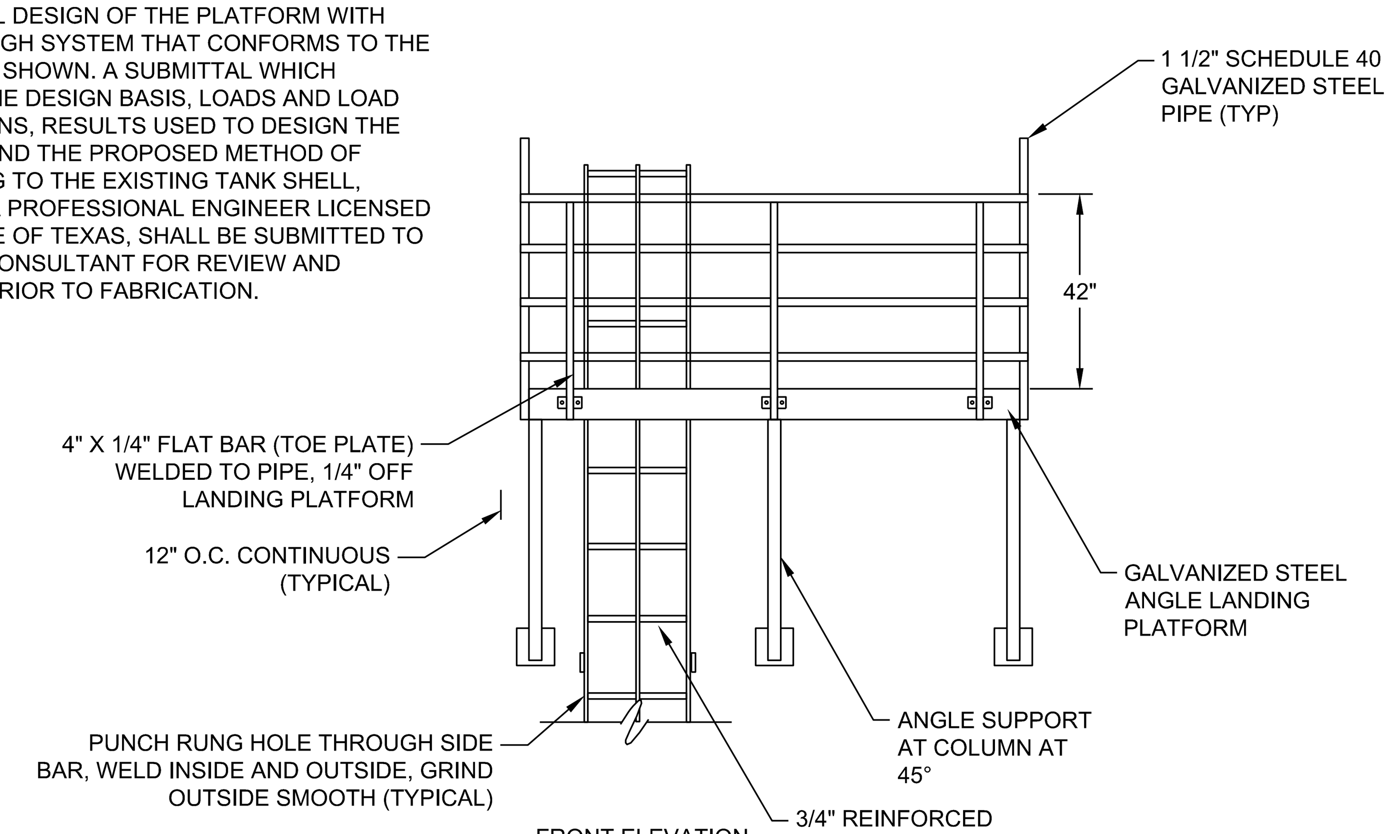


A SECTION
N.T.S

NOTES:

1. PLATFORM AND HANDRAIL SHALL BE HOT DIPPED GALVANIZED STEEL. ALL HARDWARE, BOLTS, NUTS AND HINGES SHALL BE TYPE 316 STAINLESS STEEL.
2. ALL NEW PLATFORM ADDITIONS SHALL BE SHOP PREPARED.
3. ALL WELDS TO BE CONTINUOUS FULL FILLET SEAL WELDS MINIMUM.
4. CONTRACTOR TO VERIFY ALL LENGTHS AND DIMENSIONS PRIOR TO FABRICATION.
5. PROVIDE ADEQUATE CONDUIT PENETRATION OPENINGS AT LEFT AND RIGHT OF LADDER ON NEW 1" DECKING.

