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Tel: 603.431.3937

January 31, 2020

Mr. Stephen Brewer
Public Works Director
Raymond Department of Public Works
4 Epping Street
Raymond, NH 03077

Re: Water Storage Facilities Evaluation – FINAL REPORT

Dear Mr. Brewer:

The Town of Raymond has engaged Weston & Sampson to provide engineering services to evaluate the towns water storage facilities and to provide recommendations regarding the rehabilitation and/or replacement of the facilities. We are pleased to provide guidance in management of the storage tanks while addressing concerns of water quality and pressure in the distribution system within this report.

Existing Water Storage Facilities

The town currently maintains three water storage facilities within the existing distribution system. The Orchard Street tank is located in the northern portion of the town's distribution system adjacent to Main Street and the Town Hall, the Route 156 tank is located in the northeast adjacent to Route 156/Nottingham Road, and the Long Hill tank is located at the northwest extent of the distribution system on Long Hill Road. A summary of the existing water storage facilities including their materials of construction, dimensions, and storage volumes are listed in the table below. A map showing the town's distribution system and the location of the storage tanks is included in Attachment A.

Table 1: Existing Water Storage Facilities

Facility Name	Orchard Street	Route 156	Long Hill
Year Constructed	1893	1957	2004
Diameter (feet)	15	45	59
Height (feet)	90	51	27.5
Nominal Storage Volume (gallons)	119,000	606,000	562,000
Storage Volume/Foot	1,322	11,896	20,450
Base Elevation (feet)	262.42	301.47	325.00
Overflow Elevation (feet)	350	350	350
Material of Construction	Riveted Steel	Welded Steel	Precast-Prestressed Concrete

Storage Tank Condition Assessment

All three of the town's water storage tanks were inspected between 2016 - 2018 by Underwater Solutions Inc. These reports are included as Attachment C of this report, with the results of the inspections summarized below:

Route 156 Tank

The welded-steel Route 156 Tank (inspected in 2016) was found to be relatively free of defects. The exterior coating system was found to have a dry film thickness between 7.4 – 11.9 mils, meeting or exceeding the AWWA recommended minimum dry thickness on exterior surfaces (7.0 – 10.0 mils). However, multiple areas of coating damage were observed throughout all elevations of the exterior walls. The interior steel walls were found to be

mostly sound however multiple areas of coating loss, steel exposure, and corrosion were noted. The most recent re-painting effort for the tank occurred in 1992 which corresponds with the end of the coating system's useful life since the typical life of a new painting system is between 20 – 25 years. Existing information indicates that the tank was not brought to bare steel during the 1992 repainting effort and recent laboratory sampling shows that the underlying tank coatings contain lead.

Orchard Street Tank

The Orchard Street tank (inspected in 2017) was reported to be in fair to poor condition. While the steel itself was found to be mostly sound and free of obvious leakage, the interior and exterior coating systems were found to have expired resulting in exposed steel with signs of minor surficial corrosion. It was recommended that:

- The exterior and interior coatings be removed via abrasive blasting and the tank repainted to preserve the integrity of the steel
- The tank be fitted with a new access ladder meeting current safety requirements
- We have also noted that the overflow pipe should be extended to the ground for safety reasons.

Recent laboratory sampling also indicates that the underlying coatings on the Orchard Street tank contain lead.

Long Hill Tank

Inspection of the Long Hill Tank (inspected in 2018) was found to be in good condition with minor defects noted. These included tight shrinkage cracks throughout the exterior concrete walls that were sounded and appeared limited to the surface of the shotcrete cover coating. It was recommended that:

- the exterior walls be pressure-washed to remove mildew and soiling
- Re-coat the exterior walls using an epoxy/polyurethane flexible coating to seal shrinkage cracks, prevent moisture accumulation, and to seal and protect the concrete.

The existing conditions of the Orchard Street Tank and Route 156 Tank were identified as significant deficiencies by the New Hampshire Department of Environmental Services (DES) during the town's 2019 Sanitary Survey. Further evaluation or potential rehabilitation and/or replacement options for the tanks will be discussed within this report. Any effort to rehabilitate the Orchard Street tank will require significant clearing of the adjacent trees and construction of an access driveway as no clear path to the tank currently exists.

Water System Demand

The town's water distribution system currently serves approximately 25% of the town's population. The average and maximum daily water system demands for the town are shown in Table 2 below in millions of gallons per day (mgd). The average day demand figures were taken from water usage records supplied by the town for the individual daily flows from the town's wells. The maximum day demand was taken from the town's pumping records and denotes the highest recorded daily flow during each calendar year.

Table 2: Water System Demands

Year	Average Day Demand (mgd)	Maximum Day Demand (mgd)
2016	0.293	0.481
2017	0.290	0.477
2018	0.291	0.495
3-year average (2016-2018)	**0.291**	**0.484**

For the 2016 – 2018 period the average day demand remained consistent at approximately 0.29 mgd with the 3-year average maximum day demand at approximately 0.48 mgd. The observed maximum day demand for this period is approximately 1.7 times the average day demand. The demand data was analyzed to determine trends in annual water production based on the population serviced by the town. A significant drought was observed in southern New Hampshire during the summer of 2016 however this did not have a noticeable effect on the annual average and maximum day demands of the water system. The town instituted water conservation measures during 2016 which likely contributed to the annual usage remaining similar to other non-drought years.

A brief analysis was performed to determine the potential maximum day and average day demands for planned growth within the town. Details of these growth opportunities were provided by the town and identified as projects likely to be completed in the next ten years. Projected maximum day demands for the planned growth opportunities were taken from information provided by the town or estimated by Weston & Sampson using the guidelines listed in the New Hampshire Code of Administrative Rules, Env-Wq 405, 406 and 1008. A summary of the projected water demands is shown in Table 3 below. Average day demands were determined using the 1.7 maximum day to average day demand ratio discussed above.

Table 3: Planned Growth Opportunities

Project Name	Maximum Day Demand (gpd)	Average Day Demand (gpd)
Exit 4 Project Area Expansion	2,285	1,345
Ridgewood Commons/The Meadows	59,500	35,000
Main Street Commons	2,250	1,325
Essex Commons	6,460	3,800
Total	**68,675**	**41,470**

These projects have the potential to increase the 2040 average and maximum day demands by 14%. Additional demand to the water distribution system can also be realized by an expansion of the water system. As the town currently serves 25% of the town's residents, we have assumed an additional annual growth of the water system of approximately 0.5% resulting in an additional demand increase of 10% over the next two decades. This results in an approximate 2040 average day demand of 0.36 mgd and a 2040 maximum day demand of 0.60 mgd.

Water System Storage Requirements

The DES Drinking Water and Groundwater Bureau promulgates New Hampshire state regulations regarding water distribution system and source requirements as specified in the Drinking Water Protection Program published rules in sections Env-Dw 300 (source water rules), 400 (public water system classification and design), 500 (operation and maintenance) and 700 (water quality). DES also specifies general water distribution and supply design criteria and considerations in the Standards of the Great Lakes Upper Mississippi River Board of State Public Health and Environmental Managers (Ten States' Standards).

Ten States' Standards - Recommended Standards for Water Works, states that "The system shall be designed to maintain a minimum pressure of 20 pounds per square inch (psi) at ground level at all points in the distribution system". This pressure is equivalent to 46 feet in elevation and will permit water to overcome the frictional resistance of house plumbing and rise to a height equivalent of about a three-story building. Under all conditions of flow, the normal working pressure in the distribution system should be approximately 60 to 80 psi and not less than 35 psi.

Typically, average day and maximum day water demands are satisfied by the pumping capacity of the water supply facilities and peak hour and fire flow requirements are satisfied by distribution system storage. Equalization, fire, and emergency storage are typically allocated at specific levels within a storage facility to ensure the storage volume will be available at a hydraulic gradient adequate for the intended purpose. Equalization

storage is provided within the top portion of the tank with fire storage positioned immediately below. Emergency storage is located in the lowest portion of the tank.

The quantity of system storage has been calculated using the method outlined in the American Water Works Association (AWWA) M32 Manual for Water Supply Practices - Distribution Network Analysis for Water Utilities. Calculation of the available storage was determined by the elevation of the highest house in the town's distribution system and the storage tanks' ability to provide minimum pressures as described below to that house. A water storage tank stores water to meet three distinct design criteria: equalization storage, fire storage, and emergency storage.

Equalization Storage

AWWA Manual M32 states that equalization storage makes up 20 to 25 percent of the average day demand, although these percentages are guidelines and are not recommended as design criteria. While equalization storage of 25 percent of the average day demand is acceptable for communities with large total water use and significant commercial and industrial demands, Weston & Sampson recommends a that a small primarily residential community such as the town's distribution system provide an additional equalization storage buffer of at least 25-percent of the maximum day demand for the area served by the tank. This will provide additional storage for the peak demands that arise from uses such as lawn irrigation, pool filling, etc.

The maximum day demand for the town's system is approximately 0.484 MGD under current demand conditions and a projected demand of 0.60 MGD under 2040 demand conditions. When a factor of 25-percent is applied, the current volume required for equalization storage is approximately 0.12 MG (2018) and 0.15 MG (2040). However, according to Ten States' Standards, a minimum pressure of 35 psi (81 feet) should be provided to customers under normal demand conditions. Therefore, only the volume of water within a tank that will provide a pressure of 35 psi to the highest house elevation can be considered usable as equalization storage.

Fire Storage

The Insurance Services Office (ISO) recommends that municipalities maintain a minimum pressure of 20 psi in the distribution system at all times during a fire flow event. The ISO has also established recommended time duration requirements during which the needed fire flow should be maintained. In general fire flows up to 2,500 gpm should be available for two hours, while fire flows greater than 2,500 gpm should be maintained for three hours or more depending on the flow. Any fire flow requirement above 3,500 gpm is the responsibility of the owner of the establishment although a municipality could decide to provide additional fire flow capacity beyond 3,500 gpm to attract more business development. Based on a maximum fire flow of 3,500 gpm at a duration of 3 hours, a minimum volume of approximately 0.63 MG would be required. Usable fire storage is defined as the amount of water within a storage tank that will provide a pressure of 20 psi (46 feet) to the highest house elevation in the system.

Emergency Storage

Any storage provided within a tank below the elevation required to maintain the 20-psi pressure for fire storage is considered emergency storage, and would be used for water main breaks, equipment failures, or raw water contamination. The volume required is a function of risk and the desired system dependability with respect to an interruption of supply and is typically estimated as a percentage of the combined equalization and fire storage volumes. Typically, up to 2 days of average day demand may be recommended for a system without emergency power generation at their wells and no additional supply via an interconnection. Due to the storage volume of the town's tanks (1.29 MG vs. an average day demand less than 0.3 MG), and emergency power backup for the wells that could be used under emergency conditions, only one day of average day demand is recommended in this analysis. This results in a volume of 0.29 MG (2018) and 0.36 MG (2040).

Conclusion

According to storage requirements discussed above, the town's distribution system is shown to have a storage surplus under both current and 2040 maximum day demand conditions. The table below shows the results of the evaluation based on the town-wide water system demands.

Table 4: Water Distribution System Storage Requirements

	Current (2018) (MG)	Future (2040) (MG)
Equalization Requirement (25% of Max Day Demand)	0.12	0.15
Fire Flow Requirement*	0.63	0.63
Emergency Storage (Volume Equal to Average Day Demand)	0.29	0.36
Total Required Storage	1.04	1.14
Total Storage Available	1.29	1.29
Available Storage	0.25 surplus	0.15 surplus

*3,500 gpm fire flow for a three-hour period

Information provided from the town and an examination of topographic data indicates the highest house elevation served in the system is approximately 300 feet. This elevation is found at 14 Long Hill Road adjacent to the Long Hill Tank. The ground elevation of this area, coupled with the 350-foot overflow elevation of the town's storage tanks, result in a maximum pressure of 21.6 psi that can be delivered to this property. Additionally, no equalization storage can be provided at this elevation. The town indicated that a nearby service located at 5 Stratton Lane was disconnected in 2013 due to insufficient pressure. Providing individual booster systems to this home or any adjacent property looking to connect to the water system should be considered by the town in order to comply with the Ten States' Standards.

However, the area immediately adjacent to the Long Hill Tank is geographically small and is generally not representative of the overall distribution system pressures. The town serves multiple customers with a ground elevation of 275 feet including Raymond High School and the area adjacent to the Route 156 Tank. Using this elevation and the ground elevation of each tank (listed in the table below), the total volume of equalization storage (greater than 35 psi), fire storage (greater than 20 psi), and emergency storage (<20 psi) within the town's storage tanks can be determined.

