CITY OF VERGAS, MINNESOTA

July 2021

100,000 Gallon Capacity Tower Number One

Elevated Water Tank Inspection Report

KLM Project 4300-21

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Table of Contents

1.0| PROJECT INFORMATION

KLM Project No.: 4300-21 **Customer P. O. Number:** N/A

Tank Owner: City of Vergas, Minnesota **Phone:** 218-234-5110

Street/City/State/Zip: 111 E Main St. Vergas, MN 56587

Tank Owner Contact: Mike Dufrane, Utility Supervisor

Owner's Tank Designation: Tower Number One

Tank Description: Hydrocone

Tank Street Location: East Linden St., Vergas, MN 56587

Purpose of Inspection: Condition Assessment

Date of Inspection: July 13, 2021

Inspected By: Tim Lindsay and Aaron Hageman

Type of Inspection: KLM Standard ROV Evaluation

Manufacturer: Caldwell Tank **Construction Date:** 1993

Serial No.: E-3536 **Design Code:** AWWA D100-84

Capacity: 100,000-gallons

Tank Diameter: ~35-feet

Height to: Overall ~132-feet

Height to: HWL 129-feet LWL 105’-6”

Tank Construction Drawings: Available at Owner

Previous Inspection Records: None available to KLM

EXISTING COATING INFORMATION

	Interior Wet	Interior Dry	Exterior
Date Last Coated	2007	2010	2010
Full or Spot Repair	Full	Spot	Spot/overcoat
Coating Contractor	Maguire Iron	DeLoughery Painting Co.	DeLoughery Painting Co.
Surface Preparation	Unknown	Unknown	Unknown
Paint System	Epoxy	Series N140	Series 73/700
Paint Manufacturer	Tnemec	Tnemec	Tnemec
Paint Chip Samples	No	No	No

City of Vergas, Minnesota

100,000 GALLON CAPACITY
TOWER NUMBER ONE

2.0| REFERENCES

The tank interior and exterior areas were evaluated in conformance with the following:

a. KLM Engineering, Inc. Proposal.

b. General guidelines of AWWA Manual M42 Appendix C “Inspecting and Repairing Steel Water Tanks, and Elevated Tanks for Water Storage.”

c. KLM "Procedures and Guidelines for Inspecting Existing Steel and Concrete Water Storage Tanks."

d. Appendix B Inspection and Evaluation Methods.

3.0| COATINGS EVALUATION

3.1| Lead and Chromium Content Analysis

The total lead and chromium content of the interior and exterior coatings was not analyzed. Based on the 1993 construction date of the tank, and subsequent coating repairs within the last ten to thirteen years, and regulations in effect at that time limiting the use of lead or chromium-based coatings, KLM anticipates that neither the interior nor exterior coatings are lead or chromium-based paints and will not generate hazardous waste during reconditioning.

3.2| Interior Wet Coating

The tower was constructed, and the interior wet area originally coated, in 1993 by Caldwell Tank. According to Owner provided information, Maguire Iron fully reconditioned the interior wet area in 2007. The interior wet coating is in poor overall condition, with approximately five percent coating failures above the High-Water Line (HWL) and approximately 10 percent coating failures below the HWL. Failures above the HWL consist of corrosion along unwelded roof plate weld joints and rust nodules at random locations. Failures below the HWL consist of more widespread corrosion nodules on weld joints and random locations. Due to age and condition, the coating is not a candidate for repairs and should be replaced in its entirety within three years to maximize the life expectancy of the structure. See photos in Appendix A.

3.3| Interior Dry Coating

Most of the interior dry area has coating original to the 1993 construction. According to Owner and Tnemec provided information, the sweating areas of the interior dry area were reconditioned in 2010 by DeLoughery Painting Co., a subcontractor at the time to Maguire Iron. Overall, the coating on the interior dry area is in fair condition with failures limited to areas susceptible to condensation, such as the drywell tube, bowl, and landings (sweating areas). The sweating areas have approximately 20 percent visible failures. Despite these failures, the substrate does not appear to be in danger of damage through corrosion and will continue to provide service until the next scheduled coating replacement, which should be anticipated to be performed at the same time as the interior wet coating replacement, within three years. See photos in Appendix A.

3.4| Exterior Coating

The exterior was spot repaired and overcoated at the same time the interior dry spot repairs were performed, in 2010. DeLoughery Painting Co. performed the work. The exterior is currently in good condition with the overcoat maintaining integrity. Overcoats have a typical life expectancy of 8 to 10 but can vary dramatically. The high-quality coating, Tnemec Series 700 Hydroflon, was used as final topcoat and is likely a contributing factor to the exterior overcoat having performed well. Corrosion is minimal on the exterior, consisting primarily of mechanical damage on the base cone. Understanding the typical life expectancy of an overcoat, while the exterior coating remains in fair condition now, the City of Vergas should consider replacing it in conjunction with the interior wet and interior dry coatings to lower overall project costs, maintain a uniform lifecycle, and provide superior coatings systems in all areas of the tower. See photos in Appendix A.

