

May 6, 2021

Martin Quinn, P.E.
Review Engineer
Engineering Section, Water Quality Control Division
Colorado Department of Public Health and Environment

**RE: Basis of Design Report (BDR) Amendment
Transport Colorado, New Public Water System
Public Water System Identification (PWSID) No. CO0101755, Adams County
ES Project No. ES.20.DWDR.05543**

Dear Mr. Quinn,

The Colorado Department of Public Health & Environment (Department), Water Quality Control Division, Engineering Section granted approval for the Drinking Water Final Plans and Specifications for Construction of the New Public Water System for Transport Colorado on September 8, 2020. The design were in accordance with Section 11.4(1)(b) of the *Colorado Primary Drinking Water Regulations* (Regulation 11) and met or exceeded the requirements of the *State of Colorado Design Criteria For Potable Water Systems* (Design Criteria).

The approved plans and specifications included a 1.5 MG welded steel ground storage tank. However, Transport has elected to move forward with an elevated storage tank to replace the ground storage tank and pump station. This letter is being submitted as an amendment to the previously approved BDR. The 60% construction plans and specifications are included as an attachment to this letter. Below are key design elements of the elevated tank.

- 1.5 MGD Elevated, Steel Tank with Concrete Support Pedestal
- Total Height: 165.5 ft, Head Range: 44 ft
- Tank Diameter: 86 ft, Pedestal Diameter: 44 ft
- Tank Appurtenances:
 - Inlet – 16-inch with removable silt stop 6” above tank floor, flexible coupling for expansion & differential movement
 - Outlet – 16-inch with removable silt stop 6” above tank floor, flexible coupling for expansion & differential movement
 - Drain Line – 4-inch with upper and lower drain valves and flap gate to concrete splash pad and discharging into swale routing flow to Water Quality Pond to East. Lower drain valve is 4” butterfly valve with handwheel operator and flexible coupling and flange adaptor for differential movement. Upper drain valve is 4-inch butterfly valve with handwheel operator accessible from upper catwalk with flexible coupling and flange adaptor for differential movement. 30-inch air gap above concrete splash pad.
 - Overflow – 6-inch with flap gate to concrete splash pad and discharging into swale routing flow to Water Quality Pond to East. 30-inch air gap above concrete splash pad.
 - Vent – 24” lockable combination vent-vacuum frost-proof vent and screen, approximately 27-inches off tank roof. Includes 24 mesh inner noncorrosive screen and ¼” outer noncorrosive screen.

- Access – Overhead door and man door provide access to concrete pedestal interior where an interior ladder with ladder guard door (1 ft AFF – 7 ft AFF), rest platforms every 25' vertical intervals, continues to upper catwalk. Upper catwalk provides access to 24" diameter floor manhole and roof access ladder in 5-ft diameter access tube. Interior ladder accessed from tank roof. Two (2) 30-inch square access hatches on roof – tube access and tank access. Two (2) 30-inch square painters rail access hatches on roof. 42" railing with toe board extend 8-ft each way from center of roof hatch.
- Interior cathodic protection system will be a sacrificial anode system
- Same location as previous ground storage tank.
- A Hydraulic Profile for the District's Arapahoe Well #1-A to the elevated tank is also attached.

Design Criteria:

Sections of the CDPHE Design Criteria for Potable Water Systems pertaining to the water storage are discussed below. The number and naming system used is consistent with the Design Criteria to easily reference applicable sections.

7.0 GENERAL

7.0.1 Sizing

Preliminary calculations indicate a 1.5 million-gallon (MG) tank is adequate to meet at least the first 500-acres of initial Sub-Area 1 average day demand, including fire flow. The tank site has area for future expansion once demand necessitates greater storage volume. Fire flow demands have been defined as follows:

- Commercial Fire Flow: 2,500 gpm for 2 hours
- Industrial Fire Flow: 3,500 gpm for 3 hours
- 20 psi minimum at any point in system

7.0.2 Location of Reservoirs

- a. The tank site is located out of the 100-year floodplain as indicated in the plan set. No groundwater was encountered in the boreholes as reported in the Geotechnical Report and boreholes were drilled to a depth of 80 feet.
- b. The tank is more than 50 feet from any sewer, drains, standing water or similar sources of possible contamination.
- c. The proposed tank will be elevated with a steel floor and all welds will be tested for leakage.

7.0.3 Protection from Contamination

The tank vent pipe outlet will be turned down and it will be covered with 24 mesh screen. The outlet of the tank overflow line will have a flap gate installed to prevent animals or insects from entering the tank.

7.0.4 Protection from Trespassers

Fencing with locked gates will be provided to prevent trespassing.

7.0.5 Drains

- a,b. A separate 4-inch drain line is provided. See Tank Plans.

- c-f. The drain line has an upper and lower drain valve and discharges to daylight onto a concrete splash pad to prevent erosion and provide energy dissipation. A flap gate will be installed on the tank drain outlet. The water from the drain will be directed down a drainage swale to a Water Quality pond East of the site. See Tank Plans.
- g. Incorporated into system design is yard piping that allows for manifolding to future second tank. In the interim a bypass could be employed using these connections thereby allowing for Well #1-A to maintain adequate pressure in the distribution system should the finished water storage tank need to be taken offline for cleaning and/or maintenance.

7.0.6 Stored Water Age

- a. Stored water will be continuously mixed and chlorine residual continuously monitored via a HACH CL10 analyzer. The finished water storage tank will be cycled as needed with water either “wasted” or delivered to construction ponds.

7.0.7 Overflow

- a. An overflow pipe is provided. See Tank Plans.
- b-e. The overflow piping daylights to a concrete splash pad as shown in the Tank Plans. A flap gate will be installed on the tank overflow line.
- f. The overflow pipe diameter is sized at 6 inches to accommodate the maximum inlet flowrate of 2500 gpm after a connection to the City of Auroras distribution system. It is anticipated that if this tank is filled from COA system, flows into the tank would be regulated by a fill control valve. See overflow pipe sizing calculations.
- g. The top of the overflow pipe is 1 foot below the lowest point of the roof structure. See Tank Plans.
- h. The overflow outlet will daylight to grade and be fitted with a flap gate that will gravity drain to prevent freezing issues. Flap gates open under very little pressure.

7.0.8 Access

- a. A 24” diameter floor manhole provides access to tank floor and can be accessed from upper catwalk. Two (2) 30-inch square access hatches on tank roof provide access to the 5-ft diameter access tube and interior of tank. In addition, two (2) 30-inch square access hatches for painter rails. The access openings on the top will be framed at least 12 inches above the surface of the roof at the opening, fitted with a solid, water and insect tight, gasketed cover which overlaps the frame opening and extends down around the frame, is hinged on one side and has a lock. Overhead door and man door provide access to concrete pedestal and interior ladder. See Tank Plans.

7.0.9 Vents

A dedicated downward turned vent covered with 24 mesh, non-corrodible screen with an opening a minimum of 27” above the top of the roof is proposed. The elevation for the proposed tank is 5600 feet so 24 inches of accumulated snow depth is assumed. See tank vent sizing calculations and Tank Plans.

7.0.10 Roof and Sidewall

- a-b. All openings will be designed to be watertight.
- c. See Tank Plans for pipe penetration details.
- d-e. All openings to accommodate control wires will be properly sealed to prevent contamination.

f-g. The roof will be sloped a minimum of 2% to facilitate drainage.

7.0.11 Construction Materials

Wood, concrete block or other porous materials are not proposed. The tank is proposed as welded steel with a concrete support pedestal. All coatings will be NSF-61 approved. Tank level controls are NSF-61 or fabricated from stainless steel. See Tank Plans for tank specifications.

7.0.12 Safety

An access ladder with ladder guard door (1 ft AFF – 7 ft AFF) and cable climb ladder safety device compatible with DBI SALA harness is proposed.

7.0.13 Freezing

- a. All piping inlets, outlets and overflows will be buried to reduce freezing issues. The overflow outlet will daylight to grade and will gravity drain. See Tank Plans.

7.0.14 Internal Catwalk

Interior catwalks have solid floor with sealed raised edges to prevent contamination from shoe scrapings and dirt.

7.0.15 Silt Stop

The inlet & outlet pipe penetrations have removable silt stop rising 6 inches above the floor of the tank. See Tank Plans.

7.0.16 Grading

Ground level is graded such that water does not stand within 50 feet of the tank. See Tank Plans.

7.0.17 Painting and/or Cathodic Protection

The tank is proposed as welded steel tank. All exterior and interior coatings meet the requirements of AWWA D102. Cathodic protection is proposed to include sacrificial anode system on the interior. Steel pipes and fittings utilized in inlet/outlet piping will be protected with anodes cadwelded to fittings and/or pipe.

7.0.18 Disinfection

- a-c. Disinfection of the storage tank will be completed in accordance AWWA Standard C652. See tank disinfection specification.

7.0.19 Provisions for Sampling

A sample tap will be located in the treatment building to facilitate collection of water samples for bacteriological and chemical analyses.

7.3 Distribution System Storage

7.3.3 Level Controls

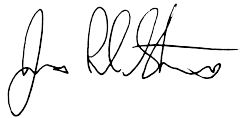
- a. A pressure transducer will be accessible from below the bowl of the elevated tank, the pressure transducer will be spanned and calibrated to its location within the tank to provide accurate readings related to the operational depth of volume within the tank. In addition to the pressure transducer for operational level indication and historical trending, the tank will be equipped with backup float level switches for Low and High Alarms as well.

The devices will be installed and their signal transmitted to a PLC in the base of the concrete support pedestal. The tank will call for water from the wells as necessary to maintain the surface tank levels.

- b. Not applicable.
- c. High and low level alarms will be provided.

Any questions may be directed to JDS-Hydro Consultants. Thank you in advance.

Sincerely,



James Plumb-Starnes

Attachments:

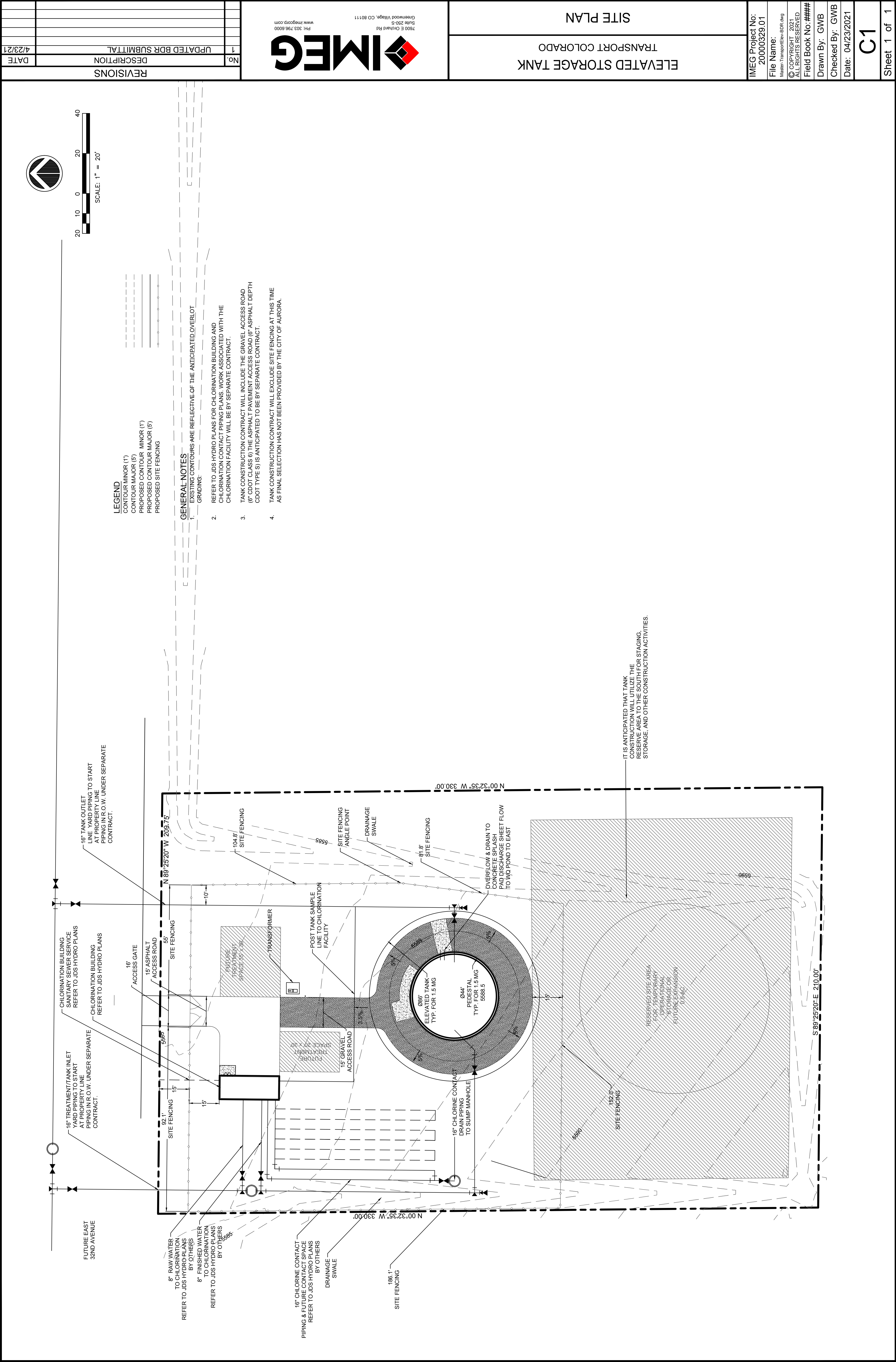
Attachment A – 60% Elevated Tank Plans

Attachment B – Overflow Capacity & Tank Venting Calculations

Attachment C – Storage Tank Specifications / Composite Elevated Tank / Tank Coatings

Attachment D – Hydraulic Profile from Well #1-A to Elevated Tank

Attachment A
60% Elevated Tank Plans

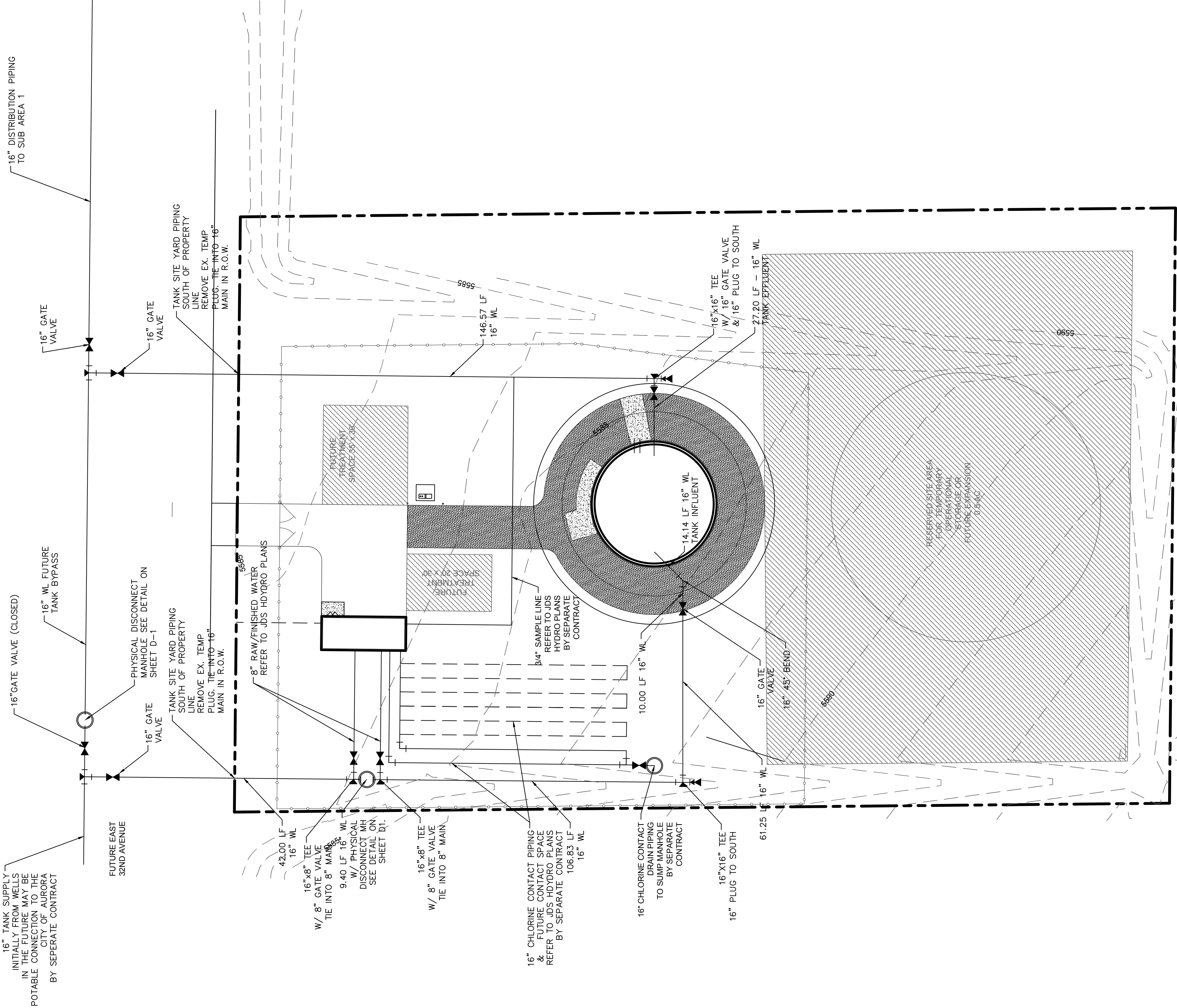


ELEVATED STORAGE TANK
TRANSPORT COLORADO
SITE PLAN

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File Name:	Master-TransportElev-BDR.dwg
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GENERAL NOTES

1. EXISTING CONTOURS ARE REFLECTIVE OF THE ANTICIPATED OVERLOT GRADING.
2. REFER TO IDS HYDRO PLANS FOR CHLORINATION BUILDING AND CHLORINATION CONTACT PIPING PLANS.
3. SEE SHEET T-1 & T-2 FOR TANK PENETRATION LOCATIONS, AND VERTICAL RUN DETAILS.
4. PROPOSED WATER INFRASTRUCTURE SHALL BE IN ACCORDANCE WITH AURORA WATER - WATER, SANITARY SEWER, & STORM DRAINAGE INFRASTRUCTURE STANDARDS & SPECIFICATIONS (SEPTEMBER 2019) AND APPROVED PRODUCTS LIST.