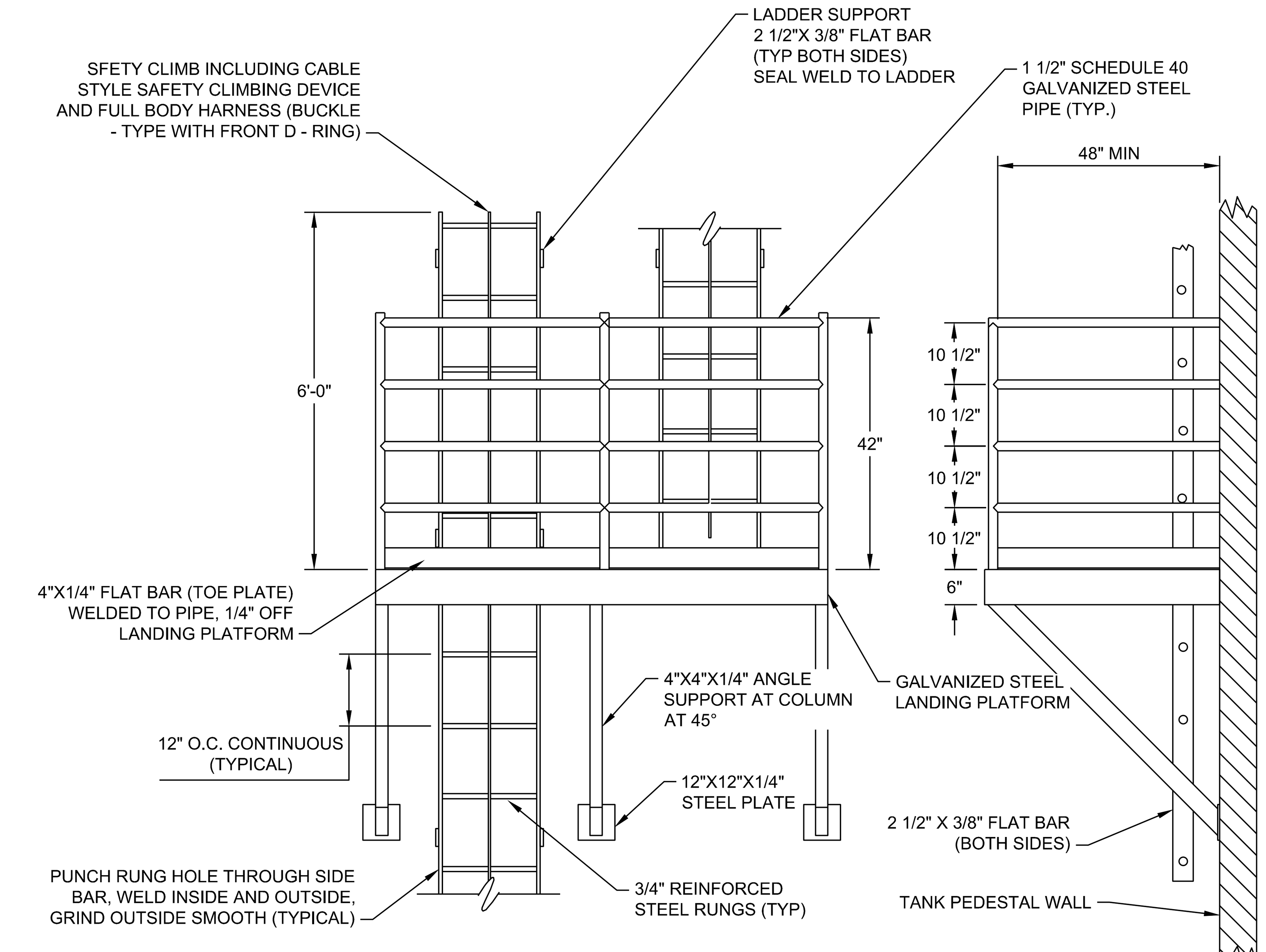
CONTRACTOR SHALL BE RESPONSIBLE FOR THE STRUCTURAL DESIGN OF THE PLATFORM WITH PASS THROUGH SYSTEM THAT CONFORMS TO THE DIMENSIONS SHOWN. A SUBMITTAL WHICH INCLUDES THE DESIGN BASIS, LOADS AND LOAD COMBINATIONS, RESULTS USED TO DESIGN THE PLATFORM AND THE PROPOSED METHOD OF CONNECTING TO THE EXISTING TANK SHELL, SEALED BY A PROFESSIONAL ENGINEER LICENSED IN THE STATE OF TEXAS, SHALL BE SUBMITTED TO SAWS AND CONSULTANT FOR REVIEW AND APPROVAL PRIOR TO FABRICATION.