3.5| Replacement Coating Systems

On January 1, 2023, NSF International will implement a new public health standard called NSF 600 for any coating in contact with potable water. This new standard significantly reduces allowable concentrations of solvents commonly used in coating formulations. Manufacturers serving the water industry have already developed new product offerings that comply with NSF 600. However, these products require more training/experience and expensive equipment to apply and are resulting in increased reconditioning costs when specified. It is important to note that currently applied products meeting NSF 61 standards do not need to be removed after the January 1, 2023 transition to NSF 600. However, coatings used to repair existing coatings after the date must comply with the new standards.

When the next full reconditioning is required, KLM recommends preparing surfaces in accordance with NACE guidance and applying a coating system for each area according to the following.

3.5.1| Interior Wet Coating

Surface preparation should be performed according to SSPC-SP10 Near White Metal Blast criteria.

Apply a three-coat system:

1. moisture cured zinc-rich
2. polyamidoamine epoxy
3. 100% solids, high-build epoxy

3.5.2| Interior Dry Coating

Surface preparation should be performed according to SSPC-SP6 Commercial Blast Clean criteria.

Apply a three-coat system:

1. moisture cured zinc-rich
2. polyamidoamine epoxy
3. polyamidoamine epoxy

3.5.3| Exterior Coating

Surface preparation should be performed according to SSPC-SP6 Commercial Blast Clean criteria.

Apply a four-coat system:

1. moisture cured zinc-rich
2. polyamidoamine epoxy

3. aliphatic acrylic urethane
4. fluoropolymer

4.0| STRUCTURE MODIFICATIONS

Based on the inspection data, it appears that some structure modifications and repairs are required. These modifications and repairs serve to bring the tank into compliance with OSHA regulations, AWWA standards, and Department of Health regulations. They also improve areas of the tank that are prone to premature development of corrosion, remove surface defects resultant from tank construction, remove abandoned and unnecessary equipment, and improve tank maintenance capabilities.

The photographs referred to in this section are in Appendix A.

Based on an evaluation of the inspection data, the recommendations are:

4.1| Interior Wet Modifications

The following structure modifications are not required to be performed at this time and can be delayed until interior coating repairs are performed.

4.1.1 Seal weld the following joints. Seal welding these joints will prevent rust streaking and corrosion in areas inaccessible to paint. See photos 2 through 4.

a. The overlap joint between the dollar plate and roof plates,
b. The inside joint between the drywell tube and the dollar plate,
c. The inside of the dollar plate butt joint,
d. The inside joint between the wet access manway and the dollar plate.

4.1.2 Epoxy caulk the shell to roof circumferential joint. Seal welding this joint is cost prohibitive, but the result is similar. See photos 5 through 7.

4.1.3 Replace the gasket on the oval bowl manway. See photos 12 and 28.

4.1.4 Grind off all weld spatter and erection scab marks below the HWL for compliance with AWWA D100-11. This work will require approximately 35 man-hours.

4.1.5 Install a Grid-Bee GS-9 Submersible Mixer in the tower to provide mixing capabilities that reduce the likelihood and magnitude of ice formation in cold weather and prevent stratification in warm weather, improving water quality and reducing the necessity of chemical additives such as chlorine. Include the installation of all electrical components and control panel for proper operation through SCADA systems.

4.2| Cathodic Protection (CP) System

4.2.1 The reservoir does not have a cathodic protection system, and one is not required if the coating is applied and maintained properly.

4.3| Interior Dry Modifications

The following structure modifications are not required to be performed at this time and can be delayed until interior coating repairs are performed.

4.3.1 Convert the top landing of the riser into a condensate ceiling by adding a ¼-inch by 2.5-inch flat bar and seal welding the perimeter to the pedestal. Install a drain in the low point of the landing with a connecting line to the overflow pipe. This will prevent condensation from running down the pedestal,

exacerbating defects in the coating, and leading to corrosion and additional painting and maintenance costs. See photos 29 and 30.

4.3.2 Replace the cable style safety climb devices on the ladders. The existing cables have been painted and are not deemed OSHA compliant. See photos 24, 30, and 31.

4.3.3 Replace the existing bowl drain valve with a stainless-steel valve similar to those designed by Babco Company. Include a clear, rigid, high pressure hose connected to the overflow pipe. Include the replacement of the coupling in the bowl with a ½ coupling. This facilitates cleaning and draining the bowl below the inlet pipe level. See photo 27.

4.3.4 Install approximately six (6) half-moon cable brackets inside the drywell tube, equally spaced, for the attachment of electrical and coaxial cables. See photo 25.

4.3.5 Install approximately ten (10) pedestal stand-off brackets in the pedestal at 8-foot maximum spacing for the mounting of the electrical and coaxial cables. Move the electrical conduits along the ladders to the stand-off bracket to bring the ladders into OSHA compliance. See photos 31, 32 and 34.