6. WATER MAIN FITTING SHALL BE ALL FITTINGS (VERTICAL/HORIZONTAL, BENDS, TEES, DEAD ENDS, IN ADDITION TO JOINT RESTRAINT ALL BENDS, TEES, PLUGS, SHALL REQUIRE PROTECTION UTILIZING THRUST BLOCKS IN ACCORDANCE WITH AURORA STANDARDS & SPECIFICATIONS.
APPROVED MANUFACTURERS - EBAA IRON MEGALUG SERIES 1500 , FORD UNI-FLANGE 1390, STAR PIPE SERIES 1100, OR SIGMA CORP ONE LOCK SLICE SERIES.

8. GATE VALVES SHALL BE CONFORM TO AWMA C500, (RESILIENT SEAT AWMA C509) AND SHALL BE EITHER RESILIENT SEAT OR DOUBLE-DISC, PARALLEL SEAT, IRON BODY, BRONZE MOUNTED, NON-RISING STEM, EQUIPPED WITH C-509 AND IRON BODY. VALVE OPERATORS SHALL BE COVERED BY A RIGIDLY TIGHT VALVE COVER, 1/4" ALUMINUM, WITH WATER-GRADE PLATE COVER.


10. VALVES ON SITE SHALL HAVE A REFERENCE MARKER 3' FROM VALVE BOX. MARKER SHALL BE 3-INCH DIA. GALVANIZED PIPE FILLED WITH DIRT CAPPED WITH CONCRETE. PIPE SHALL BE 5-FT LONG AND INSTALLED IN CONCRETE FILLED HOLE 2-FT. PIPE TO BE PAINTED FIRE HYDRANT YELLOW. VALVE BOX SHALL ALSO BE CAST IN A CONCRETE COLLAR (18-IN SQUARE BY 4-IN DEEP).

12. THE BEDDING AND PIPE ZONE MATERIAL SHALL BE CLEAN, FREE DRAINING WELL-GRADED SAND OR SQUEEGEE SAND AND SHALL CONFORM TO THE FOLLOWING LIMITS WHEN TESTED BY MEANS OF LABORATORY SIEVES:

SIEVE SIZE	PASSING BY WEIGHT
3/8 INCH	100
NO. 4	70-100
NO. 8	38-93
NO. 16	20-60
NO. 30	8-65
NO. 50	2-30
NO. 100	1-10
NO. 200	0-5

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- NOTES:
1. THESE TANK DRAWINGS AND ASSOCIATED SPECIFICATIONS DO NOT REPRESENT THE FINISHED STRUCTURE. DIMENSIONS AND GEOMETRY SHOWN ARE FOR INFORMATIONAL & BIDDING PURPOSES ONLY. DESIGNER/CONTRACTOR SHALL BE RESPONSIBLE FOR FINAL STRUCTURAL DESIGN OF BOTH THE TANK AND THE TANK FOUNDATION, ALONG WITH ASSOCIATED COMPONENT SIZING, AND LAYOUT OF ACCESSORIES.
 2. THE MATERIALS AND DESIGN FOR THIS TANK ARE IN ACCORDANCE WITH CHAPTER 7 (FINISHED WATER STORAGE) OF THE STATE OF COLORADO DESIGN CRITERIA FOR POTABLE WATER SYSTEMS (EFFECTIVE 2013). THE DESIGN, FABRICATION AND CONSTRUCTION OF THIS TANK SHALL FOLLOW THE CODED LOCAL GOVERNING CODES. FOR THE CITY OF AURORA, THIS INCLUDES THE SWM DESIGN DETAIL, AND OTHER APPLICABLE CURRENT AWWA AND ACI STANDARDS CONCERNING COMPOSITE ELEVATED TANKS FOR WATER STORAGE.
 3. TANK DESIGN DRAWINGS
 - GEOTECHNICAL ENGINEERING STUDY FOR TRANSPORT COLORADO 1.5 MG WATER STORAGE TANK (5/15/20) IS INCLUDED FOR REFERENCE BY THE DESIGNER. REPORT GIVES RECOMMENDATIONS FOR EITHER DRILLED PIERS OR SHALLOW FOUNDATIONS PLACED OVER CONTROLLED FILL, FOR A GROUND STORAGE TANK. IF ELEVATED TANK DESIGNER NEEDS SUPPLEMENTAL GEOTECHNICAL INFORMATION THEY SHALL COORDINATE THAT EFFORT DIRECTLY. STRUCTURAL DESIGNS SHALL BE SUBMITTED PER SPECIFICATIONS.
 - PRIOR TO SUBMISSION TO ENGINEER, THE CONTRACTOR SHALL REVIEW ALL SUBMITTALS FOR CONFORMANCE WITH APPROVED CONTRACT DOCUMENTS.
 - THE PURPOSE OF TANK SHOP DRAWINGS IS TO DEMONSTRATE TO THE OWNER/CITY/ENGINEER THAT THEY UNDERSTAND THE DESIGN CONCEPT AS REFLECTED ON THESE DRAWINGS, AND TO REFLECT DETAILED MATERIAL AND FABRICATION DETAILS, AND SUPPORTING STRUCTURAL CALCULATIONS.
 4. TANK CONTRACTOR SHALL SOLELY BE RESPONSIBLE FOR ALL CONSTRUCTION MEANS, METHODS, TECHNIQUES, SEQUENCES, AND PROCEDURES.
 5. CONCRETE, PEDESTAL, EXTERIOR, SHALL INCORPORATE HORIZONTAL AND VERTICAL RUSTICATIONS TO CREATE A SYMMETRICAL ARCHITECTURAL PATTERN. OPTIONS SHOULD BE PRESENTED TO OWNER FOR SELECTION. THE MINIMUM WALL THICKNESS SHALL NOT BE LESS THAN 8 INCHES EXCLUSIVE OF RUSTICATIONS OR ARCHITECTURAL RELIEF.
 6. FABRICATION NOTES:
 - FABRICATION TOLERANCE = $\pm 1/8"$ COMPARED TO SHOP DRAWING DIMENSIONS.
 - ALL SHELL BUTT WELDS TO HAVE COMPLETE PENETRATION AND FUSION.
 - TANK BOTTOM & ROOF SEAMS TO BE INSPECTED USING THE VACUUM BOX METHOD PER AWWA.
 - SHELL TO BOTTOM WELD TO BE INSPECTED USING PENETRATING OIL.
 - SHELL BUTT WELDS TO BE SPOT X-RAYED IN ACCORDANCE WITH AWWA
 6. WELD FINISHES
 - ALL WELDS TO BE GROUND SMOOTH AND BLENDED.
 - GRIND WELDS ON BOTTOM, UNDERSIDE OF DECK & ALL INTERNAL SHELL SEAMS.
 - ALL CUTOUTS FOR OVERFLOW VENTS, ETC. TO BE GROUND SMOOTH ON INSIDE OF TANK.
 - EXTERIOR WELDS TO BE GROUND TO STANDARD NACE "D" FINISH AS IS.
 - ANY SCAFFOLD OR LIFTING CLIPS ETC. SHALL BE GROUND SMOOTH AFTER REMOVAL.
 7. COATING REQUIREMENTS
 - EXTERIOR SYSTEM – EXPOSED TANK STEEL
 - SURFACE PREPARATION: SSPC-SP10/NACE NO.2 NEAR-WHITE METAL
 - PRIME COAT (3 MILS DFT): AROMATIC URETHANE ZINC RICH PRIMER
 - SW SHERWIN WILLIAMS COROATHANE 1 GALVAPAK 1K ZINC PRIMER
 - INTERMEDIATE COAT: (4 MILS DFT) ALIPHATIC ACRYLIC POLYURETHANE
 - SW FLUOROKEM HS
 - FINISH COAT: (3-4 MILS DFT) ADVANCED THERMOSET FLUOROPOLYMER
 - SW FLUOROKEM HS
 - T SERIES701 – HYDROFLON (SEMI-GLOSS)
 - COLOR BY OWNER AS COORDINATED WITH CITY OF AURORA.
 8. INTERIOR SYSTEM
 - SEE TANK CROSS SECTION AND CATHODIC PROTECTION PLAN FOR INFORMATION
 - INTERIOR SYSTEM – SACRIFICIAL ANODE SYSTEM
 9. OVERFLOW CAPACITY REQUIRED – 2500 GPM
- THIS CAPACITY IS REFLECTIVE OF CURRENT MAXIMUM FILL RATE ANTICIPATED FROM A CONNECTION TO THE CITY OF AURORA'S DISTRIBUTION SYSTEM. IT IS ANTICIPATED THAT IF THIS TANK IS FILLED FROM AURORA'S SYSTEM, FLOWS INTO THE TANK WOULD BE REGULATED BY A FILL CONTROL VALVE. FILL RATE FROM THE WELL SUPPLY IS ANTICIPATED TO BE LESS THAN 500 GPM.

ELEVATED STORAGE TANK		ELEVATED TANK PLAN & GENERAL NOTES							
TRANSPORT COLORADO									
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Greenwood Village, CO 80111

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24" TANK VENT
SCALE 1"=1'

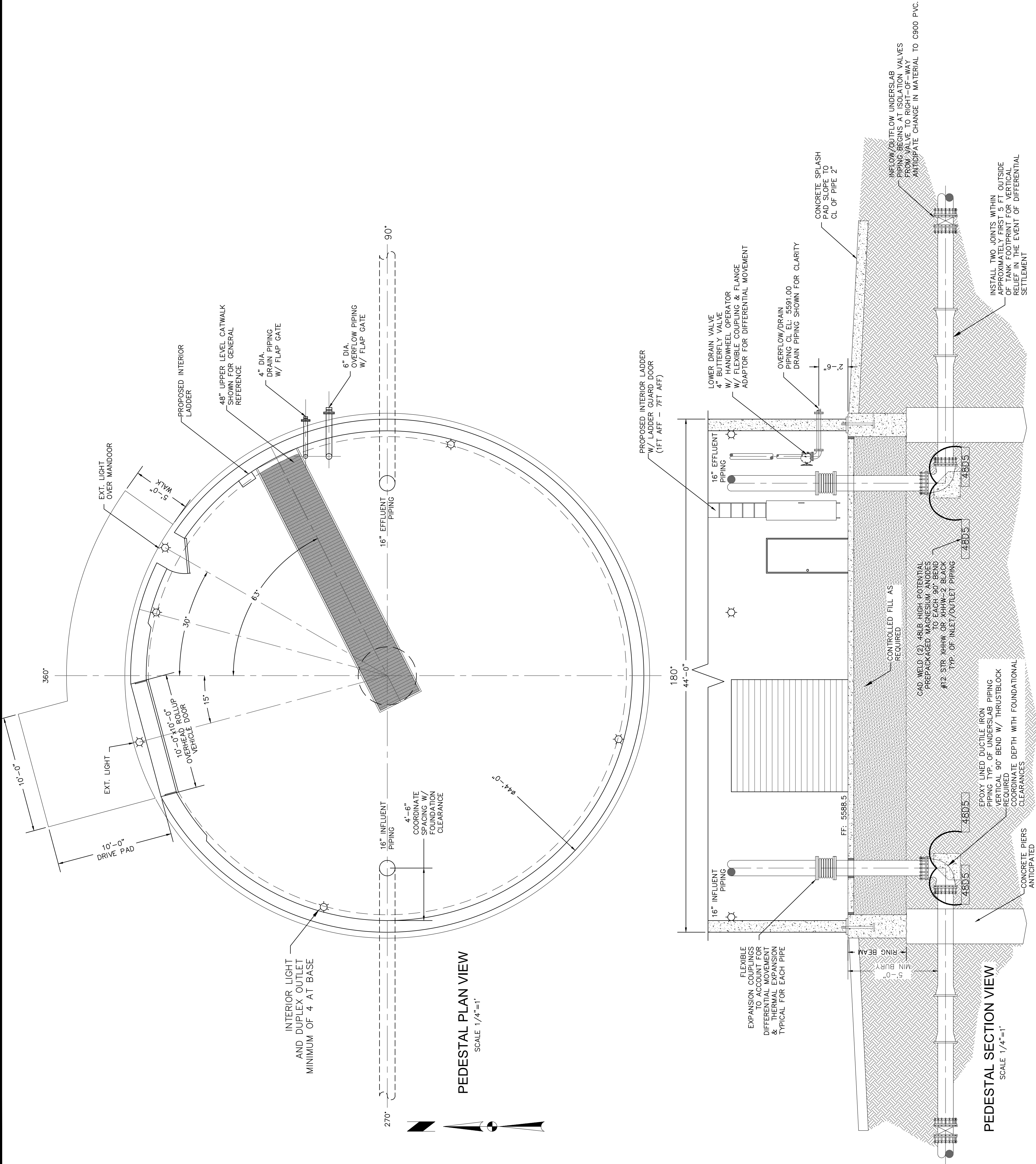
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TANK PEDESTAL PLAN

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Attachment B

Overflow Capacity & Tank Venting Calculations

TRANSPORT COLORADO
ELEVATED POTABLE WATER
STORAGE TANK
IMEG CALCULATIONS
OVERFLOW CAPACITY & TANK
VENTING

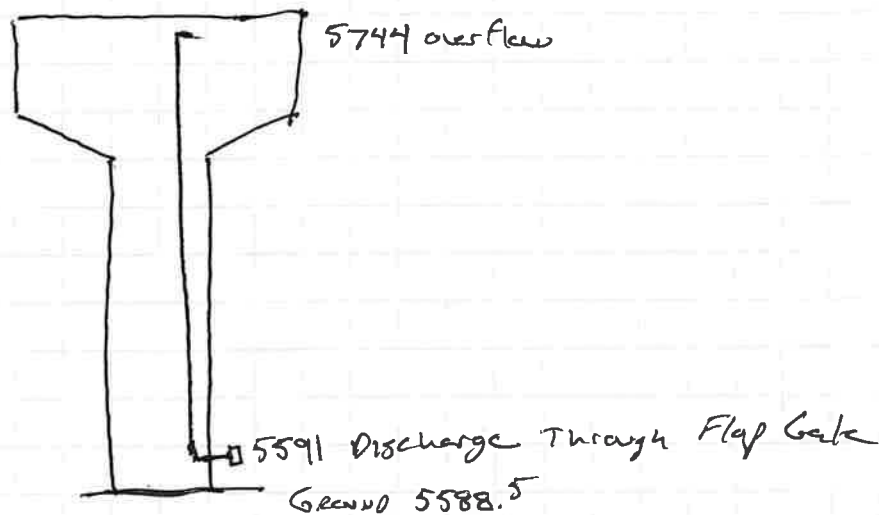




PROJECT	DATE	BY	PROJECT NO.
TRANSPORT COLORADO ELEVATED STORAGE TANK OVERFLOW CALCULATION	2/18/20	GWG	2000329.01

> Overflow CAPACITY shall meet or EXCEED capacity OF INFLOW / MAXIMUM FILLING RATE