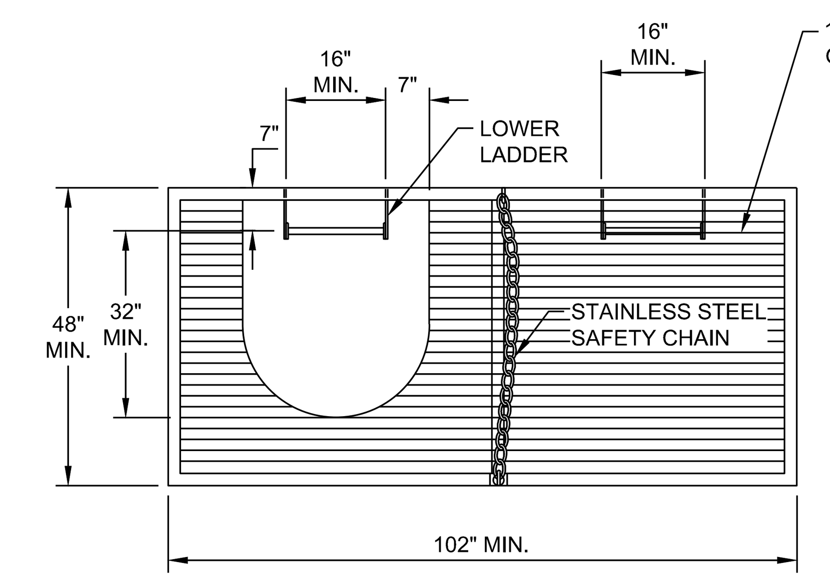
FRONT ELEVATION

1 DETAIL
N.T.S

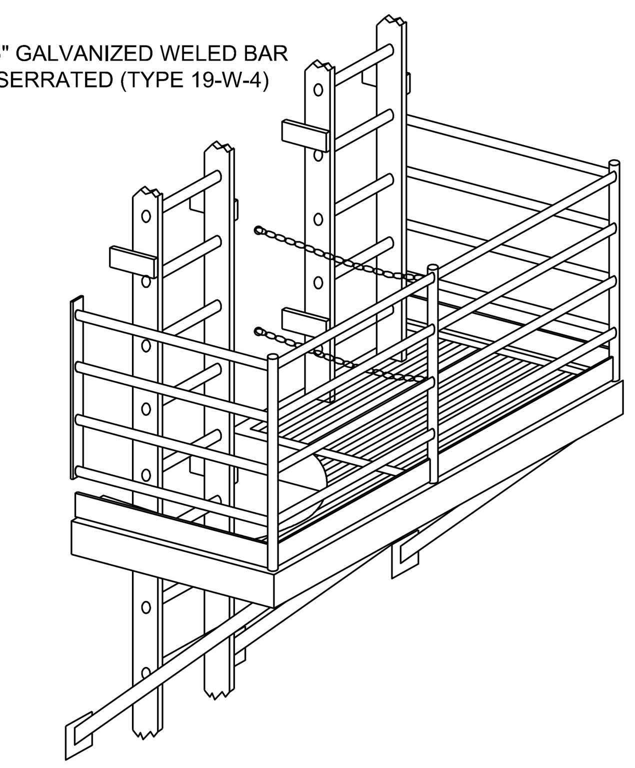
INTERMEDIATE PLATFORM



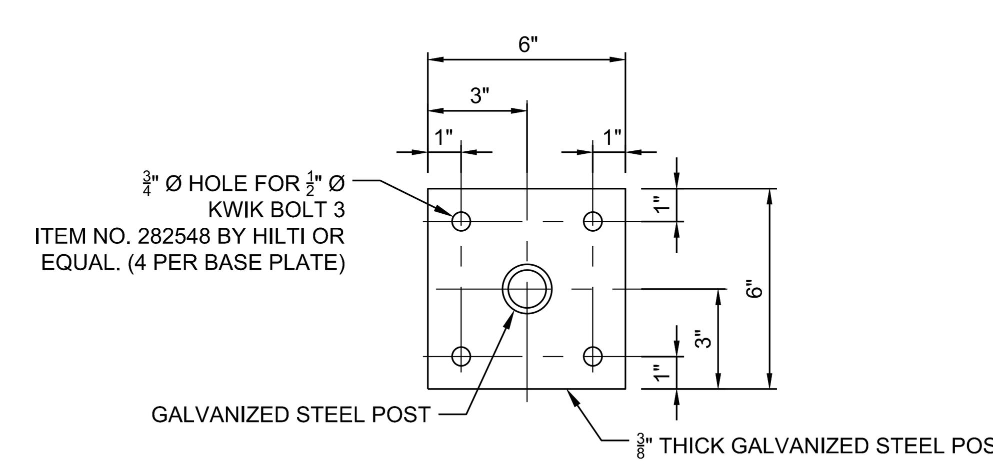
FRONT ELEVATION



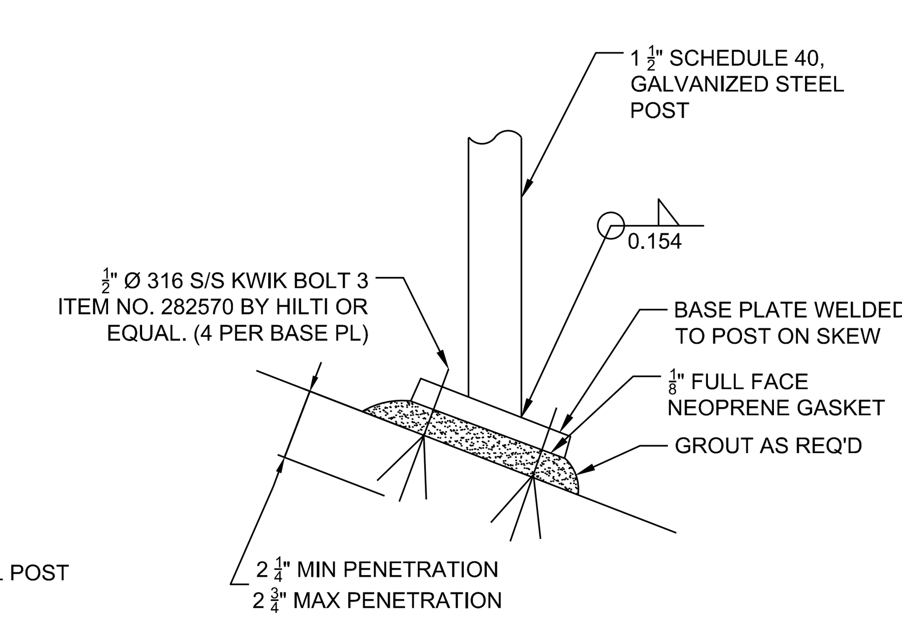
PLATFORM PLAN VIEW



2 DETAIL
SCALE: NTS



GALVANIZED STEEL PLATE DETAIL



BASE PLATE ATTACHMENT

3 DETAIL
SCALE: NTS

TETRA TECH
Texas Registration No. F-3924
www.tetratech.com
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San Antonio, TX 78205
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BID SET

SAN ANTONIO WATER SYSTEM

MARK	DATE	DESCRIPTION	BY
1	03/20/18	PER ADDENDUM #2	LM
2	03/22/18	PER ADDENDUM #3	NG

SAN ANTONIO WATER SYSTEM
CENTRAL WATER INTEGRATION PIPELINE
TERMINUS TANK PROJECT
TERMINUS SITE
GROUND STORAGE TANK
DETAILS III