4.3.6 Replace the light fixtures with LED fixtures. See photos 24, 28, and 29.

4.3.7 Install ports in the center of the upper two platform floors to facilitate containment during the next reconditioning. See photos 30 and 31.

4.3.8 Install a 4-inch-thick concrete pad in the base of the tower at grade, flush with the top of the existing ring wall foundation. Some of the existing soil will require removal. The concrete slab shall be reinforced with 6 x 6 – W1.4/W1.4 welded wire fabric, graded, float finished flat and level. See photos 34 and 35.

4.4| Exterior Modifications

The following structure modifications are not required to be performed at this time and can be delayed until exterior coating repairs are performed.

4.4.1 Install an anchor point on the exterior (roof side) of the drywell tube for securing safety harnesses with lanyards during egress from the drywell and transitioning from the drywell tube safety climb device to the tower roof. See photo 37.

4.4.2 Replace the drywell tube manway cover with an aluminum cover and stop chain. This make lifting the larger cover easier and limit the angle of travel of the cover, (prevent the cover from opening 180 degrees). See photo 37.

4.4.3 Replace the tank finial vent with a 24-inch diameter aluminum pressure pallet style vent. The new vent and vent screen design should meet AWWA D100-11 and Department of Health regulations. The removable top will improve ventilation, provide access to the tank interior during reconditioning, and aid in compliance with OSHA Confined Space Entry Requirements. See photo 38.

4.4.4 Install one (1), 24-inch diameter, hinge covered, roof ventilation manways, approximately 180 degrees from the existing roof manway. This will provide additional ventilation during the interior surface preparation and coating and aid in compliance with OSHA Confined Space Entry requirements.

4.4.5 Replace the double aviation light with a new double LED style aviation light similar to Hughey & Phillips L-810. See photo 37.

4.4.6 Replace the two, 2-inch threaded rigging couplings with the same size unthreaded couplings with weathertight covers. See photos 2, 4, 37, and 41.

4.4.7 Per Minnesota Department of Health, modify the overflow discharge pipe outlet by installing a downward bend on the end and replace the existing overflow pipe screen with a corrosion-resistant, heavy-gauge #24 mesh screen. See photo 49.

4.4.8 Urethane caulk around the perimeter of the base cone where it meets the concrete foundation. This will prevent water intrusion and corrosion along that seam. See photos 46 and 49.

5.0| PROPERTY CONSIDERATIONS

5.1| Site and Environmental Considerations

5.1.1 In conformance with Minnesota Department of Health, an analysis has been performed to determine the methods of pollution control required for this storage structure during reconditioning. During the next scheduled full reconditioning, to maintain air quality and to prevent the drift of dust and fugitive emissions, full containment will be required, including impervious ground cover, a top cover or bonnet and negative air dust collection.

5.2| Telecommunications Considerations

5.2.1 The reservoir has no telecommunications equipment, either antennas or other associated equipment. Antennas generally have the effect of dramatically increasing the cost of reconditioning water storage reservoirs. If the owner is considering allowing antennas to be installed on the tower, lease agreements should be written to ensure the antenna owners are responsible for increase maintenance costs due to their presence. Installations should be reviewed to ensure that they do not interfere with normal use or maintenance of the tower, present safety hazards, or violate state or federal regulations.

6.0| RECONDITIONING SUMMARY

6.1| Reconditioning Cost Estimate

The costs for structure modifications and replacing the interior and exterior coatings are estimated between $285,000 and $315,000. For competitive bids, the project should be bid 9 to 12 months before the desired starting date.

An experienced tank-coating contractor with the proper crew and equipment should be able to complete the project in five weeks. At the time of reconditioning, the tower will need to be drained and remain off-line during interior structure modifications, abrasive blasting, and painting. However, most of the exterior structure modifications can be performed prior to draining, with the tank in-service.

6.2| Next Reconditioning

Per the Service Agreement, the next inspection is a dry tank cleanout scheduled for 2026. Given the significant sediment accumulation, consider adjusting the schedule by performing a dry tank cleanout within the next twelve months. Not only will this clean up the reservoir but it will establish a benchmark for monitoring rate of accumulation and determine a routine for future cleanouts.

KLM recommends performing the noted modifications and interior and exterior coatings replacement within the next three years to protect the tower and serve the water system for many more years to come. If the project is performed during this timeframe, the dry tank cleanout could be delayed to coincide with the tower reconditioning.

Inspection and maintenance are critical to the longevity of the reservoir. Upon completion of reconditioning, the tank and coating should first be inspected near the end of the warranty period and every three (3) to five (5) years thereafter. New interior and exterior coatings, if applied and maintained properly, should provide service life of at least 20 years.

KLM ENGINEERING, INC.