MAX FILL RATE = 2500 gpm BASED ON CUL Hydraulic MODELING OF MAX FLOW FROM AURORA CONNECTION TO HYDRAULIC GRADE OF TANK. IT IS ANTICIPATED THAT in Interim when tank is filled by wells that max inflow could be approximately 500 gpm



$$H_s = 153.6 \geq H_f + H_m$$

H_s = static Head

H_f = Frictional Loss

H_m = Minor Loss

$$H_f = \frac{10.44 L Q^{1.85}}{C^{1.85} d^{4.87}}$$

L = Length (ft) 185 including internal reworking

Q = Flow (gpm) = 2500 gpm

C = Hazen Coeff = 120

d = diameter (in) = Try 6"
Try 8"

$$H_m = 2.60 \times 10^{-3} K Q^2 / d^4 + \text{Gate Loss}$$

K = Minor Loss Coefficient
Entrance 0.5 sharp edge
90° bend 0.9 (x2)
45° bend 0.45 (x2)

$K = 3.2 + \text{Gate Loss}$

Gate Loss varies w/ Flow
High velocity - wide open 0.1
Low velocity 1.0 \Rightarrow use 1.0



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$$H_E (6'') = \frac{10.44(185)2500^{1.85}}{120^{1.85} 6^{4.87}}$$

$$= 86 \text{ ft}$$

$$H_m (6'') = 2.60 \times 10^{-3} (4.2) \frac{2500^2}{6^4}$$
$$= 53 \text{ ft}$$

$$H_S (6'') = 139 \text{ ft} \leq 153 \text{ ft}$$

$$\text{When } H_E + H_m = 153 \quad Q = \underline{2625 \text{ gpm}}$$

6" CAPACITY w/
CONSERVATIVE ASSUMPTIONS

$$H_E (8'') = \frac{10.44(185)2500^{1.85}}{120^{1.85} 8^{4.87}}$$

$$= 21.3 \text{ ft}$$

$$H_m (8'') = 2.60 \times 10^{-3} (4.2) \frac{2500^2}{8^4}$$
$$= 16.7 \text{ ft}$$

$$H_S (8'') = 38 \text{ ft} \leq 153 \text{ ft}$$

$$\text{When } = 153 \text{ ft } Q_{\text{max}} = 5175 \text{ gpm}$$

will use 6" Diameter overflow

Seems excessive

WILL SIZE USING 6" FOR OVERFLOW



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ELEVATED STORAGE TANK

VENT CALCULATION

CRITERIA: AWWA D107 Composite Elevated Tanks
Minimum Net Free Area 500 in² is noted

Vent Area Designed For Maximum Flow Rates

Inflow Rate 2500 gpm

Outflow Rate 10,000 gpm

BASIS OF DESIGN T.A.P.CO 524 - SEE ATTACHED
FOR PUBLISHED Intake + Withdrawal CAPACITIES

LIMIT 0.5 inch/wc

Evaluate 10,000 gpm
1337 ft³/min

$$V_{\max} (\text{VELOCITY}) = \sqrt{2gH/\rho}$$

$$= 47 \text{ ft/sec}$$

$$= 2835 \text{ ft/min}$$

$$g = 32.2 \text{ lb. ft./lb. sec}^2$$

$$H = \text{PRESSURE ACROSS VENT } 0.5' \text{ w.c.}$$

$$\Rightarrow 2.6 \text{ lb/ft}^2$$

$$\rho = \text{DENSITY OF AIR}$$

$$= 0.075 \text{ lbm/ft}^3$$

$$Q (\text{FLOW}) = C \cdot V_{\text{ACT}} \cdot A$$

$$V_{\text{ACTUAL @ 1337 CFM}} = Q/C \times A$$

$$= 1337 \text{ ft}^3/\text{min} / 3.15 \text{ ft}^2 \times 0.6$$

$$= 707 \text{ ft/min}$$

$$Q = 1337 \text{ ft}^3/\text{min}$$

$$C = \text{CONSTANT REPRESENTING EXIT/Entrance LOSS}$$

$$0.6$$

$$A = \text{FREE AREA PUBLISHED INTAKE}$$

$$905 \text{ SQ-INCHES}$$

$$6.3 \text{ SQ-FT}$$

$$W/24" MESH AT 50\% \text{ FREE AREA}$$

$$3.15 \text{ ft}^2$$

@ 10,000 gpm we are well below
Vmax limit ~ 4 Times
Appears like ~ 40,000 gpm would be
calculated capacity at 0.5" w.c



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TRANSPORT COLORADO ELEVATED STORAGE TANK	4/22/20	GW3	2000329.01

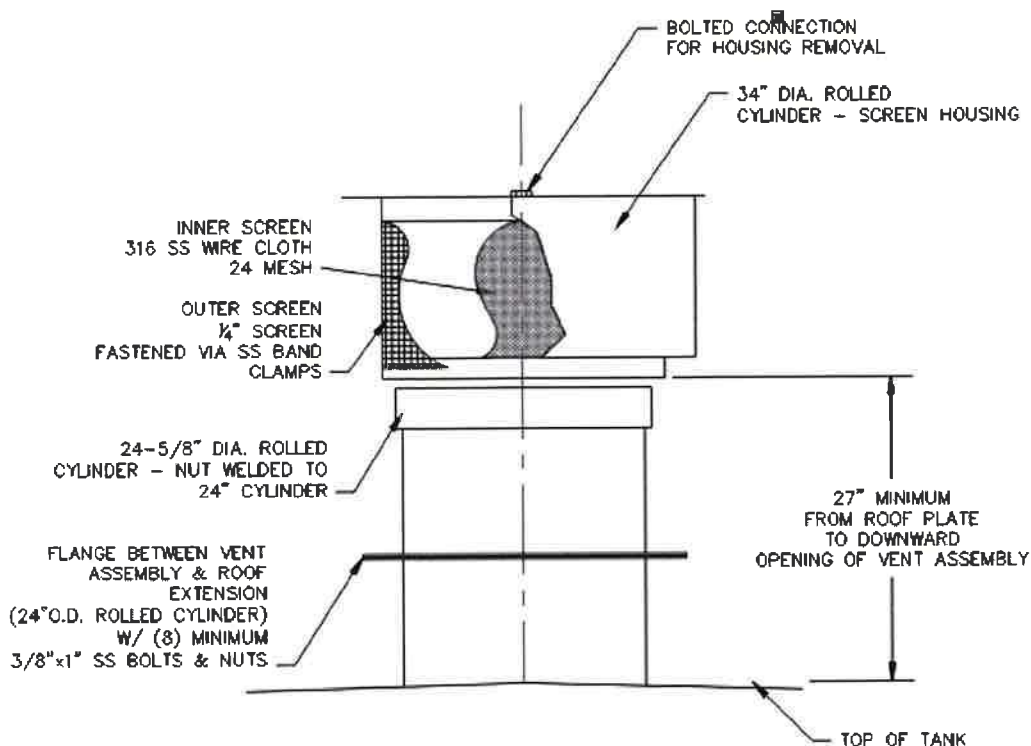
Published values are less than our calculation this is likely due to considering losses in outscreen and pipe/flange connection.

Ultimately we have selected screen size well below capacity limitations.



Vent Air Flow Rates:

Model	Stack Openings	Inner Screen	Air Speed	Air Speed	Intake and Withdraw
	Square Inches	Square Inches	Stack FPS	Screen FPS	GPM
S 4	12.57	70	22	3.94	860
PD-SD 8-5	19.64	84.5	22	5.12	1350
S 6 & SD 10-6	28.27	102	22	6.1	1940
S 8 & SD 12-8	50.26	165	22	6.71	3450
S 10 & SD 14-10	78.54	236	22	7.34	5400
S 12 & SD 16-12	113.01	280	22	8.82	7700
SD 18-14	153.93	352	22	9.57	10,500
SD 20-16	210.06	402	22	10.77	13,500
SD 24-20	314.16	628	22	15.24	21,500
S 24	452.39	905	21.32	10.63	30,000
SD 30-26	531.00	1470 (use 24" screen)	22	7.86	36,000
SD 36-32	804.25	1810 (use 24" screen)	22	9.75	55,000
SD 40-36	1018.00	2036 (use 24" screen)	22	10.99	69,000
SD 48-44	1520.00	3040 (use 30" screen)	21.11	10.55	100,000



NOTES:

1. VACUUM & PRESSURE RELIEF, FROST-PROOF VENT & SCREEN SHALL BE T.A.P. CO MODEL S24 (STAINLESS STEEL HOUSING) OR EQUAL.
2. CONTRACTOR SHALL COORDINATE ALL VENT INSTALLATION PROCEDURES WITH SUPPLIERS RECOMMENDED PRACTICES.
3. VENT MUST BE INSTALLED PLUMB TO ENSURE PROPER FUNCTIONING.
4. THE EXTERIOR AND INTERIOR SURFACES OF THE VENT ASSEMBLY SHOULD NOT BE COATED EXCEPT FOR THE FLANGE CONNECTION TO THE TANK ROOF PLATE.

24" TANK VENT
SCALE 1"=1'

Attachment C
*Storage Tank Specifications/
Composite Elevated Tank/Tank Coatings*

TRANSPORT COLORADO
ELEVATED POTABLE WATER
STORAGE TANK SPECIFICATIONS
COMPOSITE ELEVATED TANK
TANK COATINGS



SECTION 33 16 11

COMPOSITE ELEVATED TANK SPECIFICATION

PART I – GENERAL

1.1 Description

A. Scope of Work

1. The work to be performed under these specifications includes furnishing all labor, materials, tools, and equipment necessary to design, fabricate, construct, inspect, test, and commission a welded steel elevated water storage tank supported on a concrete support structure, including the foundation and accessories as shown on the drawings and specified herein.
2. The tank and support structure shall be the composite elevated tank style. The tank shall be of all welded steel design and have a sloped/domed roof, straight sides, and a cone bottom. The support structure shall be of concrete design. The concrete support structure shall be configured so that a concrete tank floor with a steel liner plate supports the water inside the steel reservoir. Suspended steel tank floor configurations are not allowed.

B. Related Work

1. The work shall also include all labor, materials, and equipment necessary to clean, paint and disinfect the water storage tank as specified in Section 09 97 00 Tank Coating.
2. The work shall also include all labor, materials, and equipment necessary to construct the site improvements and site piping as shown on the drawings.
3. Work shall include all labor, materials, and equipment necessary to install electrical work and lighting.
4. Work shall include all labor, materials, and equipment necessary to install the Cathodic protection system.

C. Related Work Specified Elsewhere:

1. SECTION 09 97 00 – TANK COATING
4. APPENDIX A – GEOTECHNICAL ENGINEERING STUDY TRANSPORT COLORADO 1.5 MG WATER STORAGE TANK ADAMS, COUNTY COLORADO.

1.2 Quality Assurance

- A. The following standards and specifications are referenced. The latest edition shall be used if the edition is not specified.

1. AWWA D107 Standard for Composite Elevated Tanks for Water Storage
2. AWWA D102 Standard for Painting Steel Water Storage Tanks
3. AWWA C652 Standard for Disinfection of Water Storage Facilities
4. ASCE 7 Minimum Design Loads for Buildings and Other Structures
5. ACI 301 Standard Specifications for Structural Concrete
6. ACI 305 Hot Weather Concreting
7. ACI 306 Cold Weather Concreting
8. ACI 318 Building Code Requirements for Structural Concrete
9. NSF 61 Drinking Water System Components
10. OSHA Occupational Safety and Health Standards
11. SSPC-PA1 Paint Application Specification

1.3 Qualification of Contractor – Bid Submission Requirements

- A. A turnkey Composite Elevated Tank Manufacturer/Contractor shall perform the work described in this Section. No part of the design or construction of the concrete support structure or welded steel water tank shall be subcontracted. The Contractor shall have designed, constructed, and placed in service a minimum of five (5) Composite Elevated Tanks of similar capacity in the past ten (10) years. At the time of the Bid Contractor shall supply experience summary of similar projects, particularly in Colorado or surrounding states, along with references.
- B. The composite elevated tank and foundation design, concrete support structure construction and welded steel tank fabrication and construction shall be performed by the Contractor's own direct hire employees and shall not be subcontracted in any way. The tank's foundation may be supervised and installed by the Contractor or a qualified local foundation subcontractor. At the time of the Bid Contractor shall supply resumes of key staff (Design and Construction Team) that will be assigned to the project.
- C. The Contractor shall own and maintain all equipment necessary for the turnkey construction of the Composite Elevated Tank as specified herein. This includes the formwork for the concrete support structure construction as well as the fabrication and erection equipment required for the welded steel water tank construction. Neither the concrete support structure construction or the welded steel water tank fabrication and erection shall be subcontracted.
- D. Schedule: At the time of the bid submission the Contractor shall provide a preliminary anticipated schedule for design, submittals, site work and the major components of

construction including foundation, concrete support structure and welded steel water tank, tank painting, electrical installation, and other significant activities.

- E. Each Bidder shall submit with their proposal a sketch of the composite elevated tank showing major dimensions and plate thicknesses. A sketch of the foundation showing type and preliminary dimensions and approximate quantities of concrete and reinforcing steel shall also be provided with the bid.

1.4 Owner Supplied Information

- A. Geotechnical Investigation Report (Appendix A as referenced) is specific to the site, however, assumptions at that time were for a ground storage tank. However, the information presented should provide understanding of the subsurface soil conditions, and considerations for foundations. If there is additional information needed for design, the CONTRACTOR shall supplement the data as needed within the Design Scope of the Contract.
- B. The District has submitted to the FAA Form 7460-1. Final requirements of obstruction marking or lighting shall be provided to the Contractor as it becomes available.

1.5 Submittals

- A. Prior to construction, the Contractor shall furnish construction drawings of the tank, concrete support structure and foundation sealed by a Professional Engineer licensed in the State of Colorado. Construction drawings for the foundation shall show applicable design and construction standards, materials of construction, design loads and allowable soil bearing or pile capacity. Submittals shall be in general accordance with SECTION 01 33 23.
 - 1. Drawings shall Incorporate:
 - a) Elevations, plans, and sectional view drawings conveying the size and location of all Structural Components
 - b) Required Strength and grade of Materials Used
 - c) Size and Arrangement of Piping, Accessories and Appurtenances.
 - 2. Reinforced concrete details shall include construction joints, openings, and inserts. Reinforcement shall be clearly indicated on the structural drawings and identified by mark numbers that are used on the fabrication schedule. Location, spacing and splice dimensions shall also be shown. Placement and fabrication details shall conform to ACI 318.
 - 3. Steel tank details shall include weld joints and a layout showing all primary and secondary shop and field welds.

- B. A summary of the design for the foundation, support structure and the tank, shall be provided prior to construction. The design summary shall show applicable design and construction standards, materials of construction, design loads and results showing conformance with the specifications. Resultant loads for Snow, Wind, and Seismic Forces, and the methods of Analysis shall be documented. The design shall be sealed by a Professional Engineer licensed in the State of Colorado.
 - 1. Provide a table showing capacity of the tank in gallons at all levels in one ft. increments.
- C. Construction Procedures
 - 1. Provide design, detail drawings and procedures for the support structure forming system. Details shall include location of form and construction joints, rustications, and any form ties. The criteria and minimum elapsed time for adjacent concrete placement shall also be clearly stated in the construction procedures.
 - 2. Provide shop and field weld procedures for all structural joints on the steel tank.
- D. Product Data
 - 1. Provide separate concrete mix designs for each specified concrete compressive strength indicated on the drawings.
 - 2. Provide technical data and manufacturer's standard color chart of all coating products to be used.
 - 3. Provide manufacturer's descriptive information for appurtenant equipment and accessories that are not detailed on the construction drawings.
- E. Welder's certifications shall be submitted in accordance with AWWA D107.
- F. Reports/Certification: Provide documentation of all tests, inspections and certifications required by this Section.
 - 1. Provide certification from the Engineer of Record that the Composite Elevated Tank has been completely designed in accordance with the requirements of the Specification, and that constructed tank is verified to have the minimum completed volume required.
- G. Operation/Maintenance: Provide operating instructions and maintenance procedures for the Composite Elevated Tank and applicable appurtenant equipment, mechanical components and miscellaneous accessories.