STATE OF TEXAS
JAIME R. KYPUROS JR.
93790
LICENSED
PROFESSIONAL ENGINEER
3/22/2018

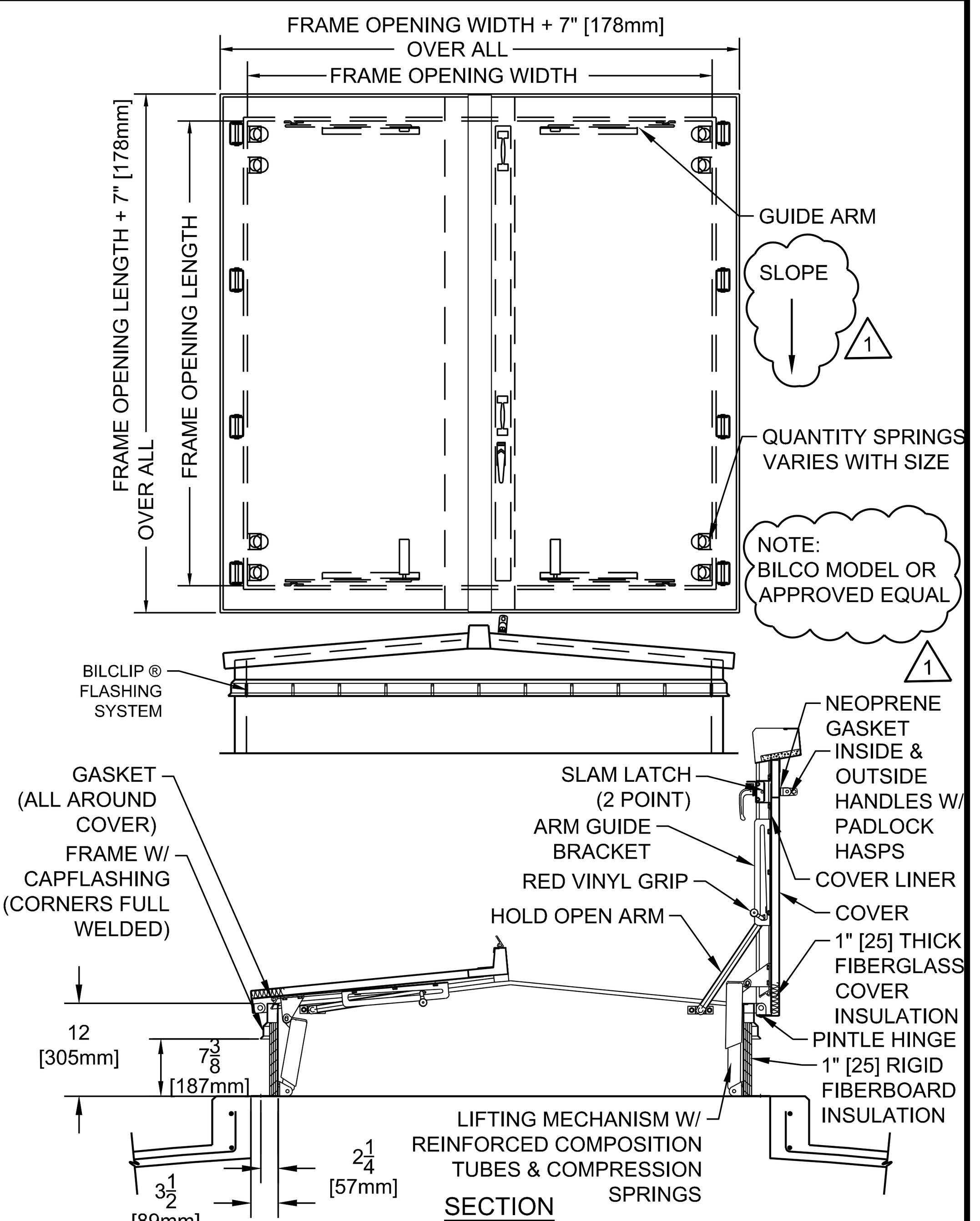
PROJ:	200-09308-18001
DESN:	BM
DRWN:	DA
CHKD:	WX

D-1304

Bar measures 1 inch, otherwise drawing is not to scale

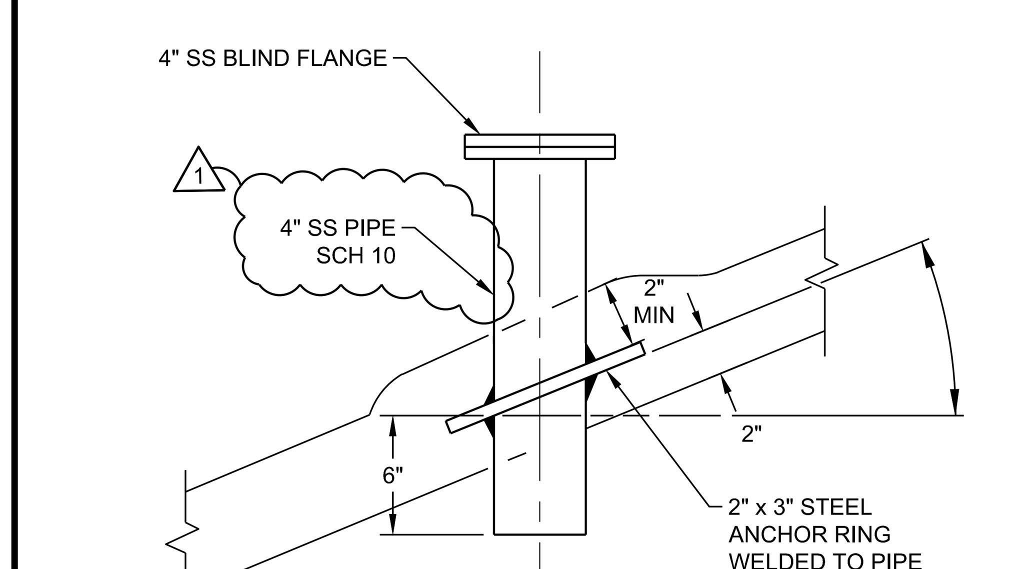
3/22/2018 1:58:24 PM - O:\PROJECTS\ORLANDO\IER\09308\200-09308-18001-B\CAD\SHEETFILES\TERMINUS_TANK\D-1304 GST DETAILS III.DWG - GARZA, NOEL