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APPENDIX A

PHOTOGRAPHS

Photo No. 1
Overall view of the tank

Photo No. 2
Dollar plate to drywell tube and roof plate, Note; rigging coupling

Photo No. 3
Drywell tube to roof connection

Photo No. 4
Dollar plate to drywell tube and roof plate, Note; rigging coupling

Photo No. 5
Roof condition and connection to shell

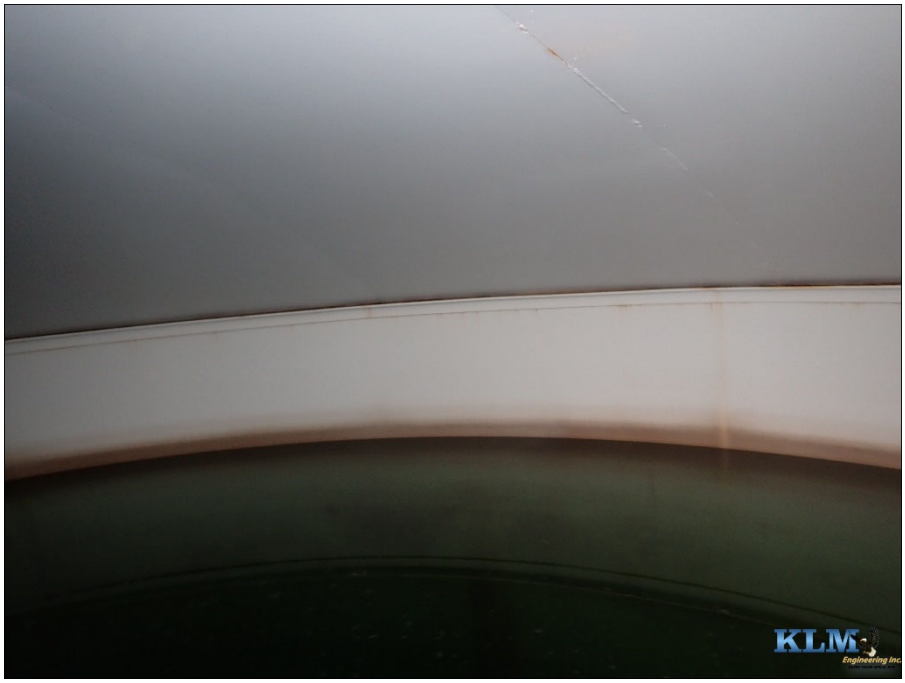

Photo No. 6
Roof condition and connection to shell

Photo No. 7
Roof condition and connection to shell

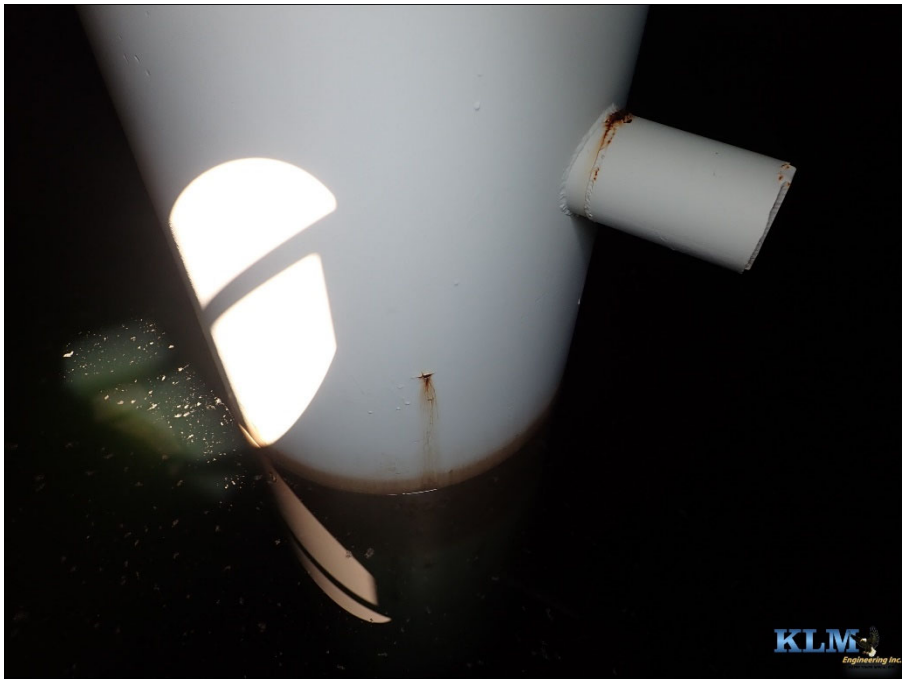

Photo No. 8
Drywell tube and overflow

Photo No. 9
Drywell tube condition

Photo No. 10
Drywell tube and bowl, Note; fill pipe and manway

Photo No. 11