Table 5: Available Storage Serving Elevation of 275 Feet

Tank	Ground Elevation (feet)	Volume (MG)	Equalization Storage (>35 psi) (MG)	Fire Storage (>20 psi) (MG)	Emergency Storage (<20psi) (MG)
Orchard St Tank	262.5	0.119	0.00	0.038	0.081
Route 156 Tank	301.5	0.606	0.00	0.343	0.263
Long Hill Tank	325	0.562	0.00	0.562	0.00
Total Available Storage		**1.287**	**0.00**	**0.63***	**0.657***

*Only 0.63 MG required to satisfy usable fire flow requirements. Surplus of 0.313 MG considered to be emergency storage

The volume required for equalization storage would need to be provided above an elevation of 356 feet (275 feet + 81 feet), which is slightly above the overflow elevation of the town's tanks. Therefore, no water within the tanks is available as usable equalization storage in a strict interpretation of the Ten State's Standards.

Usable fire storage is defined as the amount of water within a storage tank that will provide a pressure of 20 psi (46 feet) to the highest house elevation in the system. For a highest house of 275 feet, the volume of water required

for fire storage would need to be provided above an elevation of 321 feet (275 feet + 46 feet) to be considered usable. With the exception of a portions of the Orchard Street and the Route 156 tanks, the majority of the town's storage volume meets the criteria for useable fire storage and can be used to satisfy the 0.63 MG requirement.

Based on the remaining portion of the tanks, excluding the volumes allocated for equalization and fire storage, approximately 0.657 million gallons are available as emergency storage. This volume represents approximately 2.3-times (2018 demand) to 2.0-times (2040 demand) the average day demand of the water system. This volume is well in excess of the required volume needed for emergency storage as discussed within this section.

While the town has a theoretical, estimated 2040 maximum day demand storage volume surplus of 0.15 million gallons (as shown in Table 4), the town is not able to provide adequate equalization storage to homes with a ground elevation of 275-feet. Additionally, the water elevation in the tanks should be assumed to be approximately 10-feet below the overflow elevation to account for maintaining all pressure requirements under tank operations. In order to provide a typical equalization storage of 25% of the 2040 maximum day (approximately 0.15 MG, as described previously) the highest service elevation would need to be lowered to 259 feet.

Table 6: Available Storage Serving Elevation of 259 Feet

Tank	Ground Elevation (feet)	Volume (MG)	Equalization Storage (>35 psi) (MG)	Fire Storage (>20 psi) (MG)	Emergency Storage (<20psi) (MG)
Orchard St Tank	262.5	0.119	0.013	0.038	0.081
Route 156 Tank	301.5	0.606	0.119	0.343	0.263
Long Hill Tank	325	0.562	0.205	0.562	0.00
Total Available Storage		**1.287**	**0.337**	**0.63***	**0.32***

*Only 0.63 MG required to satisfy usable fire flow requirements. Surplus of 0.313 MG considered to be emergency storage

If no special considerations are currently required for high-elevation homes wishing to connect to the water system, the town should consider modifying the bylaws to deny future connections to the water system for connections above 259 feet without written acknowledgement by the developer that not all water pressure requirements will be met under all demand conditions. The town maintains limited areas of service adjacent to the Route 156 tank and the high school with connection elevations above 259 feet. The town should explore the feasibility of supplying these properties with local booster pump systems to allow all pressure requirements to be met under normal tank operations.

Storage Tank Water Age

The American Water Works Association (AWWA) recommends that water age in a storage tank should average between three and five days. Low tank turn-over rates prohibit effective standalone mixing and leads to excessive water age and thermal stratification which may contribute to low chlorine residuals and unsafe levels of disinfection by-products (TTHMs and HAA5s), high rates of sediment accumulation, ice build-up, and undesirable taste and odor. According to tank level graphs provided by the town showing water storage tank elevations during June 2019 it was determined that the time for total turnover in both the Route 156 and Long Hill tanks exceeded this recommendation with the Route 156 tank displaying an approximate 16 day turnover time and the Long Hill tank showing an 8 day turnover time. The Orchard Street tank is not currently monitored by SCADA, however, following a similar methodology the low-level setting of the tank would be 84-feet to match the other tanks, and the high level setting is assumed to be three feet below overflow (87-feet) as seen in the other tanks. Under this calculation the turnover in the Orchard Street tank is approximately 29 days.

Analysis of the data showed that both the Route 156 and Long Hill tanks maintained narrow operating bands during June 2019, with both tanks displaying an approximate three-foot band between the low and high SCADA settings and cycling approximately once per day. The town has indicated that the typical winter operations of the tanks includes using a two-foot band, however at lower tank level settings. The town should consider expanding the low-level settings of the tanks to allow more volume to be drawn down during normal tank operation. Expanding the operating band of the water storage tanks promotes turnover within the tanks and reduces water age. In order to meet a five-day turnover time as recommended by AWWA, 20% of the tank volume would be required to be drawn down daily to promote additional turnover of the stored water. This would equate to expanding the level-controlled band to approximately 18 feet in the Orchard Street tank, 10 feet in the Route 156 tank, and 5 feet in the Long Hill tank. While we understand an 18-foot band may not be achievable, a 10-foot band would allow the turnover recommendations to be met in the Long Hill and Route 156 tanks while the Orchard Street tank turnover would be reduced to 9 days. Increasing the operating band of the tanks will increase the amount of time the water treatment plant is operating to fill the tanks however it will also reduce the frequency at which the treatment plant operates to fulfill this function.

It should be noted that tank mixers are also capable of providing on-site mixing and reduction of water age within tanks. Instituting mixers eliminates plug-flow operation of the tanks (either first water in is first water out or last water in is first water out). Mixers can also assist with reducing ice formation in tanks as the town has indicated minor scour damage to the Route 156 tank from this process. The town does not currently have mixers installed in any of the storage tanks within the water system. The town should explore the effectiveness of expanding the tank operation band to 10 feet on water quality and storage tank turnover rates. If chlorine residual or positive bacteria samples are observed in the future, the town should consider installation of tank mixers for promoting additional turnover within the tanks. Tank mixers can carry a capital cost of approximately $40,000 and carry an operational cost of $120 - $200 per month for electrical costs.

Modeling Results

A brief modeling exercise was performed using the town's hydraulic model using WaterCAD Connect Edition as received from Underwood Engineers. The model was run to evaluate the effect of the Orchard Street tank on fire flow within the existing system to verify the results generated during a similar effort completed by Stantec in 2014. Three model runs were performed to assess the following scenarios:

1. Orchard Street tank online (present day scenario)
2. Orchard Street tank offline
3. Orchard Street tank offline, with approximately 1,200 linear feet of 12-inch water main improvements on Main Street between Orchard Street and Floral Avenue replacing the existing 8-inch and 10-inch water main.

The model was run under a maximum day demand scenario and in steady-state conditions. The following results were obtained:

Table 7: Orchard Street Tank Modeling

Location	Existing Available Fire Flow (gpm)	Available Fire Flow without Orchard St Tank (gpm)	Loss of Available Fire Flow (%)	Available Fire Flow without Orchard St Tank & with 12-inch Water Main (gpm)
Main St @ Moulton St	5000	3690	26%	4980
Main St @ Orchard St	5000	3690	26%	5000
Main St @ Route 101	4600	3400	26%	4110
Main St @ Church Rd	5000	3900	22%	5000
Old Manchester Rd @ Wight St	4760	4060	15%	5000
Epping St @ Gould St	4000	3540	12%	3900
Main St @ Lucille Dr	4600	4470	3%	5000
Prescott Rd @ Agent Rd	1350	1330	2%	1350
Prescott Rd @ Pond Rd	4580	4280	7%	4460
Blueberry Hill Rd @ Strawberry Ln	1180	1150	2%	1170

Fire flows within the core area of the water system adjacent to Main Street were noticeably lower with the Orchard Street tank offline. The available fire flows in the outer extremities of the water system (Prescott Road, Blueberry Hill Road) were less impacted by the removal of the Orchard Street tank. The reduction in fire flow within the Main Street/downtown area were largely offset by the installation of a 12-inch water main replacing 1,200 linear feet of existing 8-inch and 10-inch mains while no appreciable difference in available fire flow was realized in the extremities of the water system.

The model was run in a steady-state condition and the results were not generated using an extended period simulation (EPS). The dimensions and ground elevation of the existing Orchard Street tank allow for only a volume of approximately 60,000 gallons of storage above an elevation of 305 feet (threshold for minimum of 20 psi to highest house elevation). Under an EPS modeling scenario, it is anticipated that the available fire storage in the Orchard Street tank would be exhausted in less than an hour during a fire flow making the values shown in the "existing available fire flow" column of the table above unsustainable over time. However, if the town's desires an increase to the available fire flow in the Main Street/downtown area with the Orchard Street tank removed from service the water main improvements noted above assist with this goal. The costs for the water main improvements will be carried in the costing described below for all options including removal of the Orchard Street tank.

Water Storage Solutions & Costs:

As discussed within the condition assessment section of this report, the existing conditions of both the Orchard Street and Route 156 tanks were identified as significant deficiencies during the town's 2019 Sanitary Survey performed by DES. This section of the report will detail three corrective action options for these tanks including a rehabilitation of the existing tanks, a decommissioning of the Orchard Street tank, and construction of a new storage tank. The recently constructed Long Hill tank appears to be in good condition and is assumed to remain in operation under its existing conditions in all three options presented below. All three options include site work and tree clearing at the Orchard Street location as the tank is not currently accessible from any travel way. All three options also include the installation of active tank mixing systems in the existing facilities to promote turnover and reduce water age and quality concerns. All costs presented below will relate to a 90-year life cycle for each option. All costs presented are present worth values for each of the options in 2020 dollars.

Options:

1. Rehabilitate Orchard Street and Route 156 Tanks

Following the recommendations of NHDES Sanitary Survey, the Orchard Street and Route 156 tanks should be fully rehabilitated within the next two years to prevent further coating degradation and metal loss in the tank walls. The expected useful life for welded-steel water storage tanks is approximately 80 – 100 years primarily based on maintenance and environmental factors. Current coating systems typically have a 20 to 25-year life before requiring additional rehabilitation efforts. The town is not required to perform these rehabilitations at this time; however, the expected useful life of the coating systems would indicate that rehabilitation of these tanks is anticipated in the next few years. To maximize each tank's life, the town should anticipate rehabbing the tank up to three times within the 90-year timeline. The Route 156 tank was not brought to bare steel during the last coating rehabilitation and contains lead-based paint according to recent laboratory testing. The Orchard Street tank also contains lead paint resulting in both tanks requiring scaffolding and containment for the initial 2020 rehabilitation to meet lead paint removal standards. Minor appurtenance work is also anticipated at each tank. This option serves to indicate costs of a "status quo" approach. The estimated present worth value for three rehabilitations for each tank, assumed for years 2020, 2050, and 2080, is **$4,860,000** which would extend the existing tanks through the year 2110. While the Orchard Street tank is unlikely to reach a 200-year lifespan, this option presents the town with the expected costing to maintain the tanks into the future.

2. Decommission Orchard Street Tank & Rehabilitate Route 156 Tank

This option reflects the rehabilitative efforts for the Route 156 tank as described in Option 1 above with the addition of demolishing the Orchard Street tank. Based on the storage evaluation performed above, the Route 156 and Long Hill tanks are capable of meeting the town's present and future 2040 storage requirements. The town is able to remove the tank and maintain a small water storage surplus when incorporating projected 2040 demands. Removal of the Orchard Street tank would reduce the total storage within the water system and provide a slight increase to the turn-over rate of the stored water. However, removal of the Orchard Street tank will reduce the storage surplus for the town and would require the additional water main upgrades as described in the modeling review section to offset any reduction in fire flow. The cost for the water main improvements on Main Street are included within this option. Under this option the Orchard Street tank is demolished and included with the Route 156 tank rehabilitation costs from Option 1 for a total estimated present worth life cycle value of **$4,000,000**.

3. Provide New Water Storage Tank

This option includes construction of a new water storage tank suitably sized to replace the existing Orchard Street and Route 156 tanks. The tank would be designed to meet the town's storage needs as described above and also be capable of supplying a minimum of 35 PSI to all water system customers with connections to the water system at or below an elevation of 259 feet. Based on the assessment provided above, a new tank would be constructed with an overflow at or above 352.5 feet in order to meet this requirement and match the existing gradeline of the water system. As this report does not include an assessment of potential water storage tank sites it is assumed that the new tank would be located at either the existing Orchard Street location or the existing Route 156 location. In order to meet the proposed overflow elevation of 352.5 feet, a tank constructed at the Orchard Street site would need to be approximately 90 feet. The required tank height is reduced to approximately 50 feet if located at the Route 156 tank site. For this costing alternative it is assume that the tank will be sized to meet the equalization, fire, and emergency storage requirements as described above. As the town has been required to import water on two recent occasions to offset peak usage, we recommend increasing the emergency storage volume of the proposed tank to twice the average day demand. The proposed tank volume based on these considerations is approximately 0.80 MG, or slightly greater than the combined existing volume of the Orchard Street and Route 156 tanks.