1.6 Job Conditions

- A. Electric Power

1. The Contractor shall provide all necessary power required for operations under the Contract, it is unknown if permanent power will be on site at the time the project is initiated.
- B. Compressed Air
 1. The Contractor shall provide any required compressed air for operations under the Contract.
- C. Contractor shall confine operations to the property/tract boundary as reflected on the drawings. It is anticipated that the primary staging, area, would be to the south of the tank location, in order to allow for construction of the chlorination facility to the north.
- D. Working Conditions
 1. Safety and Health - The Contractor shall comply with safe working practices and all health and safety regulations of OSHA, state and local health regulatory agencies and Material Safety Data Sheets (MSDS). Provide protective and lifesaving equipment for persons working at the site.

1.7 Delivery, Storage , and Handling

- A. Handling and Shipping
 1. The Contractor shall handle materials and fabricated components in a manner that will protect them from damage. Allow painted materials adequate cure time prior to stacking or shipping.
- B. Storage and Protection
 1. Protect delivered materials and equipment from damage. Store in well drained areas and provide blocking to minimize contact with the ground.

1.8 Guarantee

- A. The Contractor shall guarantee the structure, appurtenant equipment and accessories provided under this Section against defective design, workmanship, or materials for a period of one year from the date of substantial completion. If notified within this period, the Contractor shall repair any defects caused by faulty design, workmanship, or material furnished under these specifications at no cost to the District.
- B. All guarantees obtained by Tank Supplier/Contractor from additional installers of paint, equipment, or accessories not manufactured by primary Tank Supplier/Contractor shall be obtained for the benefit of the District.

PART 2 – PRODUCTS

2.1 General

- A. Furnish an elevated water storage tank as shown on the drawings and as specified in this section. The design, materials, fabrication, construction, testing and inspection of the tank, support structure and foundation shall comply with AWWA D107, except as modified herein. The tank capacity, head range and the height to TCL and top of foundation elevation shall be as shown on the drawings. Tank net capacity shall be 1.5 million gallons.
- B. Provide all first-quality, new materials, free from defects suitable for intended use.

2.2 Materials

- A. Materials and material tests used for reinforced concrete shall conform to ACI 318 except as modified herein.
- B. The same brand and type of cement, and aggregate from a consistent source shall be used throughout the construction of the concrete support structure to maintain uniformity of color.
- C. The minimum specified compressive strength of concrete shall be 4000 psi. The specified compressive strength of concrete used for the design of the wall and dome shall not exceed 6000 psi and 5000 psi, respectively.
- D. Deformed bar reinforcing steel shall conform to ASTM A615 Grade 60 or ASTM A706 Grade 60. Plain welded wire reinforcement shall conform to ASTM A1064.
- E. Materials and material tests for the steel tank and all tank components shall comply with the latest edition of AWWA D107 except as modified herein.

2.3 Design Criteria

- A. Design loads such as Dead Load, and Water Load etc. shall be in accordance with ANSI/AWWA D100-11.
- B. Seismic Load
 - 1. Design in accordance with AWWA D107 Section 4.2
 - 2. Seismic Use Group
 - a) Horizontal and vertical seismic loads shall be based on AWWA D107 for Category IV (essential facility) structures, using tank center coordinates of 39°45'36.9458"N latitude and 104°33'12.4458"W longitude.
 - b) Seismic Importance Factor $I_E = 1.50$
 - c) Spectral Response Acceleration Coefficients as identified in the Geotechnical Engineering Study
 - d) Site Class C - As identified by Geotechnical Report.

C. Snow Loading

1. Snow load shall be determined in accordance with ANSI/AWWA D107, Section 4.2.5 and/or City of Aurora, Colorado Engineering Design Criteria. (2015 International Codes Adopted) Minimum Roof Snow Load 30 psf.

D. Wind Loading

- a. Wind pressure shall be determined in accordance with ANSI/AWWA D107, Section 4.2.6 and/or City of Aurora Design Criteria a minimum of 120 mph (Risk Category IV)

- E. The structural effects of the applied loads shall be considered with the loads defined according to ASCE 7. Load combinations used for allowable stress design and strength design shall conform to AWWA D107.

2.4 Foundation

- A. The concrete foundation shall be designed in accordance with ACI 318. Minimum specified compressive strength shall be 4000 psi at 28 days. Reinforcing steel shall be ASTM A615 Grade 60.
- B. The foundation design shall be by the Contractor and shall conform to the recommendations given in the geotechnical report. The foundation depth shall be as required for the extreme frost penetration shown in AWWA D107.
- C. Interior Floor
1. Slab on Grade - Provide a 6 in. thick, 3500 psi concrete floor slab in the base of the concrete support structure. The slab shall be supported on compacted granular fill and shall be reinforced with #5 reinforcing steel bars at 12 in. centers each way. Or as necessary to meet the requirements of the geotechnical conditions. Provide 1/2 in. expansion joint between floor slab and concrete support structure and at pipes and supports that extend through the floor. Place cap strip and sealant over the expansion joint. The slab shall be sloped at 0.5% toward the overhead door for drainage.

2.5 Concrete Support Structure

- A. The design of the concrete support structure shall conform to AWWA D107 and ACI 318 except as modified herein.
- B. The minimum wall thickness shall not be less than 8 inches exclusive of rustications or other architectural relief.
- C. The concrete support structure walls shall have a minimum reinforcement ratio in accordance with AWWA D107 Table 13. Where the seismic design category determined in accordance with ASCE 7 is D, E or F, the minimum reinforcement ratio shall be 0.25% in the vertical and horizontal directions.

- D. The concrete support structure walls shall have reinforcement placed in two layers in each direction with 50% of the minimum required steel in each layer.
- E. The vertical load capacity for walls shall be determined using the procedures in AWWA D107 Section 6.3.
- F. Horizontal reinforcement shall be provided to resist the ovaling of the wall due to wind pressure, using the procedures in AWWA D107 Section 6.3.
- G. The concrete support structure walls shall be designed to resist in plane shear using the procedures in AWWA D107 Section 6.3. The effect of openings shall be considered in the shear design.
- H. Openings in the concrete support structure walls that are less than or equal to 24 inches and are isolated do not require a beam and column analysis. Isolated openings shall have a clear distance between openings equal to 0.75 times the cumulative width of adjacent openings. Additional reinforcement having an area of not less than 1.2 times the area of interrupted reinforcement shall be distributed equally to either side of openings. Openings shall have a minimum of one No. 5 reinforcing bar placed diagonally in each corner. All reinforcing shall be fully developed beyond the opening.
- I. Openings larger than 24 inches or combinations of openings that are not isolated shall be designed using an effective beam and column analysis as per AWWA D107 Section 6.3. Vertical and horizontal reinforcement shall be provided around the opening in accordance with the requirements of this section.
- J. The corners of the openings shall be reinforced with diagonal bars. The area of bars provided shall be equal to the minimum horizontal reinforcement ratio times the column area. A minimum of two No. 5 reinforcing bars shall be placed diagonally in each corner.
- K. Reinforcement provided around openings shall be fully developed. Column reinforcement shall extend the greater of half the opening height or the development length above and below the opening or be developed into the foundation. Horizontal reinforcement shall extend the greater of the development length past the midpoint of the column or a minimum of half a development length beyond the column.
- L. Local effects at openings shall be considered when the opening is located less than half the opening width above the foundation. The foundation shall be designed to adequately develop the opening reinforcement and redistribute loads across the unsupported width.
- M. Support Structure Ventilation - As a minimum, one louvered vent shall be provided at the top of the concrete support structure. This vent shall be accessible from the upper platform and may also be designed to provide access to the exterior rigging rails located at the welded steel tank/concrete support structure intersection. Vents shall be galvanized steel with stainless steel or aluminum insect screen.

2.6 Concrete to Tank Interface

- A. The concrete to tank interface region includes those portions of the concrete support structure and welded steel tank that are affected by the transfer of forces between the concrete tank floor, ringbeam, tank cone bottom and support structure wall. The design of the interface region shall be based on an analysis using finite element or similar analysis which can accurately model the interaction of the intersecting elements. The analysis shall provide results including the shear, moment and compression or tension caused by the intersecting elements in the interface region.
- B. The analysis shall consider the transfer of forces from the intersecting elements under all anticipated load conditions. These conditions shall include the eccentricity of loads, restraint effects caused by shrinkage and temperature differentials, long term effects caused by concrete creep, and the effect of anchorage of the welded steel tank to the concrete.
- C. The geometry of the interface region shall provide positive drainage at the top of the wall and ringbeam. Condensation or precipitation shall not be allowed to accumulate in this area.
- D. The geometry of the tank shall be established such that the ringbeam provided at the top of the wall is a compression member with gravity loads acting alone (D + F). In this loading condition the compressive stress in the ringbeam shall be not less than 50 psi to minimize cracking in the interface region. No direct tension in the ringbeam under this loading condition will be allowed. The maximum compression in the ringbeam shall be no greater than 0.18f_c.
- E. The ringbeam shall be reinforced as a compression member with a minimum longitudinal reinforcement ratio of 0.40%. Tie reinforcement shall be provided in accordance with ACI 318 for compression members as a minimum. Additional tie reinforcement shall be provided if required by the analysis of the interface region.
- F. When a concrete dome supports the tank contents, it shall not be less than 9 inches thick, or less than the mean spherical radius of the dome divided by 50. The minimum reinforcement ratio shall be 0.36% in orthogonal directions. The reinforcement shall be placed in two layers with 50% of the minimum required steel in each layer.

2.7 Welded Steel Tank

- A. The design for all sections of the steel tank shall be per the unit tension/compression stresses allowed for material classes listed in the latest edition of AWWA D107.
- B. The tank shall have a domed/sloped steel roof to minimize snow accumulating and water ponding on the roof plates.
- C. For areas of the steel tank where the water is supported by a steel cone, the cone plate thickness may be determined using a nonlinear buckling analysis. A nonlinear buckling analysis may only be performed for liquid filled cones with a thickness-to-

radius ratio greater than 0.0010 and less than 0.0030. The angle of the cone measured from the axis of revolution to the plate surface shall not exceed 60 degrees. If a nonlinear buckling analysis is not performed, the cone plate thickness shall be determined in accordance with the shell stability formulas provided in AWWA D107.

1. The nonlinear buckling analysis shall include the effects of material and geometric non-linearities, residual stresses and imperfections.
 2. The imperfection considered in the analysis shall have a magnitude of not less than $0.04(Rt)^{1/2}$, where R is the radius normal to the plate measured to the axis of revolution, and t is the corroded plate thickness. The length of the imperfection shall be equal to or less than $4(Rt)^{1/2}$ and be appropriate for the type of construction used for the cone. The location and shape of the imperfection shall produce the lowest critical buckling stress.
 3. The minimum specified yield strength of the cone plate material shall be equal to or greater than 36 ksi. The yield strength used for the analysis shall be no greater than 40 ksi when the material of construction has a minimum specified yield strength greater than 40 ksi.
 4. Plate thickness used for the cone plates shall be no less than 80% of that required by the shell stability formulas provided in AWWA D107 when the thickness to radius ratio is greater than or equal to 0.00143. Cone plate thickness shall be no less than 70% of that required by AWWA D107 when the thickness to radius ratio is less than 0.00143.
 5. The nonlinear buckling analysis shall demonstrate that the provided cone plate thickness has a factor of safety of at least 2.0 against buckling in the corroded condition.
- D. The concrete tank floor shall be covered with a welded steel liner to provide a watertight boundary. The minimum thickness of the liner plate shall be 1/4-inch. Liner plates may be placed directly on the concrete when the liner plates are formed to match the shape of the tank floor. Liner plates that are not formed to match the shape of the tank floor shall have the space between the liner plates and the tank floor completely filled with a flowable grout.
- E. Unless otherwise noted, at junctions in plates where meridional forces are discontinuous such as cone to cylinder junctions, a tension or compression ring may be required to resist the radial forces generated. In these regions, the allowable stresses shall not exceed those referred to in AWWA D107.
- F. Minimum plate thickness of all tank parts shall be in accordance with AWWA D107.
- G. No corrosion allowance is required.

2.8 Accessories

A. General

1. The materials, design of tank Accessories shall be in accordance with Section 7 – Accessories for Ground-Supported Standpipes and Reservoirs of ANSI/AWWA D100-11.
2. Ladders, platforms, rails, access openings, and safety devices shall comply with OSHA standards.
3. See plans for railings, painting rails, and other miscellaneous accessories.

B. Ladders

1. Tank ladders shall be located as shown on the construction plans.
2. Dimensional Requirements
 - a. Ladder shall have side rails not less than 2 in. x 3/8 in.
 - b. spacing between the side rails of not less than 16 in.
 - c. Rungs not less than 3/4 in. round or square
 - d. Rung spacing 12 in. apart on centers.
3. Shall not have backward slope at any place
4. Ladders with single point of connection, or rolling ladders shall not be used.
5. Rungs shall be skid resistant.
6. Ladders shall have climb thru rest platforms provided at no more than 25 ft intervals.
7. Ladders shall be equipped with a fall arrest system meeting OSHA regulations. The system shall be supplied complete with safety harnesses, locking mechanisms, lanyards, and accessories for two persons. This should be compliant with DBI Sala Harness – typical of City of Aurora Installations.
8. Interior ladder shall have a landing as generally reflected on the drawings.

C. Access

1. Roof Hatches
 - a. Provide two access hatches on the roof of the tank, general location as indicated on the Construction Drawings.
 - b. Hatches shall be 30 In. square minimum and allow access from the roof to the interior of the tank. The hatch will be hinged and equipped with a hasp for locking.

- c. Roof openings shall have a 12 In. minimum curb and a downward overlap of at least 2 in.

2. Tank Vent

- a. Tank vent shall be centrally located, and shall be a vacuum-pressure, frost-proof vent, and screen. Vent shall be a T.A.P. Co Model S24 or Equal of Stainless-Steel Fabrication. The vent shall have an intake and relief capacity sufficiently large enough that excessive pressure or vacuum will not develop during flow rates of 10,000 gpm.
- b. Vents shall be designed, constructed, and screened to prevent the ingress of wind driven debris, insects, birds and animals, with an external ¼" Screen and an internal #24 SS Wire Mesh Screen.

3. Floor Manhole

- a. One 24 Inch Diameter manhole shall be provided through the concrete/tank floor interface.
- b. A flange access shall be provided.
- c. Shell plate at manholes shall be reinforced and reinforcing of the neck, bolting, and cover shall be designed to withstand weight and pressure of tank contents in accordance with Section 3.13 of ANSI/AWWA D100-11.

4. Exterior Doors

- a. Provide one 36-inch x 84-inch commercial steel door, 1¾" thick, 4¾" 16-gauge jamb, industrial duty type door closer and automatic door bottom. Door shall be minimum 16-gauge and insulated with pre-formed polystyrene insulation. Door shall be thoroughly cleaned, phosphated and finished with one coat of baked-on rust inhibiting primer in accordance with ASTM B117 and ASTM D1735. Provide three (3) full mortise, 5 knuckle hinges, 4½" x 4½" minimum. Hinges shall be steel, phosphated and primed coated for finish painting. Provide a complete and functional door lockset and tumbler-type lock, keyed to the District Standards. Door painting shall conform to the tank exterior paint system.
- b. Provide one manually operated 10-foot wide by 10-foot high overhead steel rolling door located in the base of the support structure. Door slats shall be formed of 22-gauge steel with end locks and designed for a minimum 20-psf wind load. Steel curtain construction with high-grade zinc coating per ASTM A153 hot process, and phosphate coating for paint adhesion. Provide air baffle for entire upper barrel, curtain bottom bar with brush sealing, weather end lock on alternate slats and sealing strips for weather tightness. The door shall be equipped with slide bolt locks on both sides of

interior bottom. Overhead door location shall be as shown on the drawings.

- c. Provide two (2) 8-inch diameter steel safety posts on the exterior of the overhead door opening to protect the door from vehicle impact. Safety posts shall be filled with concrete.