Sediment accumulation in bowl

Photo No. 12
Sediment accumulation in bowl

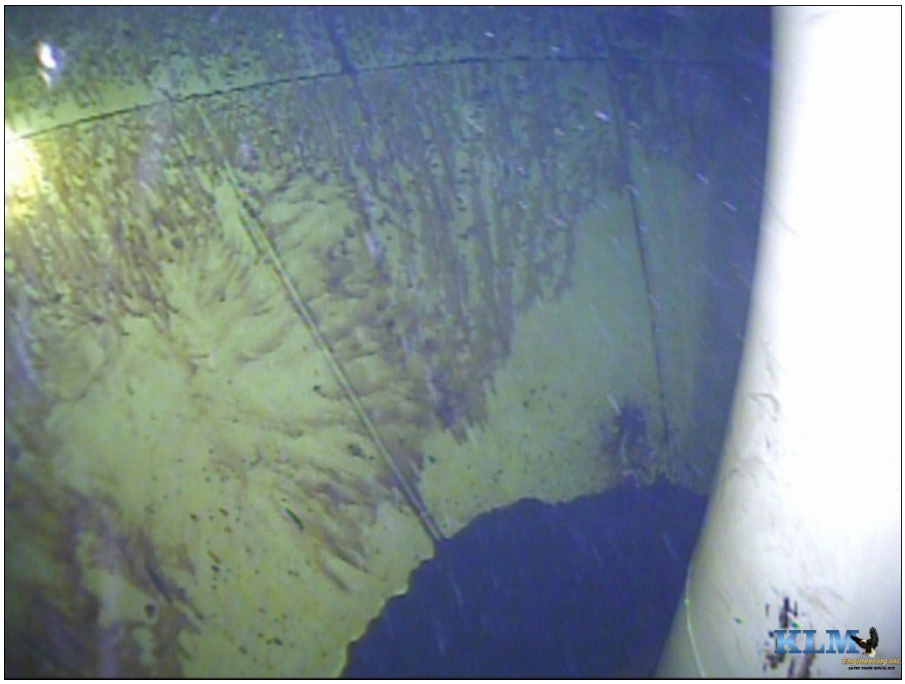

Photo No. 13
Bowl condition

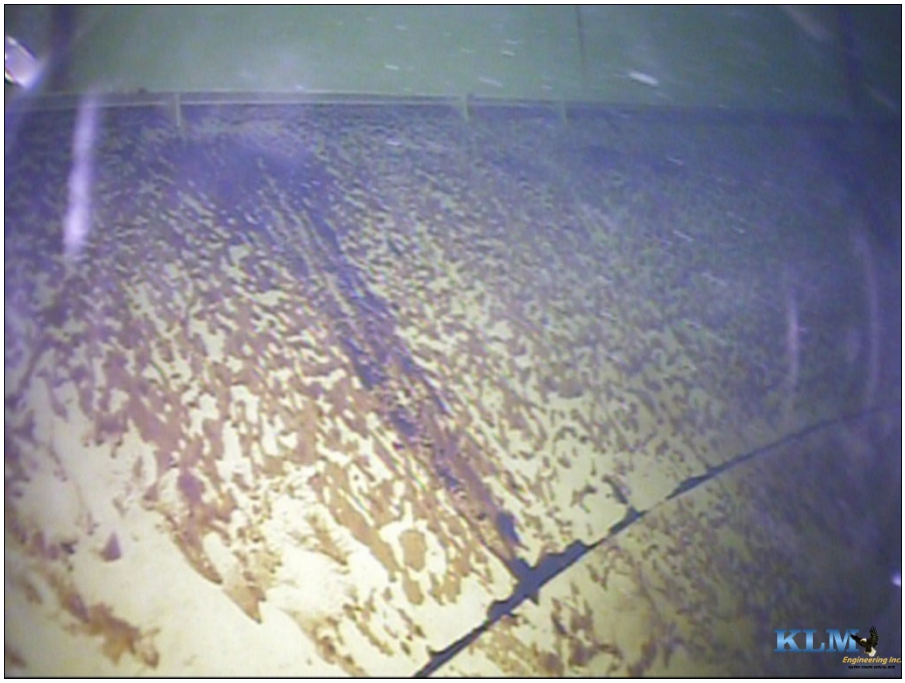

Photo No. 14
Bowl condition

Photo No. 15
Bowl condition

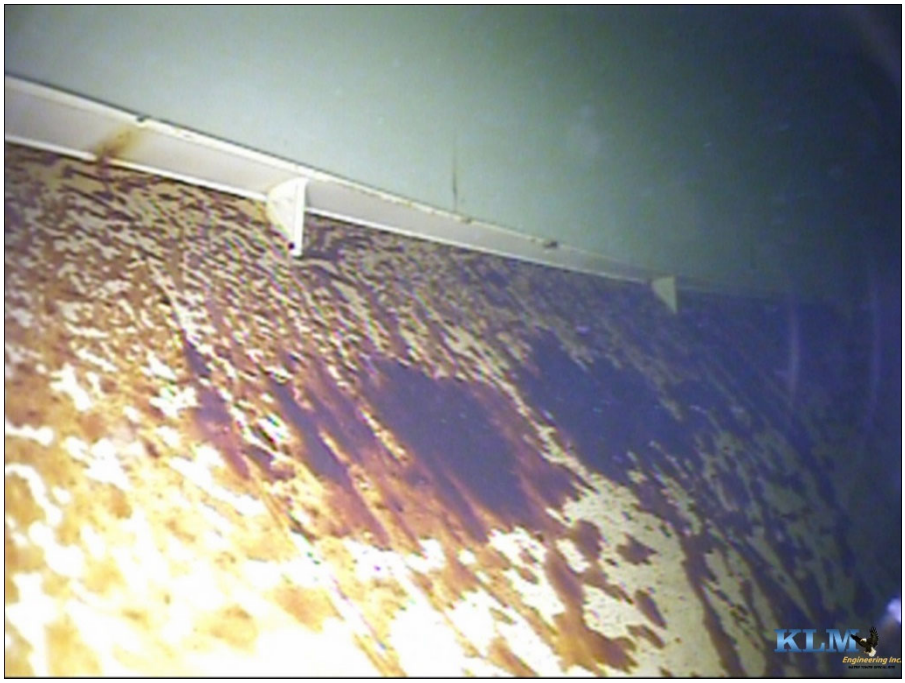

Photo No. 16
Bowl to shell connection

Photo No. 17
Leveling ring at bowl to shell connection

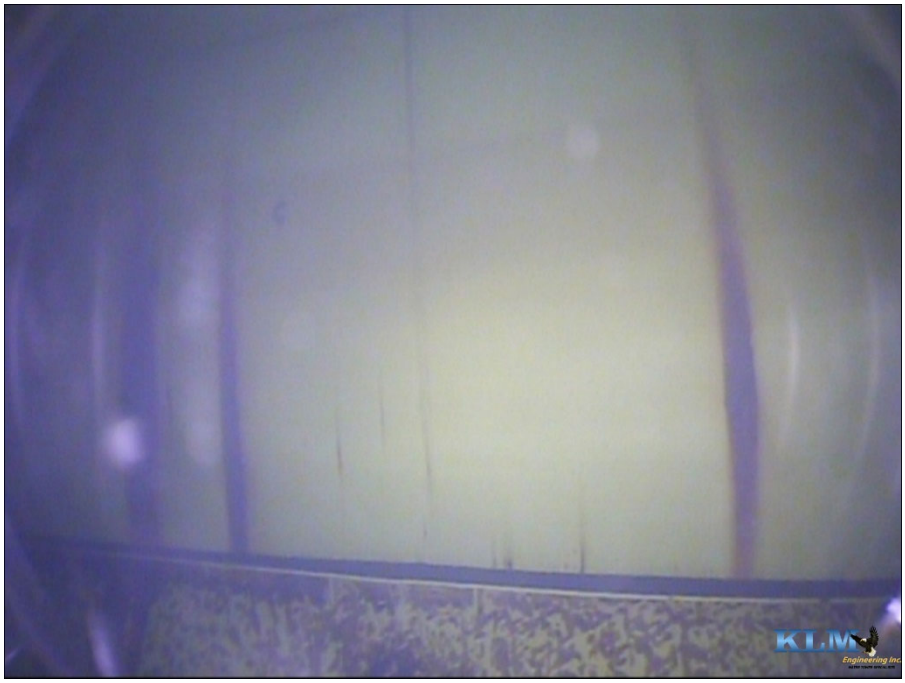

Photo No. 18
Corrosion on shell

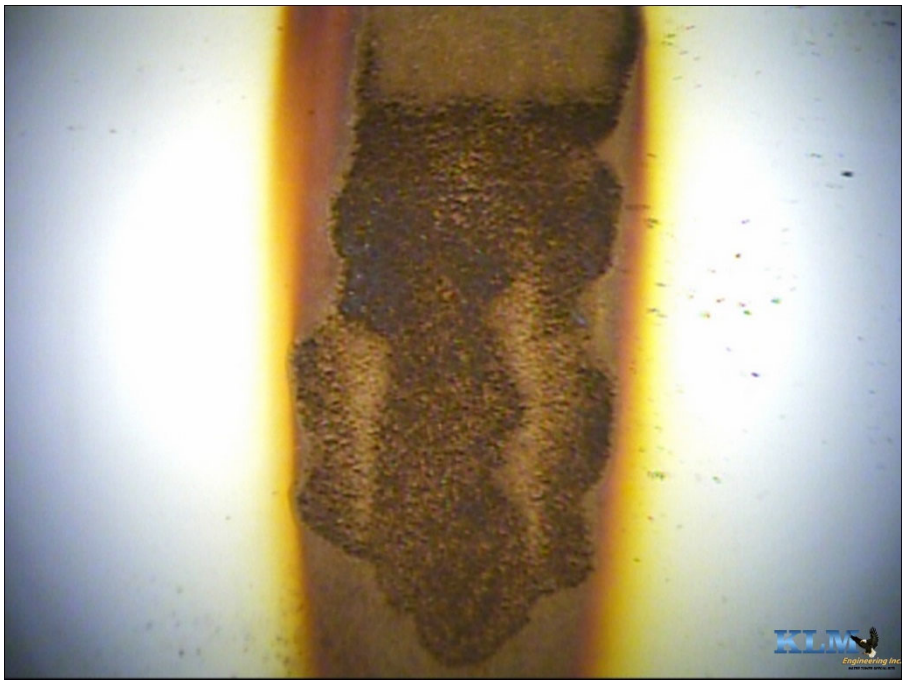

Photo No. 19
Corrosion on shell

Photo No. 20
Coating failures and corrosion on shell, Note; indication of poor surface preparation during repairs

Photo No. 21
Coating failures and corrosion on shell, Note; indication of poor surface preparation during repairs

Photo No. 22
Coating failures and corrosion on shell, Note; indication of poor surface preparation during repairs

Photo No. 23
Coating failures and corrosion on shell, Note; indication of poor surface preparation during repairs

Photo No. 24
Top of drywell tube (looking up)

Photo No. 25
Lower section of the drywell tube

Photo No. 26
Bowl condition

Photo No. 27
Bowl drain cleanout

Photo No. 28
Overall condition of bowl

Photo No. 29
Top landing

Photo No. 30
Top landing

Photo No. 31
Overall conditions in riser (looking up)

Photo No. 32
Conditions in riser (looking up)

Photo No. 33
Lower landing

Photo No. 34
Base cone conditions (looking down)