This option assumes that the Route 156 tank would be demolished, and the existing site used for construction of the new tank (additional cost is carried in the estimate for the town to acquire additional land adjacent to the existing site if needed). The Orchard Street tank would also be demolished at the end of its useful life. Water main upgrades on Main Street are also included in this cost to offset the demolition of the Orchard Street tank. A replacement tank, demolition of the two existing tanks completed in the near future, and a future rehabilitation of the new tank in the year 2050, is estimated to cost **$4,245,000.**

Summary:
The costs presented in Table 7 below contain the present worth values of the 90-year life cycle for each of the three options presented above. All costs are presented in 2020 dollars.

Table 8: Water Storage Tank Costs

Option	Life Cycle Cost
Rehabilitate Orchard St & Route 156	$4,860,000
Decommission Orchard St & Rehabilitate Route 156	$4,000,000
Construct New Storage Tank	$4,245,000

Estimated costs are present day costs including design, bidding, construction administration and construction with a 15% contingency. Present day costs are estimated from future value costs with a construction inflation rate of 3%. A full break out of the itemized costs for each of the three options is presented in Attachment B. Option 2 as presented above presents the town with the lowest present worth value for the 90-year life cycle of the tanks.

Recommendations:
At this time Weston & Sampson recommends that the town review the three rehabilitation and replacement options presented above. When considering the present worth value of the options, Option 2 including decommissioning of the Orchard Street tank and rehabilitation of the Route 156 tank presents the lowest cost alternative to the town while meeting existing and anticipated 2040 water demands. Option 3 presents a slight increase in life cycle cost to Option 2 but allows the town to increase the overall storage volume within the water system. Additionally, the town should consider installation of tank mixers for promoting additional turnover within the storage tanks. The town should also investigate the existing practice for allowing homes above 259 feet to connect to the water system and institute requirements for developers to acknowledge that pressure deficiencies may exist to these properties.

Thank you and Frank Giordano, Deputy Director of Public Works, for your assistance, time, and consideration during this study.

Sincerely,

WESTON & SAMPSON ENGINEERS, INC.

Jeffrey W. McClure, P.E.
Senior Associate
Enclosures:
-Attachment A – Distribution System Map
-Attachment B – Itemized Rehabilitation and Replacement Costs
-Attachment C – Storage Tank Inspection Reports

Project 2292-02
Water Asset Management Plan
Preliminary Map

UNDERWOOD engineers

October 17, 2019

HIGH PRESSURE ZONE

LONG HILL TANK

WELL #4

ROUTE 156 TANK

WTP

WELL #1,2,3

ORCHARD ST TANK

TUCKAWAY TAVERN

WALMART

CROSS COUNTRY CAMPGROUND

Legend

- Raymond_hydrants
- Injection Ports
- Service Valves
- Gate Valves
- Blow Offs
- Water Services
- Hydrant Services

Dia_txt

- 1.25
- 2
- 4
- 6
- 8
- 10
- 12
- 16
- Unknown

N

1 inch = 750 feet

0 750 1,500 2,250 3,000 Feet

Attachment B - Water Storage Tank Evaluation Life Cycle Costs

1/31/2020

Option	Item	Cost	Engineering	20% Contingency	Total
1	Orchard St Rank Rehabilitation 2020	$ 523,273	$ 85,000	$ 189,700	$ 798,000
	Route 156 Tank Rehabilitation 2020	$ 643,782	$ 135,000	$ 263,800	$ 1,042,600
	Orchard St Rank Rehabilitation 2050	$ 283,273	$ 85,000	$ 141,700	$ 510,000
	Orchard St Rank Rehabilitation 2080	$ 283,273	$ 85,000	$ 141,700	$ 510,000
	Route 156 Tank Rehabilitation 2050	$ 523,782	$ 135,000	$ 239,800	$ 898,600
	Route 156 Tank Rehabilitation 2080	$ 523,782	$ 135,000	$ 239,800	$ 898,600
	Tank Mixer Installation (3)	$ 120,000	$ 30,000	$ 54,000	$ 204,000
	Option 1 Total				**$ 4,861,800**
2	Orchard St Tank Demolition	$ 230,000	$ 85,000	$ 131,000	$ 446,000
	Route 156 Tank Rehabilitation 2020	$ 643,782	$ 135,000	$ 263,800	$ 1,042,600
	Route 156 Tank Rehabilitation 2050	$ 523,782	$ 135,000	$ 239,800	$ 898,600
	Route 156 Tank Rehabilitation 2080	$ 523,782	$ 135,000	$ 239,800	$ 898,600
	Tank Mixer Installation (2)	$ 80,000	$ 30,000	$ 46,000	$ 156,000
	Main Street WM Improvements	$ 300,000	$ 100,000	$ 160,000	$ 560,000
	Option 2 Total				**$ 4,001,800**
3	Route 156 Tank Demolition	$ 150,000	$ 50,000	$ 80,000	$ 280,000
	New Route 156 Storage Tank	$ 1,677,000	$ 280,000	$ 615,400	$ 2,572,400
	Orchard St Tank Demolition	$ 230,000	$ 65,000	$ 111,000	$ 406,000
	New Route 156 Tank Maintenance 2060	$ 125,000	$ 60,000	$ 85,000	$ 270,000
	Tank Mixer Installation (2)	$ 80,000	$ 30,000	$ 46,000	$ 156,000
	Main Street WM Improvements	$ 300,000	$ 100,000	$ 160,000	$ 560,000
	Option 3 Total				**$ 4,244,400**

UNDERWATER SOLUTIONS INC.

INSPECTION AND CLEANING (SEDIMENT REMOVAL) OF THE ROUTE 156 - 600,000-GALLON WELDED STEEL WATER STORAGE TANK

TOWN OF RAYMOND WATER DEPARTMENT
RAYMOND, NEW HAMPSHIRE

JULY 26, 2016

MUNICIPAL DIVING SERVICES • P.O. Box 208 • Mattapoisett, MA 02739 • Tel: (508) 758-6126 • Fax: (508) 758-6128 •
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TOWN OF RAYMOND WATER DEPARTMENT RAYMOND, NEW HAMPSHIRE

JULY 26, 2016

SCOPE:

On July 26, 2016, Underwater Solutions Inc. inspected the Route 156 - 600,000-gallon welded steel potable water storage tank to provide information regarding the overall condition and integrity of this welded steel structure and removed the sediment accumulation found on the floor.

EXTERIOR INSPECTION:

The entire exterior of this water storage tank and components was inspected, to include walls and coating, manway, foundation, ladders, overflow, roof, vent and hatch.

The exterior welded steel wall and roof dome surfaces were found having similar conditions as were found during a previous inspection completed by Underwater Solutions Inc. on August 2, 2012.

Walls And Coating

The exterior steel wall panels and associated welds were inspected and found appearing sound and free of obvious fatigue or failures at this time.

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The protective coating applied to these welded steel surfaces has become chalky due to weathering, yet remains having mostly good adhesion value at this time.

The average dry film thickness of the protective coating system applied to the exterior steel wall panels were measured during this inspection. The dry film thickness of the coating system applied to the exterior wall surfaces was found as follows:

Row	***Mil Thickness***	***Row***	***Mil Thickness***
1.	8.7 mils	5.	7.4 mils
2.	11.9 mils	6.	8.9 mils
3.	9.3 mils	7.	10.6 mils
4.	8.6 mils		

The American Water Works Association (AWWA) recommends a dry film thickness of 7.0 to 10.0 mils of coating film thickness be applied to the exterior surfaces of welded steel potable water storage tanks to provide adequate protection for riveted steel structures.

Numerous areas of coating damage (coating chips) were observed throughout all elevations of the exterior walls at this time.

These 1/4" to 1" diameter areas of coating damage appeared to be the result of objects striking the tank and have caused exposure of the underlying steel. No obvious fatigue (pitting) of the steel was evident within these areas of steel exposure, rather mild surface corrosion exists at this time.

The 1-1/2" wide steel floor extension located at the base of the lowest row of wall panels was found with coating loss and steel exposure throughout approximately 10% the circumference of the tank. No obvious fatigue or deterioration of these steel surfaces was evident within the areas of steel exposure, rather mild to moderate surface corrosion exists at this time.

An accumulation of mildew exists throughout all elevations of the exterior walls, and corrosion staining extending from the roof dome has declined in the overall aesthetics.

Manway

One 24" by 18" steel manway penetrates the lowest wall panel on the southernmost side of the tank, located approximately 20" above the tank base and is securely installed and free of leakage.

The protective coating applied to the steel manway lid and the two steel securing bars was found having mostly good adhesion value and with an average dry film thickness of 24.9 mils, while two areas of coating loss were observed on the manway lid. No obvious fatigue (pitting) of the manway lid was evident within these two, 1/4" diameter areas of steel exposure, rather mild surface corrosion and corrosion staining exist at this time.

Foundation

The exposed surfaces of the 3" wide concrete foundation ranges in height from 6" to 16" tall and was found appearing sound and remains free of cracks, spalls or other obvious fatigue of the concrete at this time.

The sealant applied throughout the circumference of the tank at the junction of where the tank base and foundation meet appeared to be dry and beginning to degrade due to weathering, yet remains having good adhesion value at this time.

Ladders

A welded steel ladder extends from approximately 12' above the ground up to the roof and is supported to the tank wall with five sets of welded steel standoffs. This ladder was found in sound condition, providing good access to the roof.

The protective coating applied to these steel surfaces was found having fair adhesion value at this time. Lifting and peeling of the coating has resulted in exposure of both the primary coating and underlying steel throughout approximately 15% of these surfaces. No obvious fatigue or deterioration of the ladder side rails or rungs was evident within these 1/4" to 1/2" diameter areas of steel exposure, rather mild surface corrosion exists at this time.

A second welded steel ladder extends from the edge of the roof dome up to the center of the vent and is secured to the vent with one bolted support, while two sets of metal wheels installed on this ladder allow it to rotate throughout the circumference of the roof dome. This ladder was found in sound condition, providing good access to the vent and center of the roof dome.

The protective coating applied to these steel surfaces was found having fair adhesion value at this time. Lifting and peeling of the coating has resulted in exposure of both the primary coating and underlying steel throughout approximately 1% of these surfaces. No obvious fatigue or deterioration of the ladder side rails or rungs was evident within these 1/4" diameter areas of steel exposure, rather mild surface corrosion exists at this time.

Overflow

The overflow consists of two 10" long by 8" wide cutouts within the top row of wall panels, located approximately 4" below the junction of where the roof and walls meet.

Each overflow cutout was free of obvious obstructions and with proper screening, preventing access to the interior of the tank.

Roof

The steel roof panels and associated welds were found appearing sound and remain free of obvious fatigue or failures at this time.

The protective coating applied to these welded steel surfaces was found having a decline in the dry film thickness and is nearing expiration at this time.

Thinning of the coating applied to these surfaces has caused exposure of the primary coating throughout approximately 30% of the roof, while coating loss has caused exposure of the underlying steel throughout approximately 40% of the roof at this time. No obvious fatigue (pitting) of the roof panels was evident within the areas showing steel exposure, rather mild surface corrosion and corrosion staining that extends down the roof and continues throughout the exterior wall surfaces, resulting in poor aesthetics.

Twenty-eight, 1-1/2" diameter rigging hole penetrations within the roof dome were found secured with threaded plugs, preventing access to the interior of the tank.

Vent

The vent is located in the center of the roof dome, having a 12" inside diameter and stands 16" tall.

A 32" outside diameter steel cap and associated screen remains securely installed over the vent penetration within the roof dome, preventing access to the interior of the tank.

Hatch

One 24" inside diameter steel hatch provides access to the interior of this tank through the roof dome. This hatch remains in good working condition and was found secured with a lock, preventing unwanted access to the interior of the tank.

INTERIOR INSPECTION:

The entire interior of this water storage tank and components was inspected, to include sediment accumulations, floor, manway, piping, walls and coating, overhead, overflow and aesthetic water quality.

Sediment Accumulations

A uniform layer of accumulated precipitate was found throughout the floor, having depths no greater than 1/16" deep.

Upon completion of this inspection, all precipitate was vacuumed from the floor.

Floor

After removing the accumulated precipitate, the steel floor panels and associated welds were inspected and were found appearing sound and free of obvious fatigue or failures of the steel at this time.

The protective coating applied to these welded steel surfaces was found having fair adhesion value at this time. Coating blisters that have ruptured were observed throughout less than 10% of these surfaces, resulting in exposure of the underlying steel. No obvious fatigue (pitting) of the steel was evident within these 3/4" diameter areas of steel exposure, rather mild surface corrosion exists at this time.

Mild staining exists throughout the floor due to the accumulation of precipitate.

Manway

One 24" by 18" inside diameter manway penetrates the lowest wall panel on the southernmost side of the tank, located approximately 20" above the floor and is securely installed and free of obvious leakage.

The protective coating applied to these steel surfaces was found having mostly good adhesion value, yet several ruptured coating blisters and steel exposure were observed throughout less than 5% of these surfaces.