D. Piping

1. Inlet/Outlet/Drain Piping

- a. The tank shall have four vertical connections to the bottom of the tank, which shall be:
 - 16-Inch Diameter (Inlet)
 - 16-Inch Diameter (Outlet)
 - 4-Inch Diameter (Drain)

The inlet/outlet pipe shall be ASTM A240-304L material. Piping shall conform to ASTM A778 and welded fittings shall conform to ASTM A774. All pipe-to-pipe joints shall be welded. The pipe shall have a minimum thickness of schedule 10S but not less than 3/16-inch. Provide a stainless-steel expansion joint near grade to accommodate differential movements between the inlet/outlet pipe and concrete support structure. The inlet/outlet pipe shall be attached to the support structure with galvanized steel brackets spaced no more than 20 feet apart. Pipe shall be equipped with appropriate transition to Ductile Iron Pipe at base elbow at the inlet/outlet pipes under the tank, this shall be coordinated with Tank Manufacturer, along with appropriate recommended bedding and/or encasement requirements to coordinate with the ring beam foundation.

- b. Down pipes shall be electrically isolated from the below ground piping and tank connections.
- d. Tank shall also have a drainpipe, 4" Diameter which shall discharge contents of tank to same general area as the overflow pipe. To allow cleaning/removal of silt, as necessary. The Drain pipe shall be equipped with an upper and lower butterfly valve to allow for draining. The end of the drain pipe shall be covered with a flap gate.

2. Overflow Piping

- a. The tank shall be equipped with an overflow to protect the tank from overpressure and overload.
- b. Overflow shall be internal to tank and shall be a minimum of 6 Inches in Diameter.

- c. Overflow pipe shall be equipped with an anti-vortex entrance. The overflow pipe within the support structure shall be ASTM A240-304L material. Stainless steel piping shall conform to ASTM A778 and welded fittings shall conform to ASTM A774. The pipe shall have a minimum thickness of schedule 10S but not less than 1/8-inch. Inside the tank, the overflow pipe shall conform to ASTM A53 Grade B and have a minimum thickness of 1/4-inch. All pipe-to-pipe joints shall be welded. The overflow shall be attached to the access tube and support structure, and discharge at a point approximately two and a half feet above grade level onto a splash pad. The attachment to the support structure shall be with galvanized steel brackets spaced no more than 20 feet apart. The end of the overflow shall be covered with a flap gate. Flow capacity shall be 2500 gpm.
- E. Lightning Protection
 - 1. Refer to Electrical Specification 26 14 31.
- F. Electrical, Lighting, Instrumentation, Controls, SCADA
 - 1. Refer to Electrical Drawings and Specifications.

PART 3 – EXECUTION

3.1 General

- A. All concrete formwork, placement and consolidation shall comply with ACI 318 and ACI 301 except as modified herein. Concrete tolerances shall comply with ACI 117 except as modified herein.
- B. Concrete placed in cold weather conditions shall be protected to prevent damage in accordance with ACI 306. The cold weather protection shall continue until the concrete has attained 35% of the specified compression strength and the allowable temperature differential can be maintained.
- C. Concrete placed in hot weather conditions shall be protected to prevent damage in accordance with ACI 305.
- D. Concrete shall be cured in conformance with ACI 318. Curing methods shall be continued until the concrete has reached a compressive strength that will allow for safe jumping of forms without causing damage to previously placed concrete.
- E. Concrete strength tests shall be taken by Contractor in accordance with ACI 318 except as modified herein. Strength test samples shall be taken as the concrete is delivered from the truck. At least one strength test sample shall be taken for every day that concrete is placed. Additional strength test samples shall be taken for every 50 yd³ of concrete placed when the total daily pour is less than or equal to 150 yd³ and for every 150 yd³ of concrete placed when the total daily pour is greater than 150 yd³.

- F. Each strength test sample shall provide at least four 6" x 12" molded cylinders. Two cylinders will be used to establish the 28-day strength in accordance with ACI 318. One cylinder should be tested at 7 days to supplement the 28-day test. The fourth cylinder shall be a spare for the other cylinders.
- G. Inspection and testing of the welded steel tank shall comply with AWWA D107 Section 9.
 - 1. Inspection procedures for the welded steel tank shall be as required by AWWA D107, Section 9, "Inspection and Testing". Radiographic inspection of full penetration butt-welded joints shall be made by an independent inspection company retained by the Contractor.
 - 2. Conical sections of the welded steel water tank designed using Method 2 or Method 3 of AWWA D107 shall be inspected in accordance with Section 9.4 of AWWA D107.
 - 3. Weld joints of plate over the structural concrete floor shall be tested for leaks by vacuum box/soap solution testing, or equivalent method.
- H. Testing
 - 1. Hydrotesting
 - a. Following the recommended period for curing of the interior coating. Tank shall be filled to Overflow with potable water as coordinated at least 48 hours in advance with the Owner or Representative.
 - b. Observe levels in tank for 24 hours.
 - c. Any leaks shall be repaired.
- I. Contractor/Supplier shall submit a written report confirming that the work was inspected as set forth by these specifications and ANSI/AWWA D107. The report shall at minimum include results of the noted concrete and welding inspections etc.
- J. Qualified persons who have an understanding of welding, fabrication, and erection of the tank shall supervise the work.
- K. Contractor will be solely and completely responsible for condition of the project site, including safety of all persons and property during the performance of the work. Safety provisions shall conform to U.S. Department of Labor, OSHA, any equivalent State, County, or Local laws, ordinances and codes. All materials equipment staging, lighting, other safety devices shall be in accordance with these standards.

3.2 Concrete Foundation

- A. If, during excavation, conditions are encountered which differ from those given in the geotechnical report, appropriate adjustments to construction schedule and price will be negotiated.

- B. All exposed formed surfaces shall receive a smooth as-cast form finish and all unexposed formed surfaces shall receive a rough form finish. All exposed unformed surfaces shall receive a trowel finish and all unexposed unformed surfaces shall receive a float finish.
- C. All concrete work shall comply with ACI 301.

3.3 Concrete Support Structure

- A. The concrete support structure wall shall be constructed using a jump form process. The form system shall use curved, prefabricated form segments of the largest practical size to minimize panel joints. Contractor shall identify the Concrete pour height as part of their design. Form panels shall extend the full height of the concrete pour using only vertical panel joints. Formwork shall be secured using bolts through the wall prior to concrete placement. Working platforms that allow safe access for inspection and concrete placement shall be provided. Form facing material shall be metal, or plywood faced with plastic or fiberglass.
- B. Attention shall be given to ensure the same concrete design mix is used throughout the concrete support structure. The proportion, type and source of cement and aggregates shall not be changed. Uniform moisture content and placing consistency shall be maintained.
 - 1. Proportioning - The proportions of materials for concrete shall be established to provide adequate workability and proper consistency to permit concrete to be worked readily into the forms and around reinforcement without excessive segregation or bleeding.
- C. The form system shall incorporate a uniform pattern of vertical and horizontal rustications to provide architectural relief to the exterior wall surface. Construction joints and formwork panel joints shall be located in rustications. Formwork panel joints shall be sealed using closures which combine with the form pattern to prevent grout leakage and panel joint lines. The top of each concrete placement shall be finished with a grade strip. The vertical and horizontal rustications shall be proportioned and combined to impart a symmetrical architectural pattern to the completed structure.
- D. Support wall forming system shall incorporate segmented concrete placement. Temporary vertical bulkheads shall divide the wall pour into segments that are less than a single batch of concrete. The bulkheads shall be located at rustications, braced rigid and tight to maintain vertical alignment under concrete load. Each segment shall be continuously placed with concrete to the full form height. Temporary bulkheads shall not be removed until adjacent concrete is placed.
- E. Formwork shall remain in place until the concrete has attained sufficient strength to support the form removal and subsequent loads without damage to the structure. The Contractor shall base formwork removal procedures and times on early-age test results. However, form movements and concrete placement shall be limited to a maximum of once per day. Additionally, in no instance shall the forms be removed

before the concrete has attained sufficient strength to prevent forming operations or environmental loads from causing surface damage or excessive stress. Form removal shall be based on early age concrete strength testing. The minimum concrete strength shall be established by the Contractor, based on an analysis of stress at critical stages throughout the forming and concrete operations. Early age concrete testing shall be in accordance with ACI 228.1R-03.

- F. Placement - Prior to concrete placement, all snow, ice, water, or other foreign material shall be removed from the spaces that the concrete will occupy. Concrete shall be deposited in its final position in accordance with ACI 318 or the applicable building code. Drop chutes or tremies shall be used in walls and columns to prevent free-fall of the concrete over 5 ft. and to allow the concrete to be placed through the cage of reinforcing steel. These shall be moved at short intervals to prevent stacking of concrete.

- G. Vibration - All concrete shall be consolidated by vibration so that the concrete is thoroughly worked into the corners of forms and around the reinforcement and embedded items to eliminate all air or stone pockets which may cause honeycombing. Internal vibrators shall be the largest practical size that can be used in the work and shall be operated by competent workmen.

- H. Dimensional tolerances for the concrete support structure shall be checked by the contractor prior to each pour and maintained as the structure is built. The tolerances for construction of the concrete support structure are:
 - 1. Support wall variation:
 - Thickness -3%, +5%
 - Diameter 0.4% ≤ 3 inch
 - Vertical alignment:
 - in any 10 feet of height ½ inch
 - in any 50 feet of height 1 inch
 - over total height 1 ½ inch

 - 2. Tank floor variation:
 - Slab floor thickness -3%, +5%
 - Dome floor thickness -6%, +10%
 - Dome floor radius 1%
 - Local deviation from true 3/4 inch
 - (Using a 5-foot sweep board)

 - 3. Level alignment variation:
 - From specified elevation 1 inch
 - From a horizontal plane 1/2 inch

 - 4. Offset between formwork:
 - Exterior exposed surfaces 1/8 inch
 - Interior exposed surfaces 1/4 inch

Unexposed Surfaces 1/2 inch

- I. All exterior exposed surfaces shall receive a smooth as-cast form finish. All interior exposed surfaces shall receive a rough as-cast form finish. All exposed surfaces shall be cleaned to remove surface contamination. All tie holes and concrete voids larger than 3/4-inch diameter and/or 1/2-inch deep shall be filled with a color matching nonshrink grout. All exposed surfaces shall be cleaned to remove any concrete paste leakage from higher placed concrete shaft rings. No additional finish of the exterior exposed surface is required unless excessive form oil remains on the concrete surface.
- J. The top of the concrete tank floor shall receive a float finish.

3.4 Welded Steel Tank

- A. All welding shall comply with AWWA D107.
- B. All welding procedures, welders and welding operators shall be qualified in accordance with ASME Section IX for the processes and positions utilized.
- C. To minimize corrosion and rust staining on the underside of the roof, the underside roof plate laps and rafter-to-roof plate seams shall be seal welded. The minimum thickness for seal welded roof plates shall be 1/4 inch.
- D. The edges or surfaces of the pieces to be joined by welding shall be prepared by flame cutting, plasma arc cutting, arc gouging, machining, shearing, grinding or chipping and shall be cleaned of detrimental oil, grease, scale and rust. The edges of the pieces may have a protective coating applied to them which need not be removed before they are welded unless specifically prohibited by the welding procedures.
- E. Field and shop welding may be done by the shielded metal arc welding process, the gas metal arc welding process, the flux core arc welding process and the submerged arc welding process.
- F. Plates and component members of the tank shall be assembled and welded following erection methods which result in a minimum of distortion from weld shrinkage. Surfaces to be welded shall be free from loose scale, slag, heavy rust, grease, paint and other foreign material.
- G. The Contractor shall remove weld of slag, spatter, burrs and other sharp or rough projections. The surface of the weld shall be suitable for subsequent cleaning and painting operations.
- H. Full penetration butt-welded joints shall be inspected using the radiographic examination method. The number and location of the radiographs and the acceptance criteria shall be as required by AWWA D107. Inspection by sectional segments is not allowed.

- I. All liner plate welds shall be tested using the vacuum box testing method before the tank is painted.
- J. When the cone plate thickness has been determined using a nonlinear buckling analysis, the contractor shall measure the actual imperfections of the cone plates after welding. The measurements shall be taken in the meridional direction. Measurements shall be taken at each meridional weld seam and midway between each meridional weld seam. Where the actual imperfections exceed the tolerances assumed in the analysis, further evaluation will be required and corrective action such as reworking the shell or adding stiffeners may be required.
- K. In order to assist in the maximization of the paint's lifecycle, all welds on the tank exterior shall be ground smooth and blended to a NACE-D profile. All welds on the tank interior shall be ground smooth and blended to a NACE-D profile. Welds on the interior dry support column can remain in an as-welded condition but must have a profile adequate for the specified paint system. Engineer/Owner reserves the right to provide third-party inspection to ensure compliance to this requirement.

3.5 Field Painting and Disinfection

- A. Field Painting shall be in accordance with SECTION 09 97 00.
- B. General Sequence of Events
 - 1. Complete Painting
 - 2. Provide recommended curing time
 - 3. Disinfect the Tank – In accordance with AWWA C652-02
 - 4. Hydrotesting – Fill tank and observe for leaks for a period of not less than 24 hours.
 - 5. Repair/Repeat if necessary.
 - 6. Place Tank into Service
- C. Disinfection
 - 1. Contractor may use any of Methods 1-3, as set forth by AWWA C652-02, but must notify ENGINEER of method to be used.
- D. Verification
 - 1. After chlorination is complete, prior to placing the tank into service, the potable water shall be sampled and tested for coliform organisms.
 - 2. If testing is negative, the tank may be placed in service, provided chlorine levels are within acceptable limits.

3.6 Miscellaneous

A. Security

1. Contractor shall be responsible for the security of the Construction site until the project is at final completion and accepted by the Owner. All temporary fences, security guards, or other measures are the responsibility of the Contractor.

B. Toxic Materials

1. Toxic materials including lead, chromates, and mercury are not permitted. Any materials or coatings containing carcinogens or toxins that require special hazardous waste treatment or disposal are not to be used.

C. Cleaning up During Construction

1. The contractor shall keep the premises occupied in a neat and clean condition. Contractor shall at his own cost, satisfactorily dispose of or remove from the vicinity of the site all rubbish, unused materials, concrete forms, and any other equipment or materials belonging to him.

END SECTION

SECTION 09 97 00

TANK COATING

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. General: This section covers surface preparation, furnishing, and application of industrial and architectural paint and special protective coatings for the Water Storage Tank, complying with ANSI/AWWA D102- 17.
- B. The intention of these Specifications is for exterior tank metal and interior tank (requiring repair due to other improvements) to be painted, whether specifically mentioned or not, except as specified otherwise. Prime and coat structural steel surfaces as specified.

1.2 REFERENCE STANDARDS

- A. General:
 - 1. The work is in general conformance with ANSI/AWWA D102-17 Standard for Coating Steel Water Storage Tank. The latest revision of the following standards shall apply, at a minimum, to the coating materials, testing, and installation except where more stringent standards are applicable. In case of conflict, the most stringent requirements shall apply.
- B. ANSI/AWWA D102-17 References the following Standards, these documents form a part of this standard.
 - 1. AAMA 2604 - Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels.
 - 2. ANSI/AWWA C210 - Liquid Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines.
 - 3. ANSI/AWWA C222 - Polyurethane Coatings for the Interior and Exterior of Steel Water Pipe and Fittings.
 - 4. ANSI/AWWA D100 - Welded Carbon Steel Tanks for Water Storage
 - 5. NACE§ RP0188 - Discontinuity (Holiday) Testing for Protective Coatings

6. NSF/ANSI 61 - Drinking Water System Components - Health Effects
7. SSPC-PA 2 - Measurement of Dry Coating Thickness with Magnetic Gages.
8. SSPC - Paint 20 - Zinc Rich Coating (Type I, Inorganic, and Type II Organic.)
9. SSPC - Paint 28 (2013) - Water-Borne Epoxy Primer for Steel Surfaces.
10. SSPC - Paint 36 - Two-Component Weatherable Aliphatic Polyurethane Top-coat, Performance Based.
11. SSPC - Paint 101 (2013) -Aluminum Alkyd Paint, Leafing (Type I) and Non-Leafing (Type 11).
12. SSPC - PS 24.00 (2013) - Latex Painting System for Industrial and Marine Atmospheres, Performance Based.
13. SSPC - PS 27.00 (2013) - Alkyd Coating System Materials Specification, Performance Based.
14. SSPC-SP6/NACE No. 3 - Commercial Blast Cleaning
15. SSPC-SP7/NACE No. 4 - Brush-Off Blast Cleaning
16. SSPC-SP1 O/NACE No. 2 - Near-White Blast Cleaning
17. SSPC-SP11 - Power Tool Cleaning to Bare Metal
18. SSPC-SP15 - Commercial Grade Power Tool Cleaning
19. SSPC-SP WJ-2/NACE WJ-2 - Waterjet Cleaning of Metals -Very Thorough Cleaning.
20. SSPC-SP WJ-3/NACE WJ-3 - Waterjet Cleaning of Metals - Thorough Cleaning.
21. SSPC-SP WJ-4/NACE WJ-4 - Waterjet Cleaning of Metals - Light Cleaning.
22. SSPC TU 3 - Overcoating

1.3 DEFINITIONS

A. Terms used in this section:

1. Applicator: The Contractor or person, company, or organization applying the coatings or linings.
2. Coating: Liquid, powder, or mastic composition that has been converted to a solid, durable, and functional adherent film after application as a thin layer.
3. Coverage: Total minimum dry film thickness in mils, or square feet per gallon.
4. Exterior Surfaces: External surfaces of the tank, roof, shell, accessories, and appurtenances that are exposed to the elemental atmosphere.
5. Inaccessible Areas: Areas of the finished structure that, by virtue of the configuration of the completed structure, cannot be accessed to perform surface preparation or coating application (with or without the use of scaffolding, rigging, or staging). Inaccessible areas include such areas as the contact surfaces of roof plate lap joints, underside of roof plates where they cross supporting members, top surface of rafters directly supporting roof plates, contact surfaces of bolted connections, underside of flat bottom tanks, etc.
6. Interior Wet Surfaces: Internal surfaces to the tank roof, shell, bottom, accessories, and appurtenances that are exposed to the stored water or its vapor.
7. Manufacturer: The company or organization, who makes or formulates and markets coating or lining products.
8. Manufacturer's Representative: Employee of manufacturer who is factory trained and knowledgeable in technical aspects of their products and systems.
9. Preconstruction Primer: Primers shop applied at relatively low (0.75-2.0 mil) dry film thickness.
10. Tank: As defined by the drawings and these specifications.