Photo No. 35
Valve pit

Photo No. 36
Conditions in valve pit

Photo No. 37
Overall conditions on roof

Photo No. 38
Finial vent

Photo No. 39
Access manway and roof conditions

Photo No. 40
Roof coating conditions

Photo No. 41
Roof coating conditions

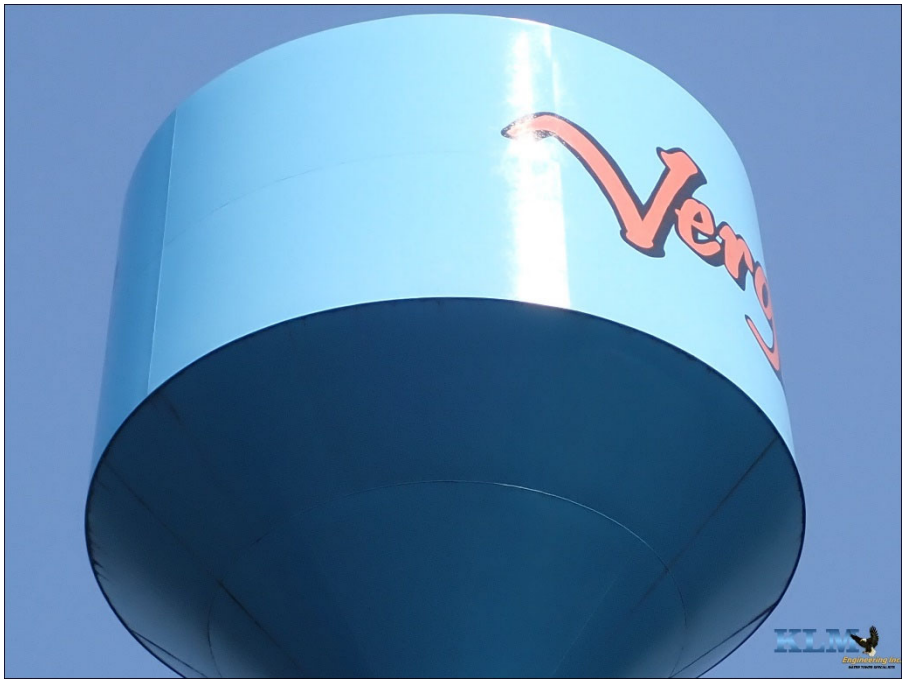

Photo No. 42
Overall condition of shell and bowl

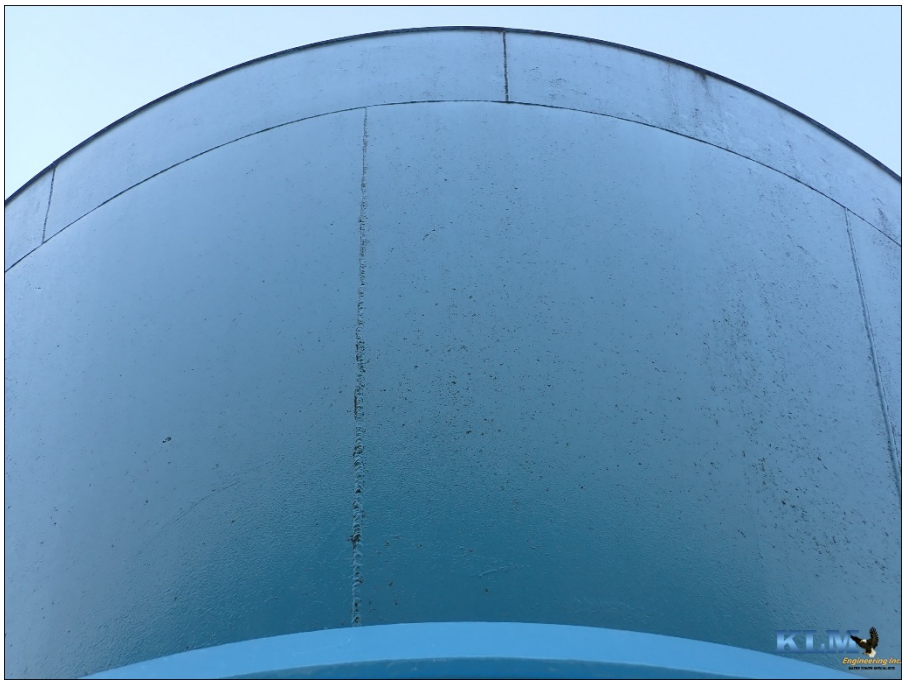

Photo No. 43
Bowl condition

Photo No. 44
Top of riser and bowl

Photo No. 45
Overall condition of riser

Photo No. 46
Overall condition of base cone

Photo No. 47
Isolated corrosion on base cone

Photo No. 48
Isolated corrosion on base cone

Photo No. 49
Overflow and splash pad

APPENDIX B

INSPECTION AND EVALUATION METHODS

1.0| INSPECTION AND EVALUATION METHODS

Some or all of the following procedures were performed as applicable.

1.1| Methods

1.1.1 The inspection of the base metal and coatings on interior and exterior surfaces included only areas accessible without scaffolding or special rigging. Where possible, the base metal and coating on the interior wet surfaces were examined from either a rubber raft while the tank was being drained, by a Remote Operated Vehicle (ROV) with the tower in service, or with both.

1.1.2 Tank plate thickness was measured at random locations on the liquid holding shell. The overall structural condition of the tank was visually examined.

1.1.3 No structural analysis was done to determine if the tank design complies with the AWWA D100-11 Standard for "Welded Carbon Steel Tanks for Water Storage." However, any observed non-conformance to the AWWA D100-11 standard is noted in this report.

1.1.4 Although compliance with OSHA regulations was not a part of this inspection, any unsafe conditions or violations of current OSHA regulation that were observed are noted in this report.

1.2| Examination and Evaluation Techniques

Some or all of the following procedures were performed as applicable.

1.2.1| Site

The tank site was evaluated for proper drainage conditions affecting access and lead paint abatement during reconditioning.

Also, the following site dimensions were obtained: distance to fence(s), power lines, owner buildings, public property, private property/buildings, school/playgrounds, public parks, and other property.