No obvious fatigue (pitting) of the steel was evident within these 1/8" to 1/4" diameter areas of steel exposure, rather mild surface corrosion exists at this time.

Piping

The influent/effluent pipe penetrates the floor approximately 12" in from the wall on the westernmost side of the tank, having a 12" inside diameter and is flush with the floor

A 12" inside diameter by 16" tall removable riser is installed above this pipe, serving as a silt stop. This pipe was free of obstructions and was found without flow at the time of this inspection.

Walls And Coating

The interior walls were inspected beginning at the floor and by spiraling the circumference of the tank up to the water surface.

These steel wall panels and associated welds were found appearing mostly sound, yet isolated areas of coating loss, steel exposure, corrosion and steel fatigue (pitting) was observed throughout these surfaces.

Adhesion loss of the coating system applied to the interior walls has resulted in exposure of the underlying steel throughout approximately 10% of these surfaces, resulting in exposure of the underlying steel.

Mild to moderate corrosion was observed within each area of coating loss and steel exposure, while fatigue (pitting) of the welds, to include the wall panel surfaces adjacent to the welds was observed throughout the weld and wall panel surfaces between the fifth and sixth rows and sixth and seventh rows of wall panels above the floor. These areas showing steel fatigue range in size from 3/4" in diameter to 3" long by 2" wide.

The depth of pitting within the welds was found to measure approximately 3/8" deep, while pitting of the adjacent wall panels was measured at 1/4" deep at this time.

Moderate to heavy staining exists throughout the interior walls, beginning approximately 36" below overflow level and extends down to the floor.

Overhead

The entire overhead was inspected from the water surface.

These steel overhead panels and angle iron supports appeared sound and remain free of obvious fatigue or failures at this time.

The protective coating applied to all steel panels and angle iron supports was found having good adhesion value, and although mild blotch rusting was observed throughout several of the edges of the steel panels and the edges of the angle iron supports, no obvious steel exposure or steel fatigue was evident at this time.

Overflow

The overflow consists of two 10" long by 8" wide cutouts within the top row of wall panels, located approximately 4" below the junction of where the roof and walls meet.

Each overflow cutout was free of obvious obstructions at the time this inspection was completed.

Aesthetic Water Quality

The aesthetic water quality was found to be good throughout this entire tank, allowing unlimited visibility for this inspection.

RECOMMENDATIONS:

It is the opinion of Underwater Solutions Inc. that this welded steel potable water storage tank requires rehabilitation within the near future, as the coating system applied to the interior and exterior surfaces of this tank has nearly expired. This condition has caused steel exposure and surface corrosion, while fatigue (pitting) of the steel was found throughout the upper elevations of the interior wall panels at this time.

EXTERIOR:

The exterior steel wall panels and associated welds appeared sound and remain free of obvious fatigue or failures at this time.

The protective coating applied to these welded steel surfaces has become chalky due to weathering, yet remains having mostly good adhesion value and appeared to have been applied uniformly and meets the specifications set by the AWWA.

Numerous areas of coating damage (coating chips) were observed throughout all elevations of the exterior walls at this time.

These 1/4" to 1" diameter areas of coating damage appeared to be the result of objects striking the tank and has caused exposure of the underlying steel. No obvious fatigue (pitting) of the steel was evident within these areas of steel exposure, rather mild surface corrosion exists at this time.

The 1-1/2" wide steel floor extension located at the base of the lowest row of wall panels was found with coating loss and steel exposure throughout approximately 10% the circumference of the tank. No obvious fatigue or deterioration of these steel surfaces was evident within the areas of steel exposure, rather mild to moderate surface corrosion exists at this time.

An accumulation of mildew exists throughout all elevations of the exterior walls, and corrosion staining extending from the roof dome has declined the overall aesthetics.

The steel roof panels and associated welds appeared sound and remain free of obvious fatigue or failures at this time.

The protective coating applied to these welded steel surfaces was found having a decline in the dry film thickness and is nearing expiration at this time.

Thinning of the coating applied to these surfaces has caused exposure of the primary coating throughout approximately 30% of the roof, while coating loss has resulted in exposure of the underlying steel throughout approximately 40% of the roof at this time. No obvious fatigue (pitting) of the roof panels was evident within the areas showing steel exposure, rather mild surface corrosion and corrosion staining that extends down the roof and down throughout the exterior wall surfaces, causing poor overall aesthetics.

It is our recommendation to abrasive blast the exterior wall, roof dome and associated exterior components of this structure to white or near white metal. We recommend then re-coating these surfaces in an effort to halt corrosion, prevent steel fatigue and to protect the steel, while improving the aesthetics of this potable water storage tank.

INTERIOR:

The steel floor panels and associated welds were found appearing sound and free of obvious fatigue or failures of the steel at this time.

The protective coating applied to these welded steel surfaces was found having fair adhesion value, yet coating blisters that have ruptured were observed throughout less than 10% of these surfaces, resulting in exposure of the underlying steel.

No obvious fatigue (pitting) of the steel was evident within these 3/4" diameter areas of steel exposure, rather mild surface corrosion exists at this time.

The interior steel wall panels and associated welds appeared mostly sound, yet isolated areas of coating loss, steel exposure, corrosion and steel fatigue (pitting) was observed throughout these surfaces.

Adhesion loss of the coating system applied to the interior walls has resulted in exposure of the underlying steel throughout approximately 10% of these surfaces.

Mild to moderate corrosion was observed within each area of coating loss and steel exposure, while fatigue (pitting) of the welds, to include the wall panel surfaces adjacent to the welds, was observed throughout the weld and wall panel surfaces between the fifth and sixth rows and sixth and seventh rows of wall panels above the floor. These areas showing steel fatigue range in size from 3/4" in diameter to 3" long by 2" wide.

The depth of pitting within the welds was found to measure approximately 3/8" deep, while pitting of the adjacent wall panels was measured at 1/4" deep at this time.

Moderate to heavy staining exists throughout the interior walls, beginning approximately 36" below overflow level and extends down to the floor.

The steel overhead panels and angle iron supports appeared sound and remain free of obvious fatigue or failures at this time.

The protective coating applied to all steel panels and angle iron supports was found having good adhesion value, and although mild blotch rusting was observed throughout several of the edges of the steel panels and the edges of the angle iron supports, no obvious steel exposure or steel fatigue was evident at this time.

It is our recommendation to abrasive blast the interior floor, wall, overhead and associated interior components of this tank to white or near white metal. We recommend then re-evaluating the floor and wall/weld surfaces for the extent of steel fatigue and the most suitable means to re-surface the areas of steel fatigue found throughout the floor and wall panel/weld surfaces. Finally, we recommend then and re-coating all interior surfaces within the next year using an A.N.S.I./N.S.F.61 approved coating for use in structures containing potable water in an effort to halt corrosion, prevent further steel fatigue and to protect these welded steel surfaces.

As always, we recommend re-inspection and cleaning of all water storage facilities in accordance with state and federal mandates, A.W.W.A. standards, and be completed by an experienced and authorized inspection corporation.

UNDERWATER SOLUTIONS INC.
Christopher A. Cole, Project Manager

This report, the conclusions, recommendations and comments prepared by Underwater Solutions Inc. are based upon spot examination from readily accessible parts of the tank. Should latent defects or conditions which vary significantly from those described in the report be discovered at a later date, these should be brought to the attention of a qualified individual at that time. These comments and recommendations should be viewed as information to be used by the Owner in determining the proper course of action and not to replace a complete set of specifications. All repairs should be done in accordance with A.W.W.A. and/or other applicable standards.

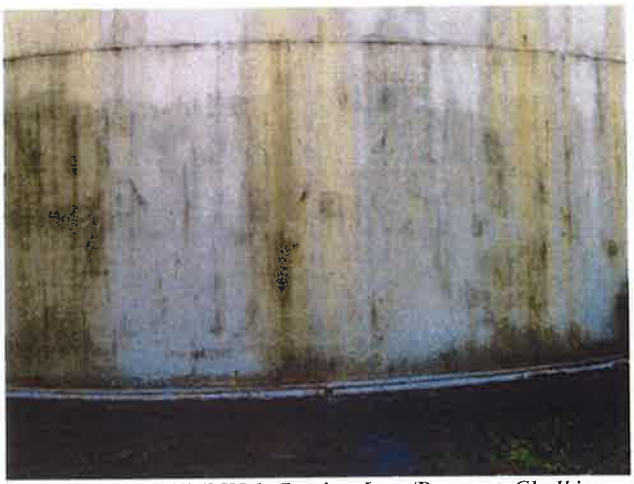
1 *Exterior Wall With Coating Loss/Damage, Chalking Exposed Underlying Steel, Mild Surface Corrosion, Mildew And Corrosion Staining*

2 *Exterior Wall With Coating Loss/Damage, Chalking Exposed Underlying Steel, Mild Surface Corrosion, Mildew And Corrosion Staining*

3 *Exterior Wall With Coating Loss/Damage, Chalking Exposed Underlying Steel, Mild Surface Corrosion, Mildew And Corrosion Staining*

4 *Exterior Wall With Coating Loss/Damage, Chalking Exposed Underlying Steel, Mild Surface Corrosion, Mildew And Corrosion Staining*

5 *Exterior Wall With Coating Loss/Damage, Chalking Exposed Underlying Steel, Mild Surface Corrosion, Mildew And Corrosion Staining*



6 *Exterior Wall With Coating Loss/Damage, Chalking Exposed Underlying Steel, Mild Surface Corrosion, Mildew And Corrosion Staining*

7 *Exterior Wall With Coating Loss/Damage, Chalking Exposed Underlying Steel, Mild Surface Corrosion, Mildew And Corrosion Staining*

8 *Exterior Wall With Coating Loss/Damage, Chalking Exposed Underlying Steel, Mild Surface Corrosion, Mildew And Corrosion Staining*

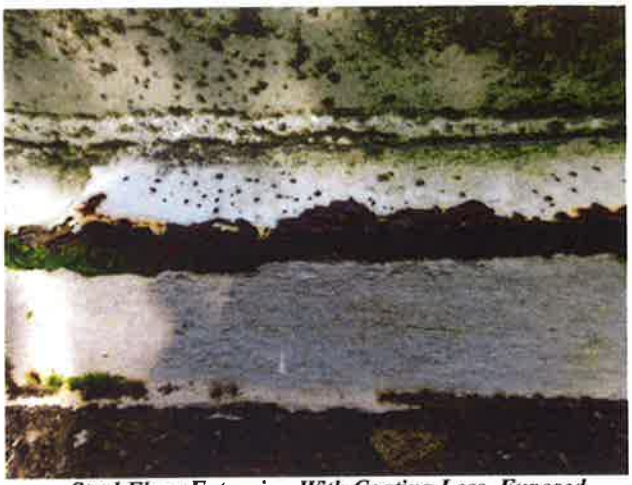
9 *Exterior Wall With Coating Loss/Damage, Chalking Exposed Underlying Steel, Mild Surface Corrosion, Mildew And Corrosion Staining*

10 *Exterior Wall With Coating Loss/Damage, Chalking Exposed Underlying Steel, Mild Surface Corrosion, Mildew And Corrosion Staining*

11 *Exterior Wall With Coating Loss/Damage, Chalking Exposed Underlying Steel, Mild Surface Corrosion, Mildew And Corrosion Staining*

12 *Exterior Wall With Coating Loss/Damage, Chalking Exposed Underlying Steel, Mild Surface Corrosion, Mildew And Corrosion Staining*

13 *Steel Floor Extension With Coating Loss, Exposed Steel, Mild To Moderate Surface Corrosion And Mildew*



14 *Steel Floor Extension With Coating Loss, Exposed Steel, Mild To Moderate Surface Corrosion And Mildew*

15 *Steel Floor Extension With Coating Loss, Exposed Steel, Mild To Moderate Surface Corrosion And Mildew*

16 *Steel Floor Extension With Coating Loss, Exposed Steel, Mild To Moderate Surface Corrosion And Mildew*

17 *Secure Manway*

18 *Manway Lid With Coating Loss, Exposed Steel And Mild Surface Corrosion*

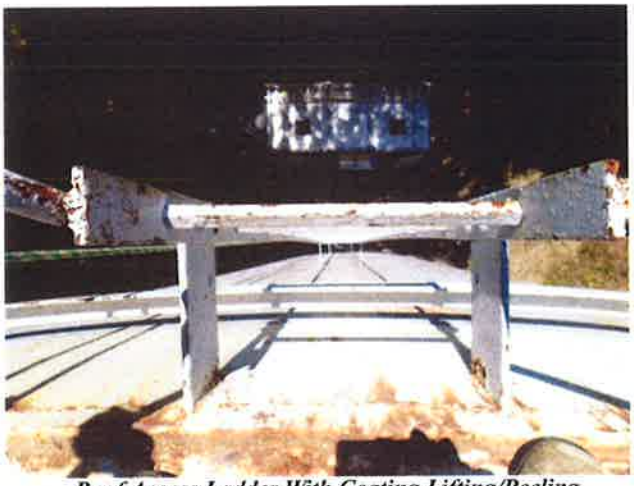
19 *Concrete Foundation*

20 *Concrete Foundation*

21 *Concrete Foundation - Tank Base To Wall Junction With Sealant Degrading Due To Weathering*