B. Abbreviations used in this section:

1. ANSI: American National Standards Institute.
2. AWWA: American Water Works Association

3. MDFT: Minimum Dry Film Thickness.
4. MDFTPC: Minimum Dry Film Thickness per Coat.
5. Mil: Thousandth of an inch (0.001) = 25.4 Microns.
6. MSDS: Material Safety Data Sheet.
7. NACE: National Association of Corrosion Engineers-International
8. NSF: National Sanitation Foundation
9. OSHA: Occupational Safety and Health Act
10. PSDS: Paint System Data Sheet.
11. SFPG: Square Feet per Gallon.
12. SFPGPC: Square Feet per Gallon per Coat.
13. SP: Surface Preparation.
14. SSPC: The Society for Protective Coatings (Formally Steel Structures Painting Council)
15. UV: Ultraviolet
16. VOC: Volatile Organic Compound

1.4 SUBMITTALS

- A. Submit in General Accordance with SECTION 01 33 23 Shop Drawings.
- B. In addition, the following specific information shall be provided.
 1. Materials
 - a) Submit manufacturer's recommended paint system suitable for intended use per the Application Schedule included herein. For each paint system, furnish a Paint System Data Sheet

(PSDS), the manufacturer's Technical Data Sheets, and paint colors available (where applicable) for each product used in the paint system.

- b) Submit current Material Safety Data Sheets (MSDS) for each product to be used.

2. Application Method: method for inside and outside coatings.

- a) Submit Material Manufacturer Coating Application Specifications and special details for each specific coating system utilized. Manufacturer's written instructions to include:
 - (1) Surface Preparation Requirements
 - (2) Application and Storage Requirements
 - (3) Testing Procedures, Frequencies, and Parameters
 - (4) Adhesion Requirements for flat stock, original and repair coatings
 - (5) Repair Procedures
 - (6) Recoat (window) time
 - (7) Cure Time
- b) Submit required information on a coating system-by-system basis.
- c) Submit list of testing equipment to be provided for project based on the type of coating being provided and the coating manufacturer recommendations and requirements of this specification. Test equipment shall be approved and at project site or factory coating site before surface preparation and coating operations start.
- d) Furnish copies of paint system submittals to the coating Applicator.
- e) Indiscriminate submittal of manufacturer's literature only is not acceptable.

C. Samples

2. Reference Panel:

- a) Prior to start of surface preparation, furnish a 4-inch by 4-inch steel panel for each grade of sandblast specified herein, prepared to specified requirements.
- b) Provide panel representative of the base material used;

prevent deterioration of surface quality.

- c) Upon approval by Engineer, preserve panel as a reference source for inspection.

3. Coating Samples

- a) Submit a minimum 2-inch by 2-inch sample of each coating system to be provided on both a rigid substrate and a flexible substrate surface.
- b) Submit color samples for specific paint systems for Owner selection.

D. Quality Control Submittals

- 1. Applicator's Experience: List of references substantiating experience in similar environments of Illinois.
- 2. Product Manufacturer's Experience: List of representative references substantiating experience.
- 3. Applicator Certification: Coating Product Manufacture shall provide letter stating that Applicator is approved and qualified by coating manufacturer to apply shop and field applied coating.
- 4. Submit name and phone number of product manufacturer technical service person proposed for project for Engineer review and approval prior to approval of coatings and linings systems
- 5. Factory Applied Coatings: Manufacturer's certification stating factory applied coating system meets or exceeds requirements specified.
- 6. If the manufacturer of finish coating differs from that of shop primer, provide both manufacturers' written confirmation that materials are compatible.
- 7. Anticipated coating sequence and schedule.
- 8. Submit copy of NSF letter of certification for coating and lining approval for use in potable water. NSF certification letter shall include product application limits, coating system, and certified colors approved for intended application.
- 9. Product Manufacturers' Certificate of Proper Installation by Applicator.

1.5 QUALITY ASSURANCE

- A. The proposed coating systems shall have similar applications in similar environments to Colorado.
- B. Applicator shall have minimum five (5) years' experience with specified or similar products and maintain an in-house quality assurance program that monitors surface preparation, coating application, and quality control testing for coating and lining operations. Level of experience, quality assurance program, and quality control testing by Applicator shall meet minimum requirements of these specifications and written product manufacturer instructions.
- C. Applicator shall be pre-approved by Coating Manufacturer. Applicator personnel involved in surface preparation, coating, and quality control testing shall be trained by coating manufacturer in correct surface preparation, coating application, and testing as required for each specific product.
- D. Where product manufacturer requires Coating Applicator Certification, provide names of personnel conducting application and copies of certificate of training for each individual from specific product manufacturer.
- E. Provide manufacturer's technical representative at factory and field application site for installation assistance, inspection, and certification of application.
 - 1. At start of project.
 - 2. At end of coating cure to confirm correct coating application and adequate cure to allow exposure of coating to liquid.
- F. The coating manufacture technical representative shall periodically visit the job site at sufficient intervals during surface preparation and coating as may be required for product application quality assurance, and to determine compliance with manufacturer's instructions and these specifications, and as may be necessary to resolve field problems attributable to, or associated with, manufacturer's products furnished for this project.
- G. Coating manufacturer shall provide technical on-site assistance upon request of Engineer as necessary to resolve surface preparation or application problems within two (2) days of time of request by Engineer and provide technical assistance for period of time as determined adequate by Engineer to resolve problem at no additional cost to the Owner.
- H. Following each site visit, Coating Material Manufacturer shall provide written letter stating that he/she has observed the application procedures and that said operations are being conducted in accordance with this specification

and the manufacturer's standards of care.

- I. Monitor environmental conditions, conduct surface preparation, and coating application quality control checks in accordance with product manufacturer's recommendations, Applicator Quality Control Program, and as required by these specifications. Complete dry film measurements and holiday inspection on cured coatings.
- J. Coating and environmental test equipment shall be available and in working order at the plant before start of factory coating and at the field site before field coating operations begin. Coating and environmental test equipment shall be stored and maintained at both factory and field sites in accurate, working condition. Test equipment shall be available to Engineer and Owner for testing purposes.
- K. Engineer may reject coated and lined items for excessive damage, poor workmanship, or inadequate surface preparation. Items determined by Engineer to have excessive problems shall be corrected in a timely manner at sole cost to the Contractor. Coating product manufacturer shall provide recommended surface preparation and repair procedures to Engineer for review and approval. Surface preparation and repair procedures shall be mutually agreed upon between product manufacturer and Engineer prior to incorporation into work by Contractor.
- L. If in the coating manufacturer or Engineer's evaluation surface preparation, application, or coating quality control are not as specified or there is excessive poor workmanship or damage, upon notification by Engineer, Contractor and Applicator shall immediately stop production. Coating application shall cease until quality control issues are resolved to the satisfaction of both the coating manufacturer and the Engineer.
- M. Failure to follow product manufacturer's written recommendations and these specifications shall be cause for stoppage of surface preparation and coating operations and rejection of all coated surfaces completed outside these parameters, at sole cost to Applicator.

1.6 REGULATORY COMPLIANCE

- A. Meet federal, state, and local requirements for project safety, confined space entry, and limiting the emission of volatile organic compounds and worker exposure.
- B. Protect workers and comply with applicable federal, state, and local air pollution and environmental control regulations for surface preparation, blast cleaning, disposition of spent aggregate and debris, coating application, and dust prevention.

Observe requirements included but not limited to the following acts, regulations, standards, and guidelines:

1. Ozone Transport Commission (OTC) Phase 1 / LADCO
 2. National Ambient Air Quality Standard
 3. Resource Conservation and Recovery Act (RCRA)
 4. OSHA Interim Final Rule on Lead Exposure in Construction
 5. SSPC Guide 61
 6. SSPC Guide 71
- C. All coatings (including thinners) for items in contact with potable water shall be approved for potable water contact and conform to NSF Standards 60 and 61.
- D. Protect workers and comply with applicable federal, state, and local air pollution and environmental control regulations for surface preparation, blast cleaning, disposition of spent aggregate and debris, and coating application. Observe applicable regulations for dust prevention.
- E. Provide worker training, equipment, and comply with confined space requirements for applicable federal, state, and local regulations where applicable.
- F. Comply with all safety-training requirements recommended by coating manufacturer and promulgated or required for this project.

1.7 SPECIAL GUARANTEE

- A. The Contractor, Applicator, and coating manufacturer shall jointly and severally warrant to the OWNER and guarantee the work under this section against defective workmanship and materials for a period of one (1) year commencing on the date of final acceptance of the work.
- B. First Anniversary Inspection:
1. A warranty inspection of the paint systems shall be made at the end of the warranty period by the ENGINEER. The ENGINEER shall notify the CONTRACTOR via an Inspection Report of any evidence of failure of the coating system.
 2. Any locations where layers of coating have peeled off, bubbled, or cracked, or locations where rusting is evident, shall be considered a failure of the coating system.

3. Any defects in the coating system discovered at this time shall be repaired in a timely manner by the CONTRACTOR or Applicator in accordance with the written coating manufacturer's instructions as reviewed and approved by the ENGINEER. All surface preparation and coating repair or any damage to other work caused by such defect or repairing of the defects including full-time inspection in behalf of the Owner shall be at sole cost to Contractor or Applicator.

PART 2 – PRODUCTS

2.1 GENERAL

- A. The existing water storage tank to be repainted and repaired should be recoated utilizing the following schedule. Coating Systems shall be in accordance with Section 4.4 of ANSI/AWWA 0102-17 and as defined in this section. All coatings and thinners must be supplied by one manufacturer.
 1. Exterior Surfaces- Underside of Tank Floor.
 - a) Self Primed Moisture Cured Urethane Coal Tar (6 Mils DFT)
Sherwin Williams (SW) Corthane 1 – Coal Tar
Tnemec (T) Omnithane Series 1
 2. Exterior Surfaces – Exposed Tank Walls/Roof Etc.
Three-Part System
 - a) Prime Coat: Aromatic Urethane Zinc Rich Primer.
(3.0 Mils DFT)
SW – Corothane 1 Galvapak 1K Zinc Primer
T- Series 91 – H2O Hydro-Zinc
 - b) Intermediate Coat: Aliphatic Acrylic Polyurethane
(4.0 Mils DFT)
SW – Acrolon 218 HS
T - Series 73 – Endura-Shield
Color: Coordinate as needed with Finish Color.
 - Finish Coat Advanced Thermoset Fluoropolymer
(3-4 Mils DFT)
SW – Fluorokem HS
T - Series 701 – Hydroflon (Semi-Gloss)
Color: Owner Selected
 3. Interior Surfaces shall be coated with an epoxy system, NSF Standard 61 approved for use in potable water.

- a) Prime Coat: Aromatic Urethane Zinc Rich Primer.
(3.0 Mils DFT)
SW – Corothane 1 Galvapak 1K Zinc Primer
T- Series 91 – H2O Hydro-Zinc
- b) Stripe/Intermediate/Finish Coat: Polyamide Epoxy (Stripe 2-4
Mils DFT, Intermediate 6 Miles DFT, Finish 6 Mils DFT)
SW – Macropoxy 5500
T – Series FC 20 HS Pota-Pox
Color: Tank White or Equivalent

Coating systems on interior surfaces of the tank shall have been tested and certified for potable water contact in accordance with NSF/ANSI 61. System shall have been evaluated for long-term freshwater resistance and demonstrated satisfactory service in potable water in similar applications for at least eighteen (18) months.

- B. Unless otherwise indicated, provide all first-quality, new materials, free from defects, in first class condition suitable for the intended use. Provide materials which are the highest quality standard of manufacturers regularly engaged in the production of such materials.
- C. The containers in which coating materials are delivered shall be marked with the manufacturer's name, product name or number, identification of components shipped in separate containers, date of manufacture or expiration of shelf-life date, batch number and safety precautions.
- D. Product Information: The following shall be provided for each product.
 - 1. Mixing Instructions: Including acceptable tinting pigments when applicable.
 - 2. Thinning Instructions: Allowable quantity and type of thinner, and application method.
 - 3. Percent Solids: For two-component materials.
 - 4. Spreading Rate: Theoretical spreading rate SFPGPC
 - 5. Weight: Unit Weight per Gallon for component materials.
 - 6. Application, drying, and cure time: Recommended drying time between coats and cure time before immersion.
 - 7. Pot Life: Life of two-component or multi-component coatings shall be stated. A description of variations caused by changes in temperature, humidity or other ambient conditions shall be stated.

8. Application Method: Brush, Roller, Spray
9. Shelf Life and other applicable Storage information.

2.2 PRODUCT MANUFACTURERS

- A. Each coating system provided herein shall be the end product of one manufacturer in order to achieve standardization for appearance, maintenance, and replacement.
- B. Alternate suppliers will be considered, subject to approval of the Engineer.

2.3 COLORS

- A. General
 1. Colors to be used are to be selected by Owner from color samples to be supplied by the coating manufacturer generally described above.
 2. Where more than one coat of a material is applied within a given system, alternate color to provide a visual reference that the required numbers of coats have been applied. Blending of two colors for visual color reference in multiple coat system will not be permitted.
 3. Interior colors shall alternate with final coat white or as selected by Owner. Stripe coats shall be alternated in color similar to a full coat.

2.4 MONITORING AND TESTING EQUIPMENT

- A. Supply the instrumentation needed for all monitoring and analysis responsibilities, specifically as noted in Part 3 of this specification. Use equipment that is free of loose dust, debris when brought onto the project site, and upon removal.

2.5 PERSONAL PROTECTIVE EQUIPMENT

- A. Supply the personal protective equipment (PPE) and hygiene facilities needed for the project. Provide all necessary protective equipment for up to two Owner Representatives each day, including proper cleaning and disposal.

2.6 WASTE CONTAINERS

- A. Supply appropriate drums, tanks, or other containers of appropriate size

suitable for the waste (hazardous/nonhazardous) generated on the project.

2.7 TEMPORARY CONSTRUCTION OPENINGS

- A. If the CONTRACTOR desires to retain a temporary opening through the permanent structure for equipment and personnel access, the CONTRACTOR shall coordinate with the TANK ERECTOR/CONTRACTOR as to the size and configuration of the proposed opening, including details at intersections with proposed weld seams, any proposed temporary stiffening along each side and across top of opening, including weld details.
- B. Contractor will be responsible for exterior coating and interior coating touch up, as necessary.

PART 3 - EXECUTION

3.1 WORKMANSHIP

- A. All materials and equipment associated with surface preparation and coating application as shown and specified herein shall be furnished and installed by the Contractor or associated sub-Contractor. Any changes in design or method of installation of an item as specified shall be reviewed and approved by the Engineer prior to installation.
- B. All work shall be in accordance with these Specifications and the printed directions and recommendations of paint manufacturer whose product is to be applied. The more stringent requirements shall apply. Where a better grade of material or a higher standard of workmanship is required, the most stringent requirement shall apply.
- C. Nothing included or omitted in this specification shall relieve the Contractor of the obligation of providing a complete and satisfactory coating system.
- D. Obtain full cure of coating systems before immersion or allowing exposure to moisture. Consult coatings manufacturer's written instructions for these requirements. Do not immerse or expose coatings to moisture for any purpose until completion of curing cycle. Conduct final hardness and cure testing before exposure to water or fluids allowed.
- E. Qualified persons who have read and understood both the recommended product manufacturers' application procedures and the requirements of these specifications shall supervise all work.