1.2.2| Foundations

The tank concrete foundation(s) were/was visually examined for cracks, spalling, conditions of grout, indications of distress/settlement, and elevation above grade.

1.2.3| Tank Plate Thickness

Plate thickness measurements were taken using ultrasonic methods (UTM). The readings were taken using a digital readout Elcometer MTG6 Ultrasonic Thickness Gage that has a dual element probe (transducer). The probe's transmitter element sends a short ultrasonic pulse through the material. The pulse gets reflected as an echo from the opposite side of the plate and returns to the probe's receiver element. The round-trip time is directly related to the material's thickness.

1.2.4| Coating Thickness

Interior and exterior coatings, where accessible, were tested in accordance with Steel Structures Painting Council SSPC-PA2-18 "Procedure for Determining Conformance to Dry Coating Thickness Requirements" using PosiTector-6000-F1 Type 2 gages.

1.2.5| Coating Adhesion

Adhesion testing of the coating to the steel, and inner coat adhesion, was performed by ASTM D-3359: Shear Adhesion Test, Measuring Adhesion by Tape Test. In addition, subjective coating adhesion evaluation was performed using a penknife.

1.2.6| Coating Serviceability

The estimated remaining coating life or serviceability evaluation was performed using a wide variety of inspection instruments such as dry film thickness gauge, pen knife, Tooke gauge, adhesion tester(s), 30x microscope and serviceability evaluation experience (minimum experience 10 years).

The instrument inspection was combined with a close visual inspection of all accessible coatings. This was done to detect any holidays (misses), skips, runs, sags, surface containments, overspray, dry spray, poor coating cohesion, inter-coat delamination, loss of adhesion to the substrate, adverse conditions of the steel underneath the coating, or any other defects affecting the intended service.

1.2.7| Coating Lead and Chromium Content Analysis

Samples may have been taken of the various types of coatings present on the interior and exterior surfaces. GPI Laboratories, Inc. of Grand Rapids, Michigan tests these coatings in conformance with ASTM D-3335 Standard Test Methods for Concentrations of Lead and Chromium in Paint.