22 *Concrete Foundation - Tank Base To Wall Junction With Sealant Degrading Due To Weathering*

23 *Roof Access Ladder*



24 *Roof Access Ladder With Coating Lifting/Peeling, Exposed Primary Coating, Exposed Underlying Steel And Mild Surface Corrosion*

25 *Vent Access Ladder With Coating Lifting/Peeling, Exposed Primary Coating, Exposed Underlying Steel And Mild Surface Corrosion*

26 *Vent Access Ladder With Coating Lifting/Peeling, Exposed Primary Coating, Exposed Underlying Steel And Mild Surface Corrosion*

27 *Roof With Coating Nearing Expiration, Exposed Primary Coating, Exposed Underlying Steel, Mild Surface Corrosion And Corrosion Staining*

28 *Roof With Coating Nearing Expiration, Exposed Primary Coating, Exposed Underlying Steel, Mild Surface Corrosion And Corrosion Staining*

29 *Roof With Coating Nearing Expiration, Exposed Primary Coating, Exposed Underlying Steel, Mild Surface Corrosion And Corrosion Staining*

30 *Roof With Coating Nearing Expiration, Exposed Primary Coating, Exposed Underlying Steel, Mild Surface Corrosion And Corrosion Staining*

31 *Roof With Coating Nearing Expiration, Exposed Primary Coating, Exposed Underlying Steel, Mild Surface Corrosion And Corrosion Staining*

32 *Roof With Coating Nearing Expiration, Exposed Primary Coating, Exposed Underlying Steel, Mild Surface Corrosion And Corrosion Staining*

33 *Roof With Coating Nearing Expiration, Exposed Primary Coating, Exposed Underlying Steel, Mild Surface Corrosion And Corrosion Staining*

34 *Roof With Coating Nearing Expiration, Exposed Primary Coating, Exposed Underlying Steel, Mild Surface Corrosion And Corrosion Staining*

35 *Secure Roof Dome Rigging Hole*

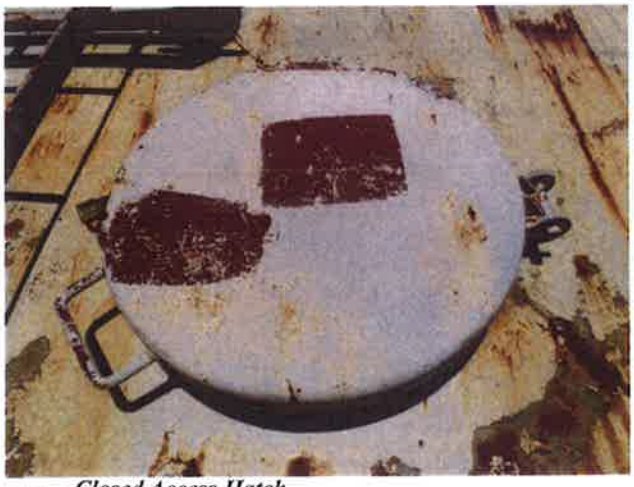
36 *Secure Roof Dome Rigging Hole*

37 *Secure Vent Cap*

38 *Screened Vent*

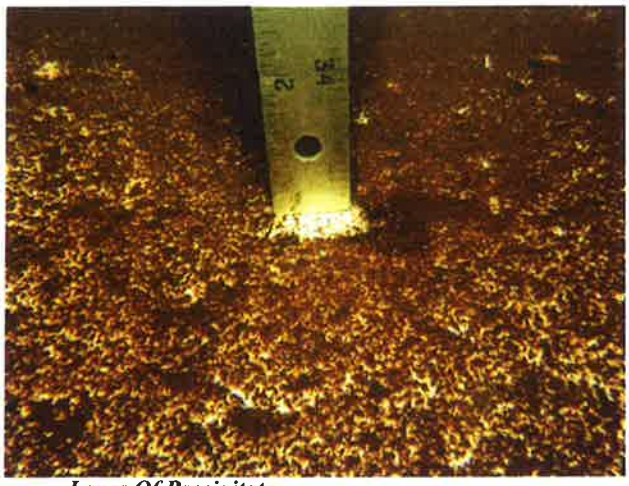
39 *Screened Vent*

40 *Open Access Hatch*



41 *Closed Access Hatch*

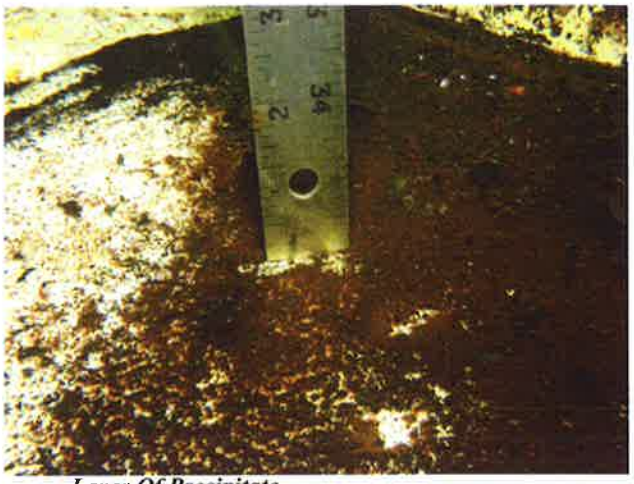
42 *Secure Access Hatch*



43 *Layer Of Precipitate*

44 *Layer Of Precipitate*

45 *Layer Of Precipitate*

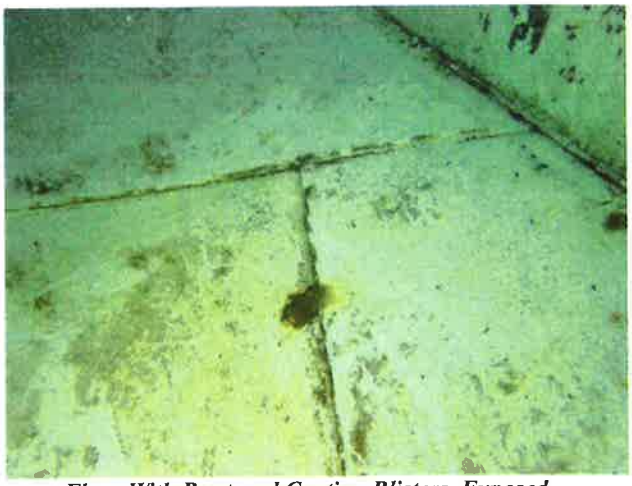


46 *Layer Of Precipitate*

47 *Floor With Ruptured Coating Blisters, Exposed Underlying Steel, Mild Surface Corrosion And Mild Staining*

48 *Floor With Ruptured Coating Blisters, Exposed Underlying Steel, Mild Surface Corrosion And Mild Staining*

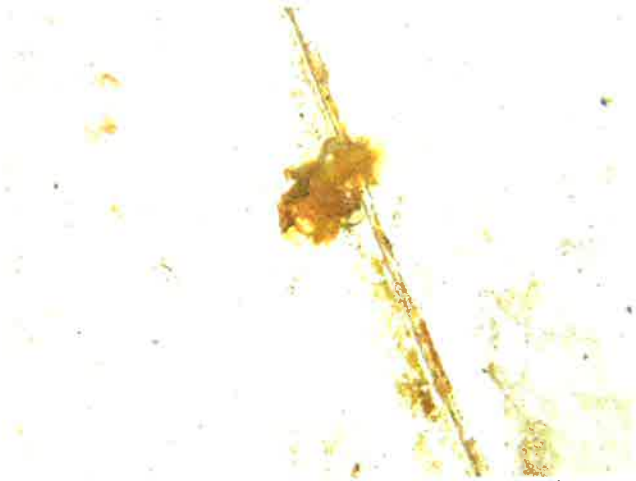
49 *Floor With Ruptured Coating Blisters, Exposed Underlying Steel, Mild Surface Corrosion And Mild Staining*



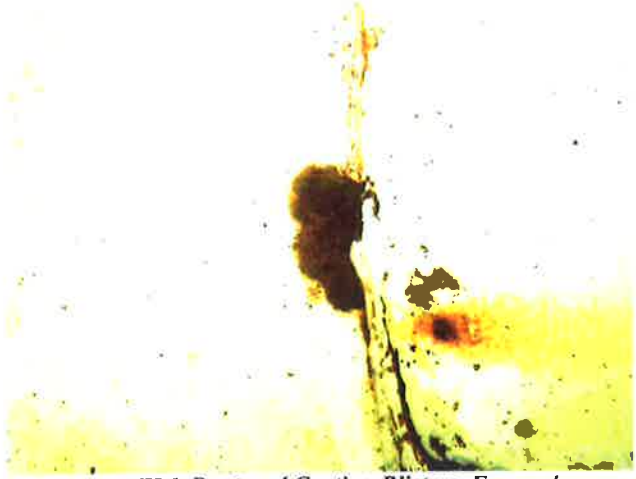
50 *Floor With Ruptured Coating Blisters, Exposed Underlying Steel, Mild Surface Corrosion And Mild Staining*

51 *Floor With Ruptured Coating Blisters, Exposed Underlying Steel, Mild Surface Corrosion And Mild Staining*

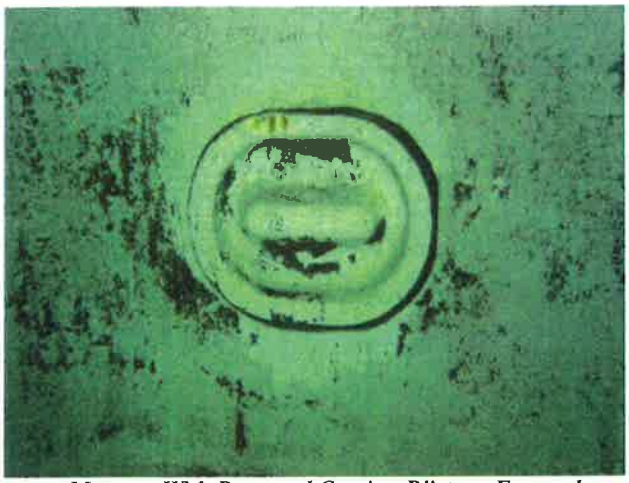
52 *Floor With Ruptured Coating Blisters, Exposed Underlying Steel, Mild Surface Corrosion And Mild Staining*



53 *Floor With Ruptured Coating Blisters, Exposed Underlying Steel, Mild Surface Corrosion And Mild Staining*



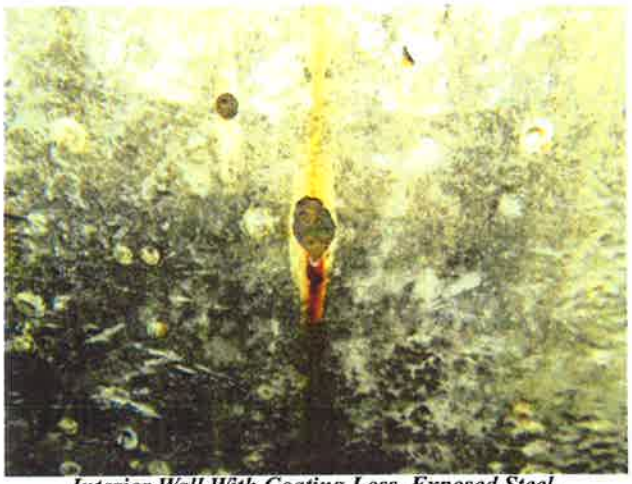
54 *Floor With Ruptured Coating Blisters, Exposed Underlying Steel, Mild Surface Corrosion And Mild Staining*



55 *Manway With Ruptured Coating Blisters, Exposed Underlying Steel And Mild Surface Corrosion*

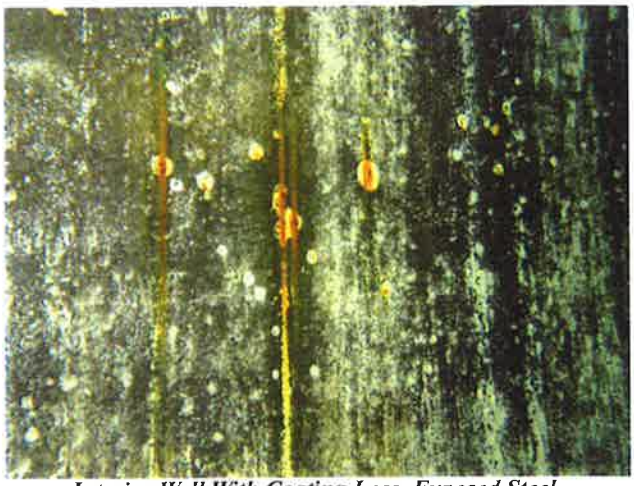
56 *Influent/Effluent Pipe*

57 *Interior Wall With Coating Loss, Exposed Steel, Surface Corrosion And Moderate To Heavy Staining*