3.2 APPLICATION SAFETY

- A. Perform surface preparation and painting in accordance with recommendations of the following:
1. These specifications.
 2. Coating manufacturer's instructions.
 3. Referenced Standards
 4. NACE - Manual for Painter Safety.
 5. SSPC-PA Guide No. 3, Guide to Safety in Paint Applications.
 6. Federal, state, and local agencies having jurisdiction.
- B. Contractor will be solely and completely responsible for condition of the project site, including safety of all persons (including employees) and property during performance of the work. This requirement will apply continuously and not be limited to normal working hours. Safety provisions will conform to U.S. Department of Labor, Occupational Safety and Health Act, any equivalent state law, and all other applicable federal, state, county, and local laws, ordinances, and codes. Contractor should adhere to written compliance programs as outlined in the submittals as noted above.
- C. Wear protective clothing and proper respirator equipment when applying coating as recommended by product manufacturer. Apply only with adequate air exchange and ventilation in enclosed areas.
- D. Provide containment sheets, rigging, ladders, dance floor, staging, ventilation, safety, confined space, and lighting equipment as necessary to safely accomplish surface preparation and coating operations. Staging shall be provided with safety handrails. Rigging and staging shall be type and placed so as allow safe and clear access to all surfaces to be coated.
- E. All materials, equipment, staging, lighting, spiders, and safety devices shall conform to applicable safety requirements of the OSHA Safety and Health Standards for Construction.
- F. Provide necessary monitoring, ventilation, and safety equipment and comply with federal, state, and local regulations for confined space entry requirements where applicable.
- G. Provide and operate equipment that meets explosion proof requirements.

3.3 ENVIRONMENTAL REQUIREMENTS

- A. Do not apply paint in temperatures outside of manufacturer's recommended maximum or minimum allowable, or in dust, smoke-laden atmosphere, damp or humid weather.
- B. Perform abrasive blast cleaning or apply coating only when relative humidity is below 85-percent and when structure surface temperature is more than 5 degrees F. above dew point and rising unless approved by coating manufacturer.
- C. Monitor environmental (weather} conditions during surface preparation and coating application. Minimum environmental tests shall consist of
 - 1. Weather at time (rain, snow, clear, etc.}
 - 2. Relative humidity
 - 3. Dew point
 - 4. Structure surface temperature.
- D. Test and record readings at least:
 - 1. Once every four hours
 - 2. At the start and end of surface preparation or coating operations
 - 3. At more frequent intervals if recommended by coating manufacturer or product specific specifications.
- E. Stop surface preparation and/or coating operations when environmental (weather} conditions are outside allowable parameters.
- F. Maintain daily written diary record of environmental conditions and surfaces prepared and coated. Daily record shall be available to paint manufacturer representative and Engineer if requested.
- G. Where weather conditions or project requirements dictate, Contractor shall provide and operate dehumidification equipment so as to allow surface preparation and coating application to be conducted as specified.
- H. Conduct surface preparation and apply coating in controlled environment protected from moisture, wind, dust, dirt, and contamination. Apply only to properly cleaned and prepared surfaces. Provide containment sheets and

partitions as required to limit surface preparation and cleaning operations to work area.

- I. Where weather conditions or project requirements dictate, provide and operate equipment so as to allow surface preparation and coating application to be conducted as specified. Contractor shall provide equipment so as to maintain surface moisture, temperature, or protection as required for coating applications.
- J. For removal of coatings containing lead, provide chemical stripping, containment systems, surface preparation power tools, blast equipment, and dust collection equipment which will prevent the discharge of dust and paint particles into the atmosphere and/or contamination of the project site in accordance with procedures developed in submittals noted previously.

3.4 OBSERVATION OF WORK

- A. Provide access to the project or shop site for Owner, Engineer/Representative, and coating manufacturer at all times during surface preparation, coating application, and to inspect finished work.
- B. Provide Engineer minimum 14 days advance notice to start of shop or field surface preparation work and coating application work.
- C. Schedule inspection in advance and obtain approval of Engineer/Representative for cleaned surfaces and for each coat prior to application of subsequent coats.
- D. Perform surface preparation and coating work only in presence of Engineer/Representative, unless granted prior approval to perform such work in absence. Approval to perform work in the Engineer's absence is limited to the current day unless specifically noted in writing to extend beyond completion of the workday.
- E. Observation by the Engineer/Representative or the waiver of observation of any particular portion of the work shall not be construed to relieve the Contractor of his responsibility to perform the work in accordance with these specifications.
- F. All materials shall be subject to observation for suitability as the Engineer may elect, prior to or during incorporation into the work.
- G. The Engineer reserves the right to reject all work that does not meet the minimum requirement of this specification. This may be done either during or after completion of the surface preparation or coating work.

- H. Repair all defective or rejected work in accordance with written recommendations of the particular coating manufacturer as reviewed and approved by the Engineer.
- I. Remedy all defective work in a timely manner to the satisfaction of the Engineer at no additional cost to the Owner.
- J. Access and Assistance During Inspection
 - 1. Where required for access, provide staging, ventilation, safety, confined space, and lighting equipment and any assistance as necessary to the Engineer for inspection.
 - 2. Provide scaffolding as required for inspection. Position and move scaffolding as requested by Engineer to facilitate inspection. Provide sufficient lighting as required to cover all areas to be inspected.
 - 3. Leave staging and lighting up until Engineer has inspected surface preparation or coating. Staging or equipment removed prior to surface preparation or coating inspection and approval shall be replaced.
 - 4. Provide additional staging, equipment, or lighting as requested and required by Engineer to perform adequate quality of inspection.

3.5 SURFACES NOT REQUIRING PAINTING

- A. Unless otherwise stated or shown, the following areas or items will not require painting or coating:
 - 1. Concrete and masonry surfaces. Concrete exterior slabs.
 - 2. Reinforcing steel.
 - 3. Nonferrous and corrosion-resistant ferrous alloys such as copper, bronze, monel, aluminum, chromium plate, atmospherically exposed weathering steel, and stainless steel, except where:
 - a) Required for electrical insulation between dissimilar metals.
 - b) Aluminum and stainless steel are embedded in concrete or masonry, or aluminum is in contact with concrete or masonry.

3.6 SURFACE PREPARATION

A. General

1. This section describes surface preparation for interior and exterior coating systems.
2. Requirements shall be followed unless coating manufacturer has more stringent requirements, in which proprietary requirements shall prevail, or alternative recommendations due to specific site or environmental conditions at the time of work.

B. Interior Tank Surfaces

1. Shall be cleaned in accordance with SSPC-SP10/NACE No. 2 or as recommended by Coatings Supplier.

C. Exterior Tank Surfaces

1. Exposed: Shall be cleaned in accordance with SSPC-SP10/NACE No. 2 or as recommended by Coatings Supplier.
2. Underside of Tank Floor: Shall be cleaned in accordance with SSPC-SP14/NACE No. 8 or as recommended by Coatings Supplier.

D. Blast Cleaning

1. Minimum surface preparation is as specified herein.
2. Do not perform surface preparation blast prior to submission and approval of samples.
3. Provide materials, equipment, procedures, and safety equipment for personnel in accordance with current SSPC specifications.
4. Abrasive: Either wet or dry blasting sand, grit, steel shot, C02, Nitrogen, sponge, or nuts h e l l per coating manufacturer's recommendations.
5. Select various surface preparation parameters such as size and hardness of abrasive, nozzle size, air pressure, and nozzle distance from surface such that surface is cleaned, and adequate profile provided without pitting, chipping, or other damage.
6. Verify parameter selection by blast cleaning a trial area that will not be exposed to view.
7. Engineer will approve acceptable trial blast cleaned area and will use area as a representative sample of surface preparation.

8. Repair or replace surfaces damaged by blast cleaning.
9. The words "solvent cleaning", "hand tool cleaning", "wire brushing", and "blast cleaning", or similar words of equal intent in these Specifications or in paint manufacturer's specifications refer to the applicable SSPC Specifications.
10. Where OSHA or EPA regulations preclude standard abrasive blast cleaning, wet or vacuum-blast methods may be required. Coating manufacturers' recommendations for wet blast additives and first coat application shall apply.
11. Hand tool clean areas that cannot be cleaned by power tool cleaning.

E. Pit Filling and Surfacing

1. After the specified surface preparation, any pits, rough areas or seams defined for pit filling or surfacing by ENGINEER shall be filled with solvent-less polyamide epoxy seam sealer of the type recommended by the supplier of the interior paint system.
2. Epoxy seam sealer shall be applied neatly and smoothly to the steel surfaces and any rough areas of the seam sealer shall be sanded smooth prior to the application of the coating system.

F. Interior Chipping and/or Grinding

1. Any irregular surfaces defined by Engineer, including but not limited to surface protrusions, burrs, fitting scars, sharp edges or corners, weld spatter, overlap and rough weld beads shall be removed from the interior surfaces of the tank, by chipping and/or grinding these irregular surfaces to a smooth curve, suitable for application of a uniform thickness coating with voids.

3.7 PAINT MIXING

A. Multiple-Component Coatings:

1. Prepare using the contents of the container for each component as packaged by paint manufacturer.
2. No partial batches will be permitted.
3. Mix coating in manner and for length of time as recommended by coating manufacturer.

4. Allow coating to set or "sweat" for amount of time as recommended by product manufacturer.
 5. Do not use multiple-component coatings that have been mixed beyond their pot life.
 6. Furnish small quantity kits for touchup painting and for painting other small areas.
 7. Mix only components specified and furnished by paint manufacturer.
 8. Do not intermix additional components for reasons of color or otherwise, even within the same generic type of coating.
- B. Use of accelerators, thinners, or other additives is not acceptable for coatings in contact with potable water unless approved by product manufacture and provided with ANSI/NSF certification letters for the coating system.
- C. Keep paint materials sealed when not in use.

3.8 APPLICATION

- A. General:
1. Apply coatings in accordance with these specifications, the paint manufacturers' printed recommendations, and project specific details. The more stringent requirements shall apply.
 2. Ensure surfaces are clean and dry prior to painting.
 3. Paint surfaces the same day they are sandblasted before they start to rust. Reblast surfaces that have started to rust.
 4. Provide ventilation, heating, and/or dehumidification as required to meet environmental requirements of coating being applied.
 5. Allow sufficient time between coats to assure thorough drying of previously applied paint.
 6. Coat previous coated surfaces within recoat window. Consult specific product data sheets for necessary cure and recoat times.
 7. Vacuum clean surfaces free of loose particles. Use tack cloth just prior to applying next coat.

8. Coat units or surfaces to be bolted together or joined closely to structures or to one another prior to assembly or installation with specified number of coats and thicknesses.
9. Where more than one coat of a material is applied within a given system, alternate color to provide a visual reference that the required number of coats has been applied.
10. Some paint systems require specific application details that are included in other sections of the Contract Documents. These specific detail requirements shall be considered as part of the work.

B. Field Coating Testing

1. Conduct wet film measurements during paint application.
2. Conduct dry film thickness measurements and electrical holiday inspection of the cured coatings in accordance with coating manufacturer's written directions and these specifications.
3. Conduct dry film measurements for each coat.
4. Conduct electrical holiday testing only after complete coating system has cured for a sufficient time period as recommended by the coating manufacturer.
5. Recoat and repair as necessary for compliance with the Specifications per FIELD REPAIR.
6. Retest after repaired and recoated areas have dried sufficiently.

C. Stripe Coat:

1. Provide stripe coat on all bolted connections, edges, angles, welds, bolts, rivets, structural steel flanges and all other areas where paint application may not result in adequate paint millage and coverage.
2. Apply stripe coat between primer and intermediate coats.
3. Alternate stripe coat color with full coat color so as to provide a visual reference that the required number of coats have been applied in multiple coat systems.

D. Film Thickness:

1. Coverage is listed as either total minimum dry film thickness in mils

(MDFT) or the spreading rate in square feet per gallon (SFPG). Per coat determinations are listed as MDFTPC or SFPGPC.

2. Dry film thickness mils shall be in accordance with Coating System Requirements, and manufacturer's recommendations -said criteria is the absolute minimum allowed.
3. Number of Coats: Minimum required irrespective of the coating thickness. Additional coats may be required to obtain minimum required paint thickness, depending on method of application, differences in manufacturers' products, and atmospheric conditions.
4. Where dry film thickness measurements are below the specified minimum, provide additional coat of paint, as necessary to meet the thickness required.
5. Maximum film build per coat or system shall not exceed coating manufacturer's recommendations.
6. Give particular attention to edges, angles, flanges, bolts, nuts, rivets, and other similar areas, where insufficient film thicknesses are likely to be present, so as to ensure proper millage and coverage in these areas.

E. Coating System Curing:

1. If required by weather conditions or project schedule, provide and operate heating equipment during cure period in accordance with coating manufacturer's instructions. Provide continuous forced air ventilation during interior tank or interior structure painting and paint curing, air turn-over shall be according to paint manufacturer's recommendations for tank or structure size and coating applied.
2. Provide forced air-drying and/or heat curing in strict accordance with the methods and for the time recommended by the coating manufacturer. Heat shall be provided with indirect fired heaters and performed in a manner which provides uniform heating of the metal surfaces. Use only heat source types approved by coating manufacturer.
3. Cure time will be based on the coldest surface temperature and the average daily surface temperature measured during forced curing.
4. Allow sufficient time between coats to allow thorough drying of previous coat before application of finish coats.

5. Full cure of coating system shall be achieved before any exposure to liquid or water shall be permitted.
 6. Conduct solvent wipe test and consult coating manufacturer for recommendations.
 7. Obtain and provide approval letter from coating manufacturer prior to allowing exposure to water.
- F. Manufacturer Applied Paint Systems:
1. Repair abraded areas on factory finished items as recommended by coating manufacturer.
 2. Carefully blend repaired areas into original finish.
- G. Clean surfaces of all dust and residual particles by dry air blast cleaning, vacuuming, or other methods prior to coating. Take precautions to minimize dust-settling problems, especially in enclosed areas.
- H. The tank prime coat may at the Contractor's option be shop applied (if applicable). Blast clean and prime in accordance with these specifications for metal surfaces. Centrifugal wheel blast cleaning is an acceptable alternative to shop blast cleaning. Coordinate with Engineer for inspection of shop cleaned and primed work at factory coating production site.
- I. Conduct final cleanup of the interior of each tank to include a broom sweep of the floor to remove all foreign objects and a high-pressure wash of all walls, ceiling, and supporting structures to dislodge any fine grit material. The floor shall be high pressure washed and brushed clean to remove any material that may be bonding to the floor. Water must be disposed of properly. Water necessary for cleaning may be provided by the Owner at no-cost, but Contractor shall be responsible for getting to site.
- J. Conduct final holiday inspection of interior tank floor and bottom sidewalls following completion of final tank cleanup.

3.9 FIELD REPAIR

- A. Unsatisfactory Application
1. If item has an improper finish color, or insufficient film thickness, clean surface and topcoat with specified paint material to obtain specified color and coverage.
 2. Obtain specific surface preparation and coating repair information from coating manufacturer for coatings that have exceeded the maximum recoat time (window).

3. Hand or power sand visible areas of chipped, peeled, or abraded paint, and feather the edges. Follow with primer and finish coat. Depending on extent of repair and appearance, a finish sanding and topcoat may be required.
4. Evidence of runs, bridges, shiners, laps, or other imperfections is cause for rejection.
5. Repair defects in accordance with written recommendations of coating manufacturer as reviewed and approved by Engineer.

B. Damaged Coatings, Pinholes, and Holidays:

1. Perform surface preparation or blasting as required to restore damaged surfaces. Materials, equipment, procedures shall meet
2. Requirements of Steel Structures Painting Council, these specifications, and coating manufacturers recommendations.
3. Feather edges and repair in accordance with recommendations of paint manufacturer as reviewed and approved by Engineer.
4. Coating applications with pin holing, overspray, or dry spray shall be removed and recoated by brushing to fill pores in coating followed by spray application or another coat in accordance with product manufacturer's recommendations.
5. Final coating thickness shall not exceed coating manufacturer's recommended maximum coating system thickness.
6. Apply finish coats, including touchup and damage-repair coats in a manner, which will present a uniform texture and color-matched appearance.