ACCESS HATCH DETAIL (6' - 0" X 6' - 0" OPENING)



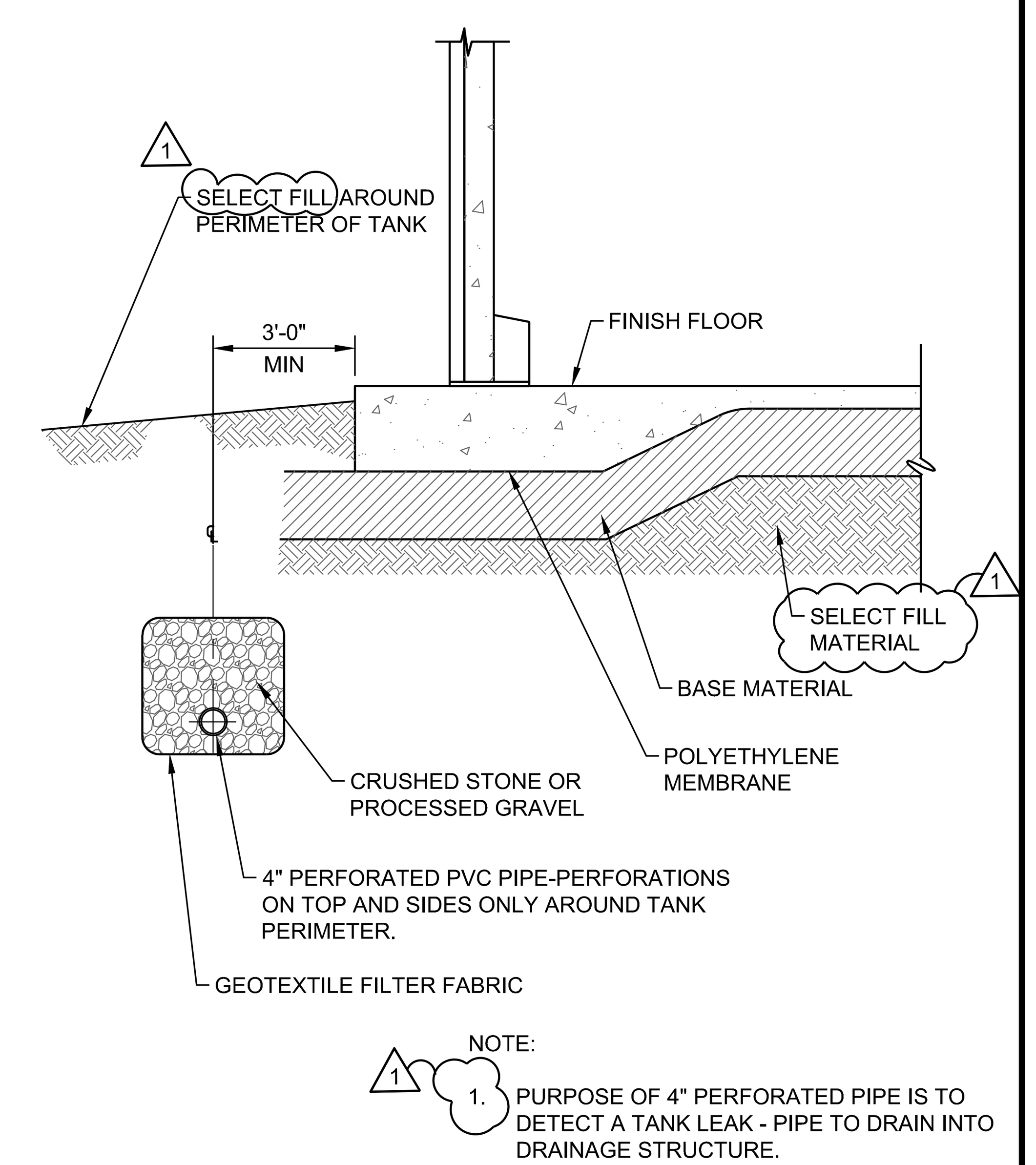
1 DETAIL
SCALE: NTS

DOME SLEEVE AT ROOF HATCH



2 DETAIL
SCALE: NTS

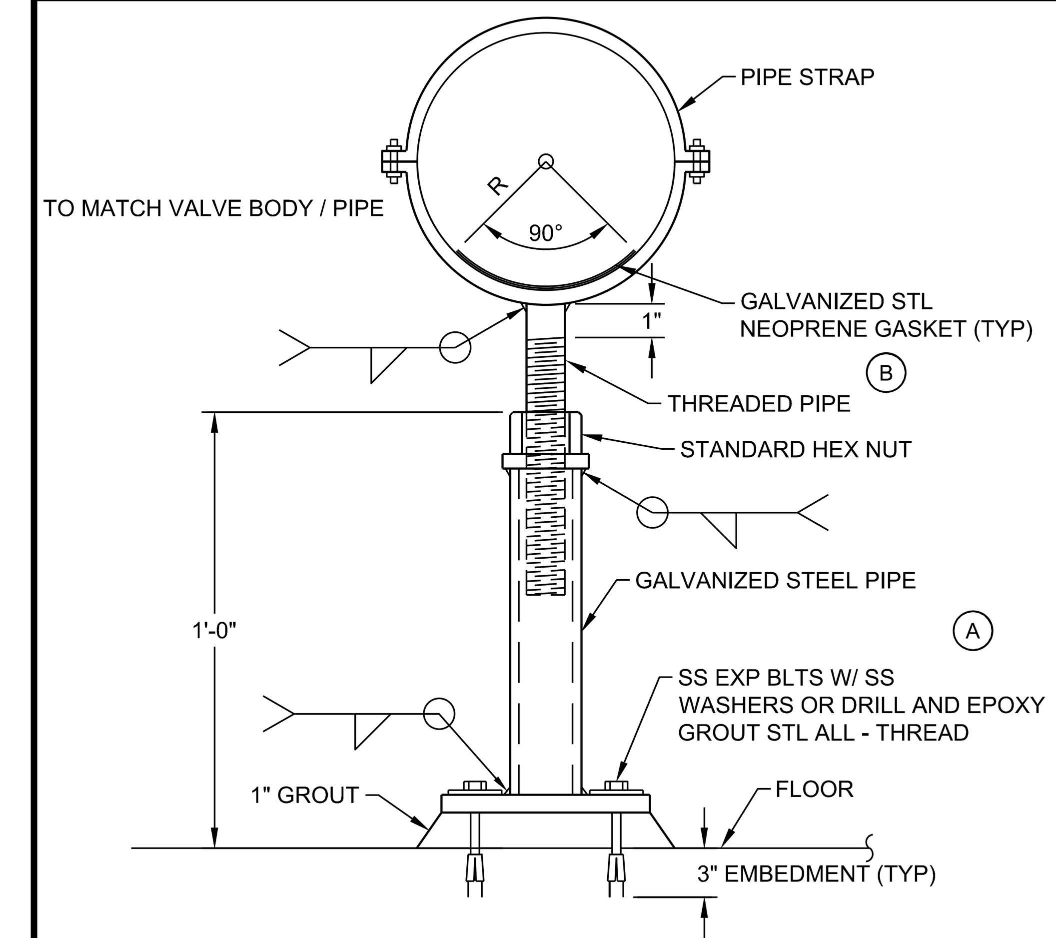
PERIMETER DRAIN



NOTE:
1. PURPOSE OF 4" PERFORATED PIPE IS TO DETECT A TANK LEAK - PIPE TO DRAIN INTO DRAINAGE STRUCTURE.

3 DETAIL
SCALE: NTS

STANCHION PIPE SUPPORT (LARGE)