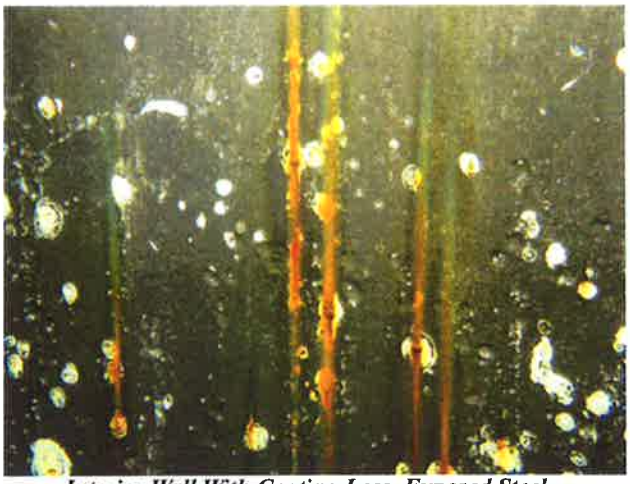
58 *Interior Wall With Coating Loss, Exposed Steel, Surface Corrosion And Moderate To Heavy Staining*

59 *Interior Wall With Coating Loss, Exposed Steel, Surface Corrosion And Moderate To Heavy Staining*

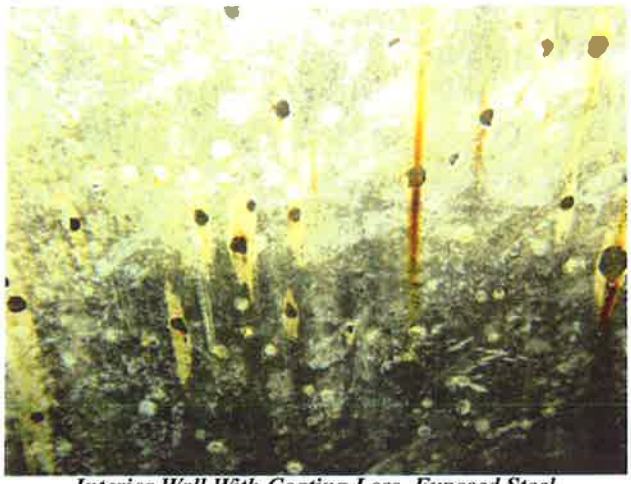


60 *Interior Wall With Coating Loss, Exposed Steel, Surface Corrosion And Moderate To Heavy Staining*

61 *Interior Wall With Coating Loss, Exposed Steel, Surface Corrosion And Moderate To Heavy Staining*

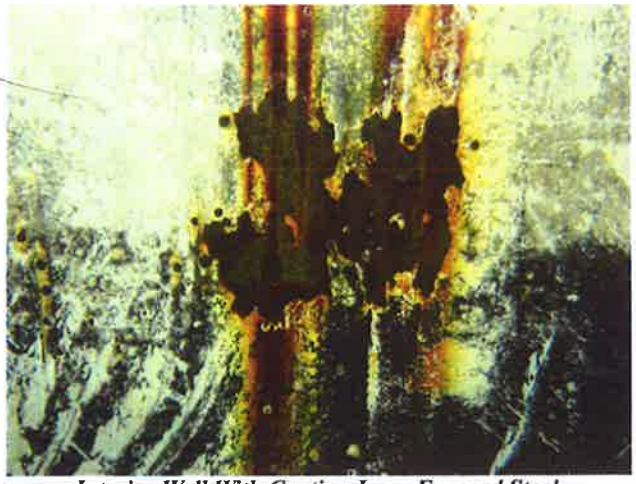


62 *Interior Wall With Coating Loss, Exposed Steel, Surface Corrosion And Moderate To Heavy Staining*

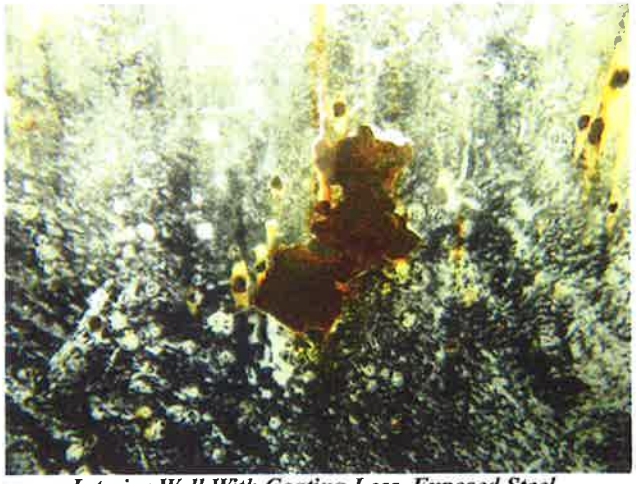


63 *Interior Wall With Coating Loss, Exposed Steel, Surface Corrosion And Moderate To Heavy Staining*

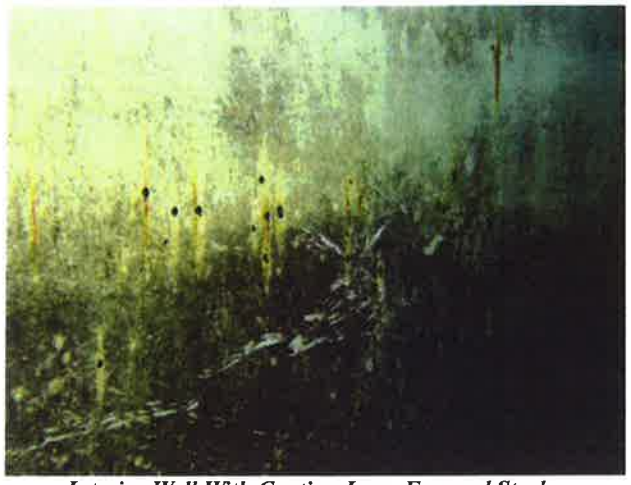
64 *Interior Wall With Coating Loss, Exposed Steel, Surface Corrosion And Moderate To Heavy Staining*



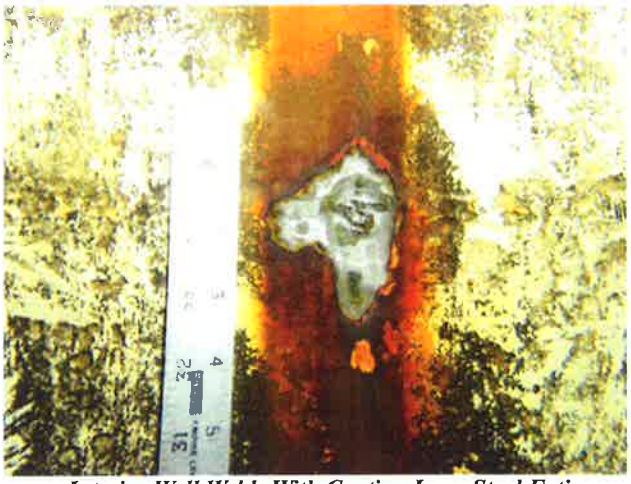
65 *Interior Wall With Coating Loss, Exposed Steel, Surface Corrosion And Moderate To Heavy Staining*



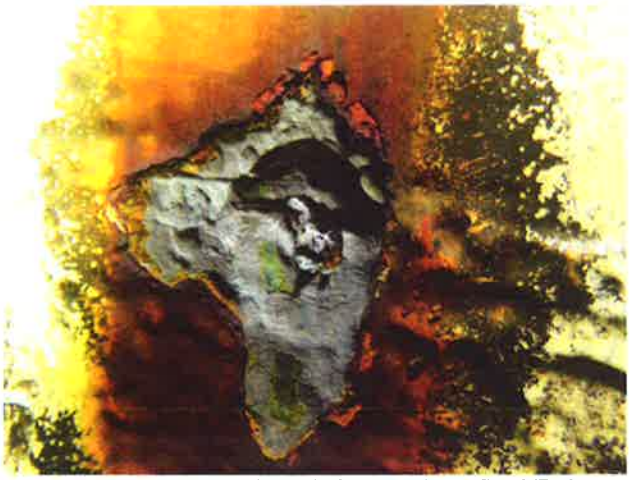
66 *Interior Wall With Coating Loss, Exposed Steel, Surface Corrosion And Moderate To Heavy Staining*



67 *Interior Wall With Coating Loss, Exposed Steel, Surface Corrosion And Moderate To Heavy Staining*



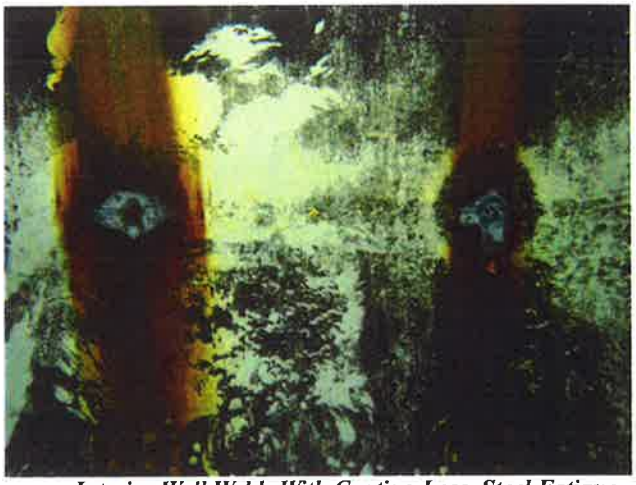
68 *Interior Wall Welds With Coating Loss, Steel Fatigue (Pitting) And Moderate To Heavy Staining*



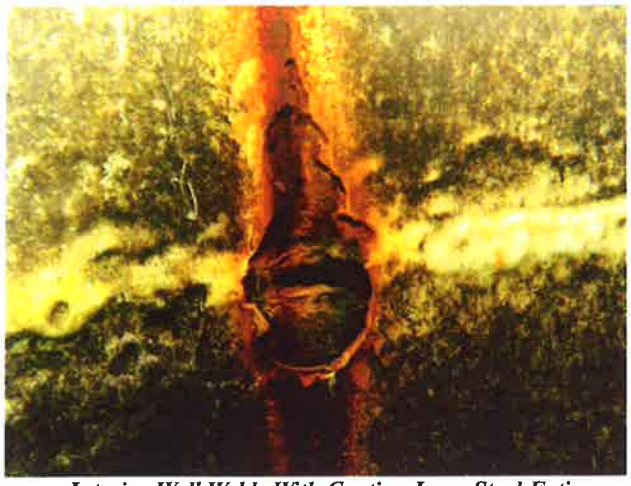
69 *Interior Wall Welds With Coating Loss, Steel Fatigue (Pitting) And Moderate To Heavy Staining*

70 *Interior Wall Welds With Coating Loss, Steel Fatigue (Pitting) And Moderate To Heavy Staining*

71 *Interior Wall Welds With Coating Loss, Steel Fatigue (Pitting) And Moderate To Heavy Staining*

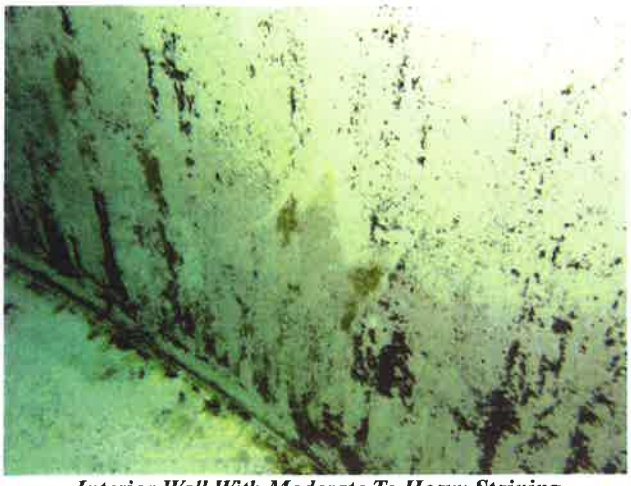


72 *Interior Wall Welds With Coating Loss, Steel Fatigue (Pitting) And Moderate To Heavy Staining*