3.10 PRESERVATION. RESTORATION. AND CLEANUP

- A. Confine operations to work areas as described, or as approved by the Owner/Engineer. Protect existing structures, equipment, vehicles, and utilities and keep work area neat and orderly at all times. Keep the work site, free from accumulation of waste materials or rubbish.
- B. Control all contamination from surface preparation and coating application. Damage due to surface preparation, coating operations, or overspray on buildings, vehicles, or other surfaces not specified to be painted with the sole responsibility of the Contractor.
- C. Prevent contamination of the project site or surrounding areas. Do not dump

coating materials, spent abrasive, paint debris, waste oil, rubbish, or other similar materials on the ground or in any water way. Use caution to prevent soil, stream, or groundwater contamination. Contractor shall be liable for containment and cleanup or any contamination of any aquifer, stream, or soil at his sole expense.

- D. Clean up work site of all excess equipment, materials, and debris and place in designated areas at the end of each day. Place cloths and waste that might constitute a fire hazard in closed metal containers or destroy in a legal manner at the end of each day.
- E. Upon completion of the work, remove all materials, scraps, and debris from project area and from interior of all devices and equipment. Remove staging, scaffolding, and containers from the site or destroy in a legal manner. Leave work site free of rubbish or excess materials of any kind.
- F. Completely remove paint spots, oil, or stains upon adjacent surfaces and floors and leave entire job clean. Touch up coating scratches, scrapes, or chips in interior and exterior surfaces.
- G. Upon completion of coating operations, clean surrounding sidewalks, parking areas, and buildings, vehicles, and homes by water wash if required. Clean and wipe windows down so as no streaks are visible.
- H. Any damage to structures, equipment, utilities, vehicles, nearby facilities, or to the project site resulting from Contractor related work activities shall be promptly corrected in an Engineer approved method by the Contractor. Repair shall be completed in a timely manner to restore item to preconstruction condition to the Engineer's satisfaction by the Contractor at his sole expense.

3.11 APPLICATOR'S QUALITY CONTROL TESTING PROGRAM

- A. Minimum requirements for Applicator Quality Control Program test procedures, testing frequencies, and record keeping shall be as recommended by the coating manufacturer and as required by these specifications. All Quality Control Testing shall be accessible to manufacturer's representative, Engineer or Representative.
- B. Applicator factory and field-testing procedures shall be in accordance with the product manufacturer's written instructions, NACE RP0288 Inspection Procedures, ASTM D 3276 Standard Guide for Painting Inspectors, these specifications, and the referenced Standards.
- C. The testing shall be conducted in accordance with the equipment manufacturers recommended procedures with accurately calibrated test equipment. Instrument calibration and testing procedure shall be in accordance with referenced standards and equipment manufacturer's written instructions.

- D. Electrically inspect coated items with either a low voltage or high voltage type holiday detector.
- E. The frequency of measurements shall be according to each coating manufacturer, but the minimum surface preparation and coating application testing frequency shall consist of at least:
 - 1. Abrasive Blast:
 - a) Check Air Supply (per ASTM D-4285) for moisture and oil contamination, (Minimum of once each day at start of abrasive blast operations).
 - b) Check recycled blast medium for oil, water, or other deleterious contamination per coating manufacturer's recommended procedure and frequency, (Minimum of once each week).
 - 2. Environmental (Weather) Monitoring Tests (Minimum of once every four hours):
 - a) Date and Time
 - b) Weather during Day
 - c) Precipitation for Day
 - d) Ambient Temperature
 - e) Relative humidity (ASTM E-337)
 - f) Dew point
 - g) Structure surface temperature
 - 3. Prepared Surface Tests (Minimum of once every four hours):
 - a) Visual Inspection
 - b) Degree (grade) of abrasive blast or cleaning method
 - c) Surface profile and shape (ASTM D 4417)
 - d) Surface cleanliness tests.
 - 4. Coating Application (During and Following Application)

- a) Coating System Utilized Product Name and Batch Number
 - b) Mix and Sweat In Time
 - c) Wet film coating thickness
 - d) Dry Film Coating thickness
 - e) Physical checks to assure adhesion.
 - f) Electrical Holiday Test (100 percent).
 - g) Repair Coating.
 - h) Results of final visual coating inspection.
 - i) Coating Cure
- F. Quality control test data shall be recorded and filed for project in such a manner so as to allow copies to be provided readily, to either coating manufacturer or Engineer, if requested.
- G. Failure by the Applicator during factory or field coating, to perform testing correctly and follow Quality Control Program requirements, frequencies, and documentation as required by product manufacturer and these specifications, shall result in rejection and recoating of all items coated or lined outside these parameters at sole cost to Contractor.

3.12 COATING INSPECTION TEST EQUIPMENT

- A. Product Manufacturer or Contractor shall provide the following equipment as required depending on the coating type; the product manufacturers' recommended quality control procedures, and/or specific requirements of these specifications.
- 1. Provide the following Environmental Monitoring Equipment to measure ambient temperature, relative humidity, and dew point. At Contractor's option, provide either:
 - a) Psychrometer, wet and dry bulb (sling or automatic fan type):
 - (1) Sling Psychrometer, Bacharach Sling Psychrometer, Pittsburgh, PA; Taylor Sling Psychrometer Model 1330, or approved equal.
 - (2) Automatic Fan Type. Psychro-Dyne or approved equal.

- (3) Relative Humidity and Dew Point Graph, US Weather Bureau Psychrometric Tables. or Elcometer Dew Point Calculator as necessary to calculate relative humidity and dew point values from Psychrometer measurements.
- b) Digital Psychrometer, Mannix Model No. SAM990DW. or approved equal.
- 2. Provide a minimum of two Surface Thermometers. magnet mounted dial thermometer to measure surface temperature. PTC Instruments Surface Thermometer Model 315 F (0 to 150-degree F.) or approved equal.
- 3. Provide Ambient Maximum/Minimum Temperature Thermometer
- 4. Surface Profile Test Equipment at Contractor's option, provide either:
 - a) Surface Profile Comparator Reference Disks and 10 power illuminated magnifier. Provide disk for each type of abrasive blast material being used.
 - b) Surface Profile Replica Tape. Testex Press-0-Film Coarse (0.8 to 2 mils) and X-Coarse (1.5 to 4.5 mils) Replica Tape and Testex Spring Micrometer or approved equal.
- 5. Provide one (1) Set of Visual Standards for Abrasive Blast Cleaned Steel (SSPC-VIS 1-89) Standard Reference Photographs.
- 6. Provide Wet Film Thickness Gauge (1 to 80 mils)
- 7. Provide a magnetic type dry film thickness gauge to test coating thickness specified in mils (0 to 40 mil range). Mikrotest III as manufactured by Nordson Corp., Anaheim, CA; Positest as manufactured by DeFelsko Corporation, Ogdensburg NY; or approved equal.
- 8. Provide NIST (National Bureau of Standards, NBS) Certified Coating Thickness Calibration Standards, Model PF (0 to 38 mil range).
- 9. Electrical Holiday Test Equipment
 - a) Provide low voltage (less than 90 volts), non-destructive, wet sponge type, holiday detector to test thin film (less than 20 mils) coatings for holidays and discontinuities, Model M-1 as

manufactured by Tinker and Rasor, San Gabriel, CA; or approved equal. Provide with approved surfactant or wetting agent for testing.

10. Coating and Environmental Test Equipment shall be stored and maintained at both factory and field sites in accurate, working condition. All equipment shall have appropriate manufacturers' data sheets. Test equipment shall be available to Engineer and Owner for testing purposes.

3.13 SURFACE PREPARATION INSPECTION

A. Visual Inspection

1. Blasted surface shall be visually inspected for degree of surface preparation and surface imperfections. Imperfections, which can be detrimental to application of the coating, shall be reblasted or removed by filing or grinding.
2. Degree of surface preparation shall be visually inspected and compared to test coupons or visual standards (SSPC VIS 1) to verify grade of cleanliness.
3. Surface profile depth and angular shape shall be visually inspected and/or measured with either Surface Profile Comparator or Replica Tape in accordance with ASTM D-4417. Type of testing shall be according to specific coating manufacturers recommendations and these specifications and shall consist of:
 - a) Visual comparison with a 10-power illuminated magnifier of blast cleaned surface to reference discs or previously approved and preserved test samples.
 - b) Replica tape test consists of using a moldable tape to duplicate the surface profile to allow the depth between the peaks and valleys on the tape to be measured. Press tape onto clean blasted surface to form a reverse replica of actual surface profile
 - c) Measure the replica tape with a modified spring micrometer to determine the depth of profile. Record profile depth and retain replica tape for documentation.

B. Surface Cleanliness

1. Remove all dust, grit, or other foreign matter from surface by blowing off with clean, dry, oil free, compressed air. Vacuum cleaning or other methods of cleaning may be used with or in place

of compressed air. The prepared surface shall be clean and dust free before application of coating.

2. Visually inspect and conduct scotch tape test to determine surface cleanliness in accordance with ISO 8502-3. Conduct scotch tape test by placing a 1-inch by 6-inch piece of clear scotch tape with the sticky side down on cleaned surface. Remove the tape and visually evaluate the amount of dust and debris on the tape. Reclean if there is visible dust or other contamination on scotch tape.
3. Conduct surface preparation operations so as to not contaminate already cleaned surfaces or items being coated.
4. Keep nearby surfaces clean so as to prevent wind or air blown contamination of cleaned surfaces or coating operations.
5. Keep prepared surface clean and protect from moisture, weather, dust, dirt, sandblast debris, and other contamination. Coat before surface starts to flash rust. Completely reblast if the prepared surface starts to blush or rust stains develop.

3.14 COATING INSPECTION

A. Visual Inspection:

1. Visually inspect all prepared surfaces and each coating system coat. The coating appearance shall be smooth and free of misses, blisters, bubbles, sags, or uncured areas.
2. Repair all areas of visual skips, misses, or coating damage. Repair or replace any visual areas of improper surface preparation or coating application.

B. Wet Film Coating Thickness Measurements

1. Conduct wet film measurements as coating is being applied to verify estimated dry film thickness in accordance with ASTM D4414. Place wet film thickness gauge on flat surface. The last tooth of the gauge with wet coating will indicate the wet film thickness. Calculate dry film thickness by multiplying the wet film thickness by the percent solids by volume of the coating being tested.

C. Dry Film Coating Thickness Measurements

1. Test dry film thickness of coatings in accordance with SSPC PA2 with a Type I or Type II magnetic thickness gauge.

2. Test frequency and procedure for dry film thickness testing of coatings with a magnetic film thickness gauge shall be in accordance with SSPC PA2 with the exception that the minimum coating thickness allowed shall be the minimum DFTM specified. The coating thickness specified herein is the absolute minimum.
3. Provide an appropriate magnetic type dry film thickness gauge to test coating thickness specified in mils.
4. Check each coat for correct millage. Do not make dry film measurements before coating has cured the minimum length of time after application as recommended by coating manufacturer' written recommendations.
5. Perform with properly calibrated instruments. Calibrate a minimum of once each day in the area where they are to be utilized.
6. Calibrate dry film thickness gauge with NIST (National Bureau of Standards, NBS) Certified Coating Thickness Calibration Standards or Plastic Calibration Shims in accordance with product manufacturer's recommendations.
7. Reduce dry film thickness measurements with Type I instrument by the average magnetic base reading for material being measured. Calculate magnetic base reading in accordance with SSPC PA2 calibration procedures. Measure bare cleaned surface at a minimum of 3 locations to obtain an average magnetic base effect. Subtract this average magnetic base metal value from the coating thickness readings to obtain actual thickness of the coating without the magnetic surface substrate interference. This corrected value is the actual thickness of the coating and shall be used to measure the minimum applied coating thickness.
8. The coating thickness specified is the absolute minimum. Coating thickness measurements shall meet or exceed the specified minimum coating thickness. All locations which fail to meet the minimum coating thickness test shall be recoated or repaired according to coating manufacturer's written instructions as reviewed and approved by Engineer.

D. Electrical Holiday Inspection

1. General:
 - a) Conduct electrical holiday testing in accordance with NACE RP0274 and RP0188 for thick film coatings (above 20 mil coating thickness) and NACE RP0188 for thin film coatings (less than 20 mil coating thickness).

- b) Utilize low voltage detectors for thin film coatings (below 20 mils).
- c) Conduct testing per the coating manufacturer's written directions for type and thickness of coating being tested. Conduct testing in accordance with manufacturer's recommendations to avoid damage to coating.
- d) Depending on coating type and thickness, test factory and field coated and areas of damaged or questionable coating or coating repairs with a portable low voltage or high-voltage holiday detector to determine the presence and number of discontinuities (holidays) in the coating. Retest areas as directed by the Engineer.
- e) Test areas only after coating has adequately cured.
- f) Conduct testing in safe manner so as to avoid electrical shock. Check enclosed areas for explosive conditions from solvents prior to holiday testing.
- g) Mark location of detected holidays for repair with marking that is compatible with repair coating or easily removed. Record location of holidays for repair. Repair coating per specifications.
- h) Retest after coating repair has had sufficient time to cure in accordance with coating manufacturer's recommendations.

2. LOW VOLTAGE:

- a) Furnish one low voltage detector for thin film coating (less than 20 mils).
- b) For low voltage (wet sponge) testing soak wet sponge in water mixed with approved surfactant (wetting agent). A minimum of 1 fluid ounce of surfactant (low sudsing wetting agent such as photographic film development fluid, Kodak Photoflo or equal) shall be added to each gallon of water for testing.
- c) When holiday testing is being performed between coats, a wetting agent shall not be used unless approved by coating manufacturer.
- d) Attach ground wire to bare area on structure to be tested.

Attach wire to wet sponge to the other terminal of instrument. Provide a good ground and a low electrical resistance between the holiday detector and the structure.

- e) Check sensitivity of instrument by touching sponge to a known bare spot. Instrument should provide an audio and/or visual indication a holiday. If no indication of holiday, instrument is defective, replace or repair instrument.
- f) Move wet sponge along coated surface in smooth even manner with a double pass over each area as recommended by wet sponge detector manufacturer in accordance with NACE RP0188. Do not exceed 1 foot of travel per second as the maximum rate of speed during low voltage holiday testing.

E. Solvent Wipe Tests

- 1. Coating Cure: Conduct solvent wipe and hardness testing of cured coating in accordance with coating manufacturer directions to determine if coating is adequately cured before allowing exposure to water or other liquids. Obtain and submit letter from product manufacturer stating that coating is adequately cured before exposure is allowed to water or other liquids.
- 2. Coating Type Verification: Conduct solvent wipe test of cured coatings to verify correct coating was applied for each system. If coating system softens with solvent wipe, it may be an alkyd system or not cured correctly.

3.15 MISCELLANEOUS

A. Disinfection

- 1. Following the full recommended curing time, CONTRACTOR shall disinfect the tank in accordance with AWWA C652-02. CONTRACTOR may use methods 1-3 as set forth in the standard but must notify the Owner/Engineer of the method used.
 - a) Fill tank and observe for leaks a period of not less than 24 hours.
- 2. After chlorination is complete, prior to placing tank into service the potable water shall be sampled and tested for coliform organisms. If testing is negative, the tank may be placed in service, provided chlorine levels are within acceptable limits.

B. Security
Transport Elevated Tank

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1. CONTRACTOR shall be responsible for security of the Construction site until the project is at final completion..

END SECTION

Attachment D
Hydraulic Profile from Well #1-A
to Elevated Tank

JDS-HYDRO

CONSULTANTS, INC.

5540 TECH CENTER DR., SUITE 100
COLORADO SPRINGS, COLORADO 80919
(719) 227-0072

DISCLAIMER: THE CONTRACTOR SHALL VERIFY ALL DIMENSIONS. ANY ERRORS OR OMISSIONS SHALL BE REPORTED TO JDS-HYDRO CONSULTANTS, INC. JDS-HYDRO ASSUMES NO LIABILITY FOR UNAUTHORIZED CHANGES AND/OR REVISIONS MADE TO PLANS.

TRANSPORT METROPOLITAN DISTRICT NO. 1

WELL #1-A SITE IMPROVEMENTS

HYDRAULIC PROFILE

REVISIONS			
NO.	DESCRIPTION	BY	DATE
1			
2			
3			
4			
5			
6			
7			

FOR BID

Project No.: 336.01
Date: 05/05/21
Design: MTV
Drawn: ACH
Check: JPS