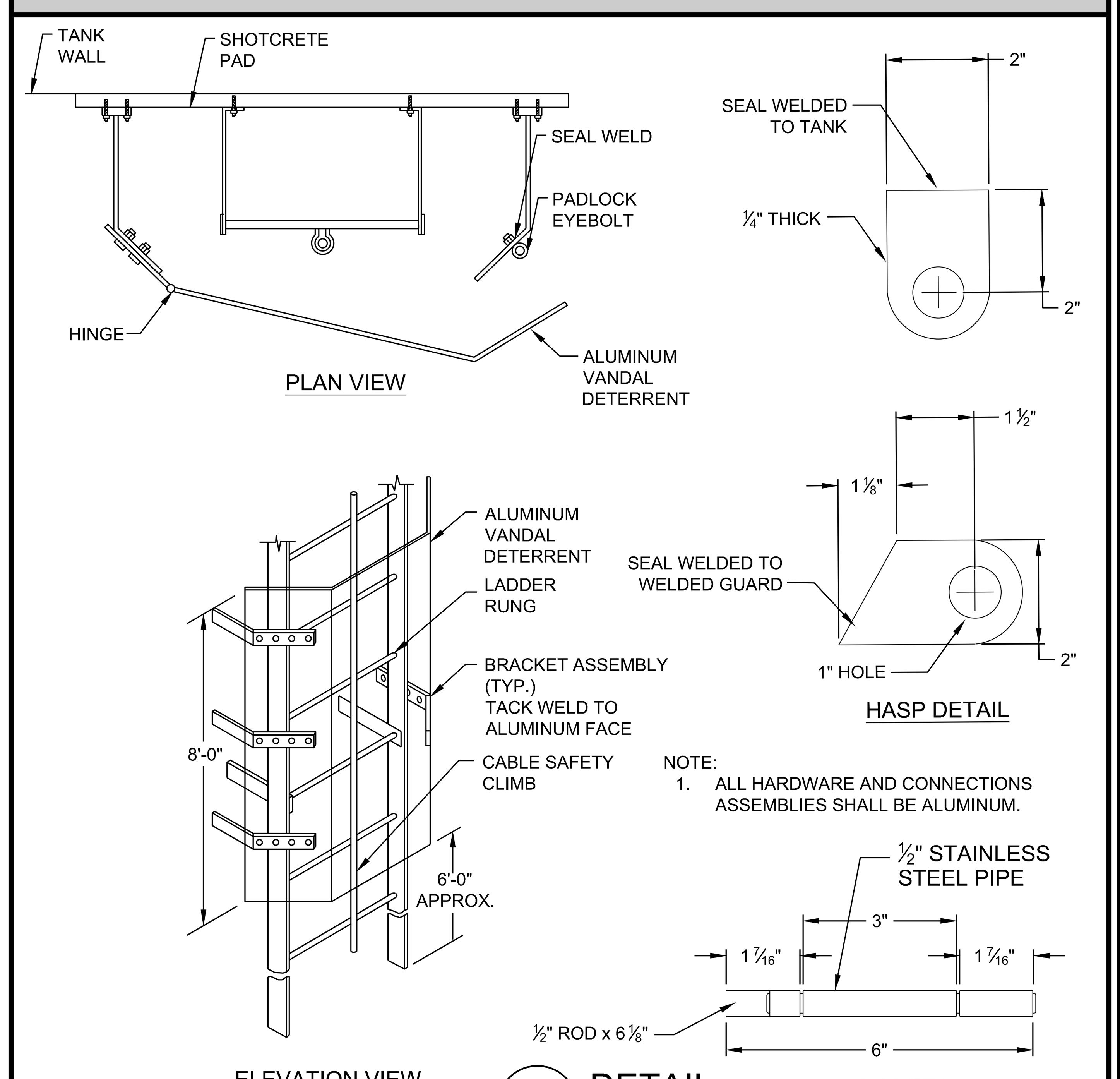


ADJUSTABLE PIPE SUPPORT DIMENSIONS

PIPE SIZE	PIPE SUPPORT SIZE (A)	PIPE ADJUSTER SIZE (B)
30"	6"	4"
36"	6"	4"