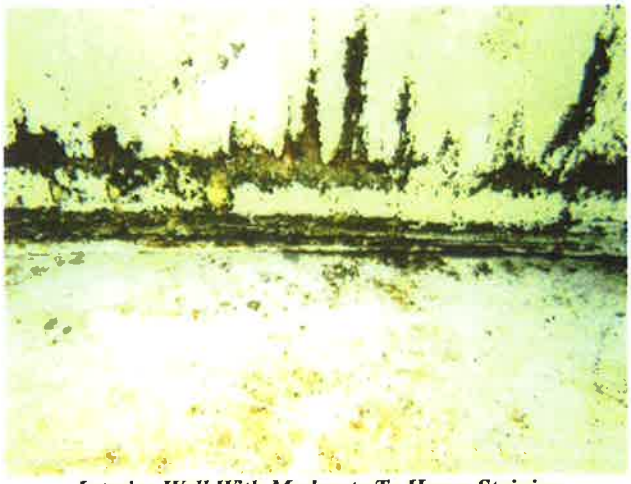


73 *Interior Wall Welds With Coating Loss, Steel Fatigue (Pitting) And Moderate To Heavy Staining*

74 *Interior Wall With Moderate To Heavy Staining*



75 *Interior Wall With Moderate To Heavy Staining*

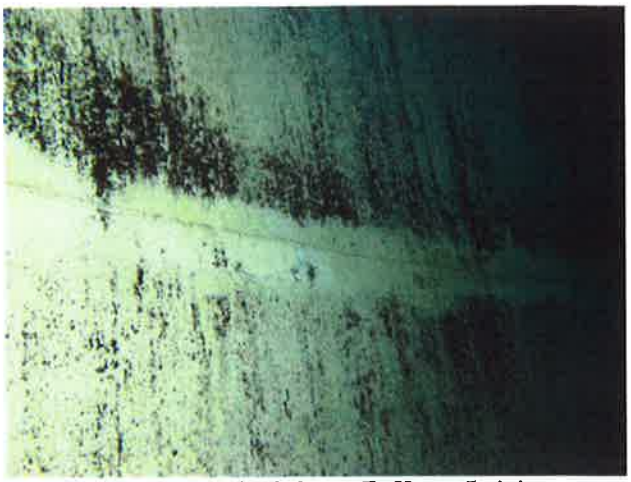


76 *Interior Wall With Moderate To Heavy Staining*

77 *Interior Wall With Moderate To Heavy Staining*

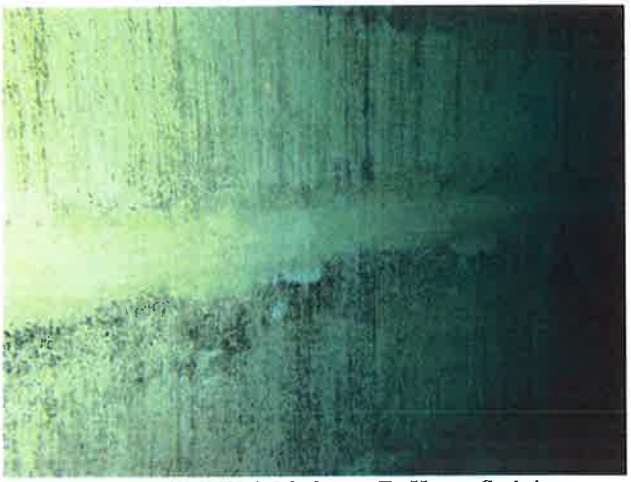
78 *Interior Wall With Moderate To Heavy Staining*

79 *Interior Wall With Moderate To Heavy Staining*



80 *Interior Wall With Moderate To Heavy Staining*

81 *Interior Wall With Moderate To Heavy Staining*



82 *Interior Wall With Moderate To Heavy Staining*

83 *Interior Wall With Moderate To Heavy Staining*

84 *Interior Wall With Moderate To Heavy Staining*

85 *Interior Wall With Moderate To Heavy Staining*

86 *Overhead With Mild Blotch Rusting*

87 *Overhead With Mild Blotch Rusting*

88 *Overhead With Mild Blotch Rusting*

89 *Screened Overflow Cutouts*

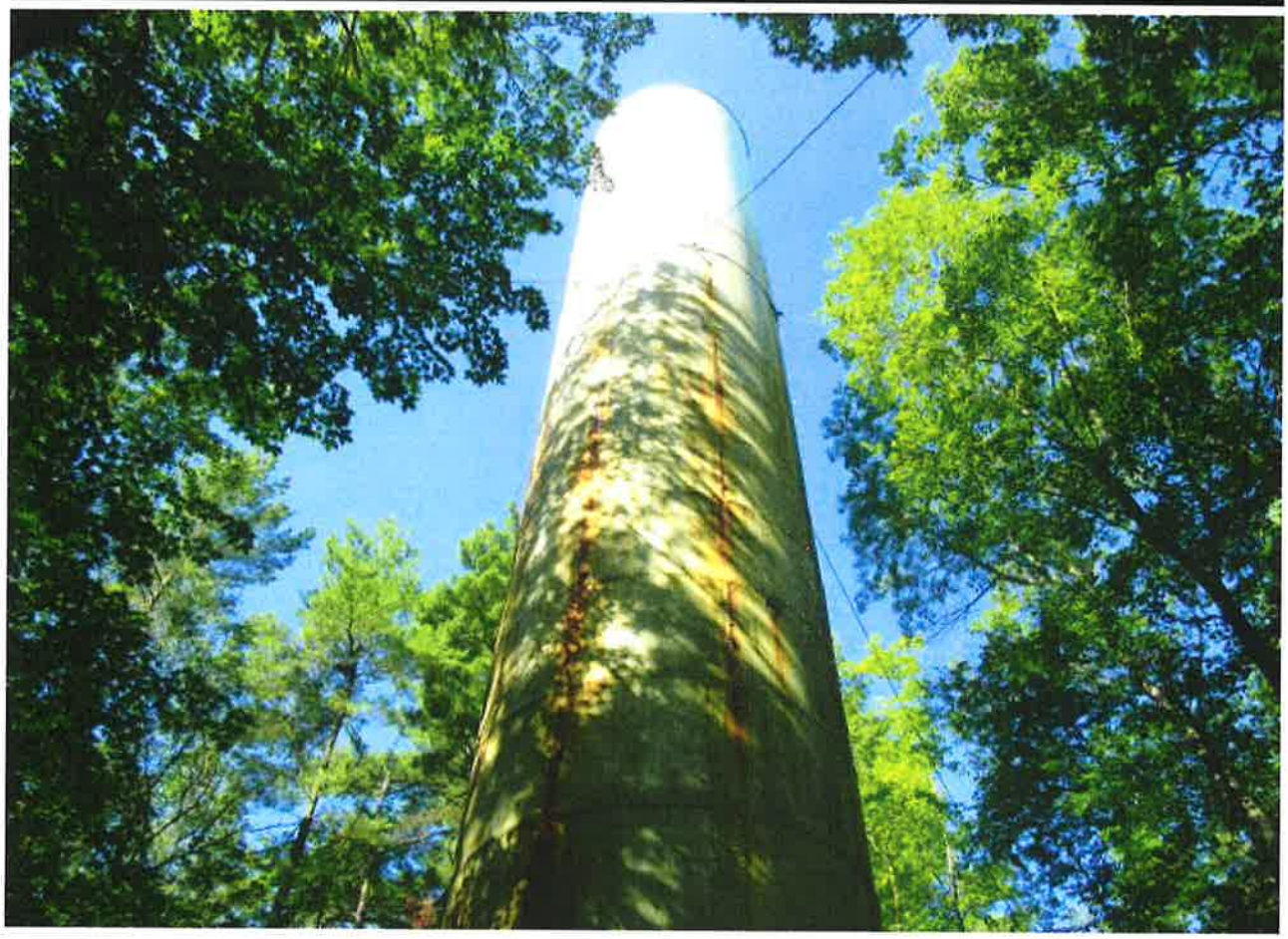
90 *Discharge During Cleaning*

UNDERWATER SOLUTIONS INC.

INSPECTION AND CLEANING (SEDIMENT REMOVAL) OF THE ORCHARD STREET 125,000-GALLON RIVETED STEEL WATER STORAGE TANK

TOWN OF RAYMOND WATER DEPARTMENT RAYMOND, NEW HAMPSHIRE

JULY 26, 2017



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INSPECTION AND CLEANING (SEDIMENT REMOVAL) OF THE ORCHARD STREET 125,000-GALLON RIVETED STEEL WATER STORAGE TANK

TOWN OF RAYMOND WATER DEPARTMENT RAYMOND, NEW HAMPSHIRE

JULY 26, 2017

SCOPE:

On July 26, 2017, Underwater Solutions Inc. inspected the Orchard Street 125,000-gallon riveted steel potable water storage tank to provide information regarding the overall condition and integrity of this tank and removed the sediment accumulation found on the floor.

EXTERIOR INSPECTION:

The entire exterior of this water storage tank and components was inspected, to include walls and coating, manway, foundation, anchor bolts, support cables, ladder, overflow, roof, vent and hatch.

The exterior of this potable water storage tank was found having similar conditions as were found during a previous inspection completed by Underwater Solutions Inc. on June 11, 2014.

Walls And Coating

The exterior steel wall panels and associated rivets were inspected and found appearing sound and remain free of obvious fatigue or failures of the steel at this time.

The protective coating applied to the exterior steel wall panels and associated rivets has nearly expired throughout all surfaces and throughout all elevations, resulting in varying degrees of coating fatigue.

The protective coating applied to the lowest two rows of wall panels is peeling, resulting in exposure of the underlying primary coating throughout approximately 50% of these two wall panels, while complete coating loss and exposed steel were observed throughout less than 5% of these two rows of wall panels at this time.

Several cross hatch adhesion tests completed by another company are located within the first and second rows of wall panels above the ground (approximately 5') and have not been coated over, causing exposure of the underlying steel.

The protective coating applied to the third row of wall panels above the ground through the twelfth row of wall panels above the ground has declined in film thickness and is thinning. This condition has caused blotch rusting to show through the coating throughout approximately 60% of these ten rows of wall panels. Peeling of the coating has caused exposure of the underlying steel throughout approximately 15% these ten rows of wall panels.

The protective coating applied to the thirteenth row of wall panels above the ground through eighteenth rows of wall panels above the ground has declined in film thickness and is thinning. This condition has caused blotch rusting to show through the coating throughout approximately 10% of these rows of wall panels, while peeling of the coating has caused steel exposure throughout approximately 10% of these rows of wall panels.

Although mild to moderate surface corrosion was observed throughout the areas of steel exposure, no obvious fatigue (pitting) of the steel wall panels or deterioration of the rivets was evident.

Surface corrosion and corrosion staining was observed throughout the length of each vertical lap joint throughout all elevations due to coating loss, yet no fatigue or deterioration of the steel lap joint surfaces was evident.

A vertical lap joint on the easternmost side of the tank, located within the third row of wall panels above the ground, appeared damp and moist, yet no obvious leakage could be detected within this lap joint from the interior of the tank at the time of this inspection.

An accumulation of mildew and rust staining throughout all elevations of the exterior walls has reduced the overall aesthetics.

Manway

One 24" by 18" inside diameter manway penetrates the lowest wall panel on the easternmost side of the tank, located approximately 24" above the ground and is securely installed and free of obvious leakage.

Although the protective coating applied to this manway remains with good adhesion value, weathering has caused chalking of the coating throughout the surfaces of the manway.

Foundation

The exposed surfaces of the granite block and stone foundation ranges in height from 6" to 33" tall and appeared sound and remains free of obvious fatigue or settlement throughout the circumference of the tank.

Anchor Bolts

Four 2" diameter steel anchor bolts extend up from the ground into steel chairs riveted to the lowest row of wall panels, located approximately 6" above the base of the tank. The two remaining 2" diameter anchor bolts extend up from the ground into steel chairs welded to the lowest row of wall panels, located approximately 7" above the base of the tank.

Each anchor bolt is secured with one nut that remain sound and free of fatigue. The protective coating applied to this hardware has fair adhesion value, yet has lost adhesion in several 1/4" to 1/2" diameter areas throughout the surfaces of each anchor bolt, nut and support chair, yet this steel support hardware remains sound and securely installed at this time.

Support Cables

One 5/8" diameter steel cable extends around the circumference of the tank, located between the eleventh and twelfth rows of wall panels above the ground and appeared to be properly installed and remains free of obvious fatigue or failures.

Six additional 5/8" diameter steel cables are secured to the cable that extends around the circumference of the tank and extend down and away from the tank to a turnbuckle that is secured to a steel pad eye drilled into six large granite boulders at ground level.

Each of the six cables, turnbuckles and pad eyes and the associated hardware are not coated and were found having mild to moderate corrosion on all surfaces, yet these steel cables and associated hardware remain free of obvious fatigue or failure and appeared to be properly installed at this time.

Ladder

A welded steel ladder extends from approximately 18' above the ground up to the roof dome and is supported to the wall with six sets of bolted standoffs.

The protective coating applied to all surfaces of this ladder has nearly expired, resulting in exposure of the underlying steel throughout approximately 50% of the length of the ladder, to include all ladder rungs.
Although mild corrosion exists within all areas of steel exposure, no obvious fatigue of these steel surfaces was evident. This ladder remains securely installed, providing good access to the roof.