42"	6"	4"

4 DETAIL
SCALE: NTS

VANDAL DETERRENT

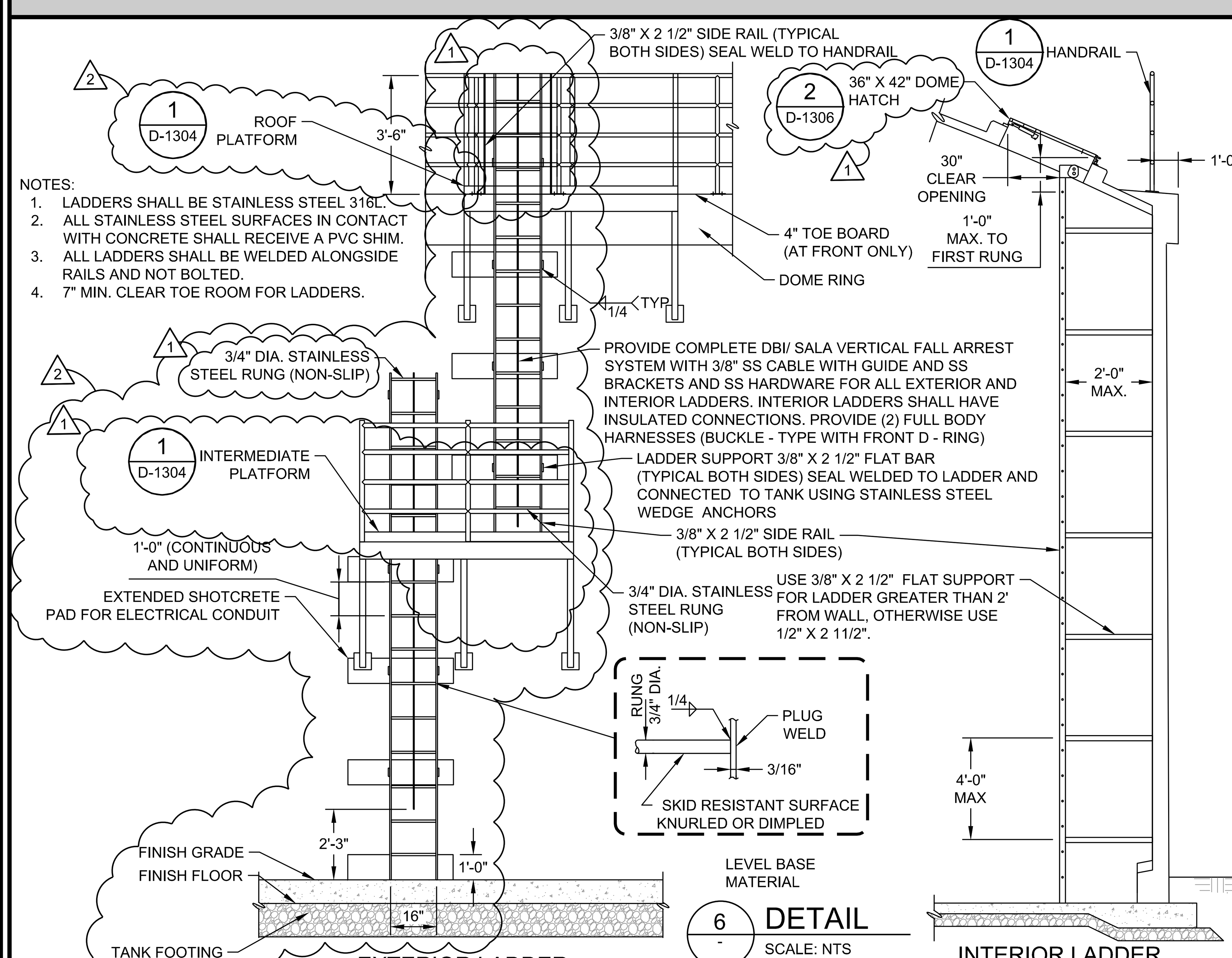


NOTE:
1. ALL HARDWARE AND CONNECTIONS ASSEMBLIES SHALL BE ALUMINUM.

5 DETAIL
SCALE: NTS

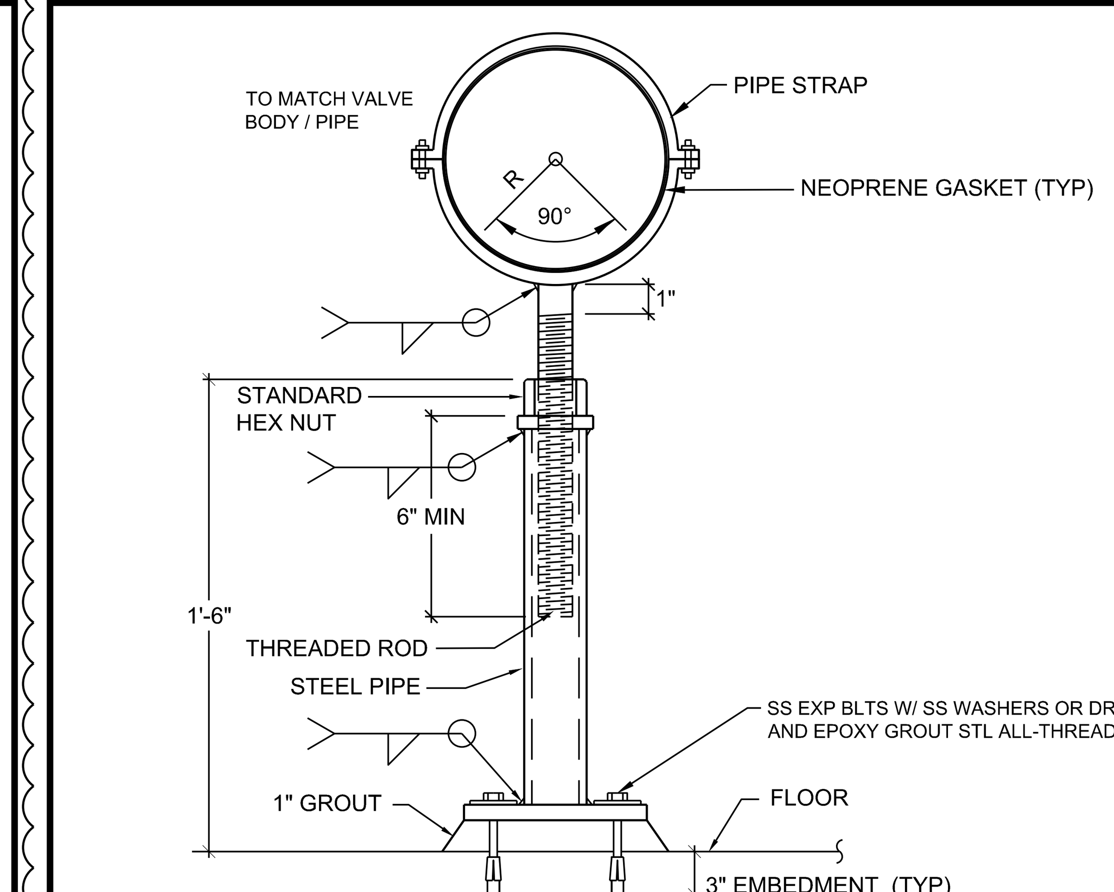
STAINLESS STEEL EXTERIOR AND INTERIOR LADDERS

NOTES:
1. LADDERS SHALL BE STAINLESS STEEL 316L.
2. ALL STAINLESS STEEL SURFACES IN CONTACT WITH CONCRETE SHALL RECEIVE A PVC SHIM.
3. ALL LADDERS SHALL BE WELDED ALONGSIDE RAILS AND NOT BOLTED.
4. 7" MIN. CLEAR TOE ROOM FOR LADDERS.



6 DETAIL
SCALE: NTS

STANCHION PIPE SUPPORT (SMALL)



ADJUSTABLE PIPE SUPPORT DIMENSIONS

PIPE SIZE	PIPE SUPPORT SIZE (A)	PIPE ADJUSTER SIZE (B)
12"	2"	1-1/2"
16"	3"	2"
24"	3"	2"
30"	6"	4"
36"	6"	4"
42"	6"	4"

7 DETAIL
SCALE: NTS

TETRA TECH
Texas Registration No. F-3924
www.tetratech.com
700 N. St Mary's, Suite 300
San Antonio, TX 78205
Ph (210) 299-7900 Fax (210) 226-8497

BID SET

SAN ANTONIO WATER SYSTEM

MARK	DATE	DESCRIPTION	BY
1	03/20/18	PER ADDENDUM #2	DA
2	03/22/18	PER ADDENDUM #3	DA

SAN ANTONIO WATER SYSTEM
CENTRAL WATER INTEGRATION PIPELINE
TERMINUS TANK PROJECT
TERMINUS SITE
GROUND STORAGE TANK
DETAILS IV

STATE OF TEXAS
JAIME R. KYPUROS JR.
93790
LICENSED PROFESSIONAL ENGINEER
3/22/2018

PROJ:	200-09308-18001
DESN:	BM
DRWN:	DA
CHKD:	WX

D-1305

Bar measures 1 inch, otherwise drawing is not to scale