Overflow

An 8" inside diameter overflow pipe penetrates the top wall panel on the northernmost side of the tank, located approximately 18" below the junction of where the roof and walls meet and extends away from the tank at a 10° downward angle. This pipe extends outward approximately 12" and terminates with a screen installed at its end, preventing access to the interior of the tank.

Roof

The fiberglass paneled roof dome was inspected and the fiberglass panels appeared sound and remain free of obvious fatigue or failures at this time.

These fiberglass surfaces are uniformly coated, while the sealant applied to the joints between panels is deteriorating. During the interior inspection, daylight was observed showing through four of the seven joints between the roof panels, therefore allowing rainwater run-off to enter the tank.

Vent

The vent is located in the center of the roof dome, having a 24" inside diameter and stands 18" tall.

A 42" outside diameter fiberglass cap remains securely installed over the vent penetration in the roof, and although the screen for this vent remains secure, it was found torn at this time.

Hatch

One 36" by 36" fiberglass hatch provides good access to the tank interior through the roof. This hatch remains in good working condition and is secured with a lock, preventing unwanted access to the interior of the tank.

INTERIOR INSPECTION:

The entire interior of this water storage tank and components was inspected, to include sediment accumulations, floor, manway, piping, walls and coating, overhead, overflow and aesthetic water quality.

Sediment Accumulations

A uniform layer of accumulated precipitate was found throughout the floor, having depths no greater than 1/8" deep.

After completing this inspection, all precipitate was vacuumed from the floor.

Floor

After removing the accumulated precipitate, the steel floor panels and associated rivets were inspected and found appearing sound and remain free of obvious fatigue or failures of the steel panels or rivets at this time.

The protective coating applied to these riveted steel surfaces remains having good adhesion value, providing good protection for the steel. Mild staining exists throughout the floor due to the accumulation of precipitate.

Manway

One 24" by 18" inside diameter manway penetrates the bottom wall panel, located approximately 10" above the floor and is securely installed and free of obvious leakage.

The protective coating applied to the manway lid remains having good adhesion value, while mild corrosion was observed on several of the rivets throughout the outer circumference of the manway due to coating loss, yet these rivets remain sound and free of obvious fatigue at this time.

The 2" by 2" by 48" long tube steel support that was designed to hold the manway upright while the tank is de-watered and the manway is in the open position has failed. This tube steel support remains laying on the tank floor, as was documented in a previous inspection completed on June 11, 2014.

This support was not removed from the tank during this inspection due to its size and weight and is located and positioned in a way that it will not obstruct the pipe or the opening of the manway.

Piping

The inlet/outlet pipe consists of a 12" inside diameter T-fitting pipe that penetrates the floor within the center of the tank and stands 24" tall and has an open-ended top, having a 12" inside diameter.

Approximately 8" above the floor on either side of the T-fitting are two additional 12" inside diameter penetrations.

Each of the three 12" inside diameter penetrations within this T-fitting were free of obvious obstructions and with flow entering the tank at the time of this inspection.

Walls And Coating

The interior walls were inspected beginning at the floor and by spiraling the circumference of the tank up to the water surface.

These steel wall panels and associated rivets appeared sound and remain free of obvious fatigue (pitting) or other deterioration of these steel surfaces at this time.

The protective coating applied to all interior wall panels has fair adhesion value, yet has declined in film thickness and is nearing expiration at this time.

Mild blotch rusting shows through the coating throughout approximately 10% of the lowest seventeen rows of wall panels due to decline in coating film thickness and causing a mild rust stain, yet these steel panels and steel rivets remains sound and free of obvious fatigue at this time.

The protective coating applied to the top row of wall panels was found having poor adhesion value and is blistering throughout approximately 15% of all wall panels within this row. Each coating blister within the top row of wall panels has ruptured, resulting in exposure of the underlying steel. No obvious fatigue (pitting) of the steel was evident within these areas of steel exposure, rather mild to moderate surface corrosion exists at this time.

The protective coating applied to the steel rivets has fair adhesion value and is blistering throughout approximately 30% of all rivets at this time. Each coating blister found on the rivets has ruptured, resulting in exposure of the underlying steel. Although mild corrosion was observed on the surfaces of the rivets, no obvious fatigue or deterioration of the steel was evident at this time.

The protective coating applied to the edges of the panels at all vertical and horizontal lap joints has poor adhesion value and is peeling. This condition of adhesion loss has resulted in exposure the edges of the steel panels throughout approximately 40% of all lap joints.

Although moderate surface corrosion was observed throughout the exposed panel edges (lap joints), no obvious fatigue (pitting) or deterioration of the steel was evident.

Heavy staining exists throughout the interior walls, beginning approximately 1" below overflow level and extends down to the floor.

Overhead

The entire overhead of this potable water storage tank was inspected from the water surface.

All fiberglass panels were found appearing sound and remain free of obvious fatigue or failures of these fiberglass surfaces at this time. Deterioration of the sealant applied to the panel joints on the exterior of the tank allows daylight to show through four of the seven panel joints and allowing rainwater run-off to enter the tank.

The spider supports that are located at the junction of where the roof and walls meet consist of eight, 3/4" diameter steel rods that that interweave the tank and penetrate the top wall panel and were found securely bolted in place at this time.

These steel supports are not coated and mild surface corrosion was observed throughout all surfaces of each support, yet these steel supports remain sound and free of obvious fatigue or deterioration at this time.

Overflow

The overflow consists of a 10" inside diameter flush penetration in the top wall panel, located approximately 18" below the junction of where the roof and walls meet was free of obvious obstructions at the time of this inspection.

Aesthetic Water Quality

The aesthetic water quality was found to be good throughout this entire tank, allowing for unlimited visibility for this inspection.

***RECOMMENDATIONS*:**

It is the opinion of Underwater Solutions Inc. that this riveted steel potable water storage tank appeared mostly sound and free of obvious leakage, yet requires rehabilitation within the very near future, as the interior and exterior coating systems have expired.

EXTERIOR:

The exterior steel wall panels and associated rivets appeared sound and remain free of obvious fatigue or failures of the steel at this time.

The protective coating applied to all exterior steel wall panels and rivets has nearly expired, causing varying degrees of coating fatigue.

Exposed primary coating and exposed steel were observed throughout all elevations of the exterior walls, resulting in surface corrosion throughout the wall panels, lap joints and rivets, yet no fatigue (pitting) or deterioration of these steel surfaces was evident at the time this inspection was completed.

The fiberglass roof panels appeared sound and remain free of obvious fatigue or failures of the fiberglass, while and the protective coating applied these fiberglass panels remains having good adhesion value.

The sealant applied to the joints between each fiberglass panel and is deteriorating and no longer seals the joints between the fiberglass panels at this time.

The granite block and stone foundation that provides support for this tank appeared sound and remains free of obvious shifting or settling of the granite block or stones at this time.

The cable that extends around the circumference of the tank between the eleventh and twelfth rows of wall panels above the ground appeared to be properly installed, while each of the six support cables that extends down to and secured to turnbuckles that are drilled in to granite stones at ground level are also properly installed and in good condition. Although moderate corrosion was observed on this support rigging, no obvious fatigue or deterioration of these support components was evident at the time this inspection was completed.

All components affixed to this tank are properly installed at this time. The screen installed at the end of the overflow pipe appeared to be securely installed, preventing access to the interior of the tank. The screen installed around the circumference of the vent is secure, yet was found torn at the time of this inspection.

The interior access hatch located on the roof remains in good working condition and was found secured with a lock, preventing access to the interior of the tank.

INTERIOR:

The interior riveted steel floor and wall surfaces appeared sound and remain free of obvious fatigue or failures of the steel at this time.

The protective coating applied to interior riveted steel floor surfaces remains having good adhesion value, providing good protection for these riveted steel surfaces.

The protective coating applied to all interior steel wall panels and rivets shows varying degrees of coating fatigue and has nearly expired. Coating loss and exposed steel was observed throughout most of the interior wall panels, wall panel edges at all lap joints and rivets and has resulted in exposure of the underlying steel. Although mild to moderate surface corrosion was observed in these areas of coating fatigue and steel exposure, no obvious fatigue of deterioration of these steel panels or steel rivets was evident at the time this inspection was completed.

The fiberglass overhead panels appeared sound and remain free of obvious fatigue or failures, while deterioration of the sealant applied to the panel joints on the exterior of the roof causes daylight to show through four of the seven joints, allowing rainwater run-off to enter the tank.

The 3/4" diameter steel spider supports, located at the junction of where the roof and walls meet, remain securely bolted in place and free of obvious fatigue or failures at this time. Although these steel supports are not coated and were found with mild corrosion throughout their surfaces, these supports remains sound and free of obvious fatigue or deterioration of the steel at this time.

The tube steel support designed to hold the manway while in the open position remains on the tank floor and was not removed from the tank due to its size and weight. This tube steel support is positioned in a way to not affect water flow or the operation of the manway.

It is our recommendation to abrasive blast all exterior steel surfaces and steel components affixed to this tank to white or near white metal. We recommend then re-coating these steel surfaces using an epoxy/polyurethane flexible coating in an effort to halt corrosion, prevent steel fatigue and to provide good protection for these steel surfaces and associated components, while improving the overall aesthetics.

It is also our recommendation to abrasive blast all interior steel surfaces and associated steel components within this tank to white or near white metal and to coat all wall panels, lap joints and rivets using a polyamide epoxy flexible coating having an A.N.S.I./N.S.F.61 approval for use in structures containing potable water in an effort to halt corrosion, prevent steel fatigue and to provide good protection for the interior steel surfaces of this tank.

We also recommend considering the cost of replacing this tank with the cost of rehabilitation, as the required safety, sanitary and structural upgrades could potentially exceed the cost of rehabilitation.

It is our recommendation that prior to complete rehabilitation/replacement of this tank is completed that the joints between the roof panels be re-sealed and a new screen be installed around the circumference of the vent in an effort to prevent rainwater run-off and other contaminates from accessing the tank interior.

As always, we recommend re-inspection and cleaning of all water storage facilities in accordance with state and federal mandates, A.W.W.A. standards, and be completed by an experienced and authorized inspection corporation.

UNDERWATER SOLUTIONS INC.
Christopher A. Cole, Project Manager

This report, the conclusions, recommendations and comments prepared by Underwater Solutions Inc. are based upon spot examination from readily accessible parts of the tank. Should latent defects or conditions which vary significantly from those described in the report be discovered at a later date, these should be brought to the attention of a qualified individual at that time. These comments and recommendations should be viewed as information to be used by the Owner in determining the proper course of action and not to replace a complete set of specifications. All repairs should be done in accordance with A.W.W.A. and/or other applicable standards.

1 *Identification Plaque*

2 ***Exterior Wall With Expired Coating/Peeling, Exposed Underlying Primary Coating, Rust Staining And Mildew***

3 ***Exterior Wall With Expired Coating/Peeling, Exposed Underlying Primary Coating, Rust Staining And Mildew***

4 *Exterior Wall With Expired Coating/Peeling, Cross Hatch Adhesion Test Causing Exposed Underlying Steel, Surface Corrosion And Mildew*

5 ***Exterior Wall With Expired Coating/Peeling, Exposed Underlying Steel, Blotch Rusting, Mild To Moderate Surface Corrosion, Corrosive Staining, Rust Staining And Mildew***

6 *Exterior Wall With Expired Coating/Peeling, Exposed Underlying Steel, Blotch Rusting, Mild To Moderate Surface Corrosion, Corrosive Staining, Rust Staining And Mildew*

7 *Exterior Wall With Expired Coating/Peeling, Exposed Underlying Steel, Blotch Rusting, Mild To Moderate Surface Corrosion, Corrosive Staining, Rust Staining And Mildew*

8 *Exterior Wall With Expired Coating/Peeling, Exposed Underlying Steel, Blotch Rusting, Mild To Moderate Surface Corrosion, Corrosive Staining, Rust Staining And Mildew*

9 *Exterior Wall With Expired Coating/Peeling, Exposed Underlying Steel, Blotch Rusting, Mild To Moderate Surface Corrosion, Corrosive Staining, Rust Staining And Mildew*

10 *Exterior Wall With Expired Coating/Peeling, Exposed Underlying Steel, Blotch Rusting, Mild To Moderate Surface Corrosion, Corrosive Staining, Rust Staining And Mildew*

11 *Exterior Wall With Expired Coating/Peeling, Exposed Underlying Steel, Blotch Rusting, Mild To Moderate Surface Corrosion, Corrosive Staining, Rust Staining And Mildew*

12 *Exterior Wall With Expired Coating/Peeling, Exposed Underlying Steel, Blotch Rusting, Mild To Moderate Surface Corrosion, Corrosive Staining, Rust Staining And Mildew*

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15 *Exterior Wall With Expired Coating/Peeling, Exposed Underlying Steel, Blotch Rusting, Mild To Moderate Surface Corrosion, Corrosive Staining, Rust Staining And Mildew*

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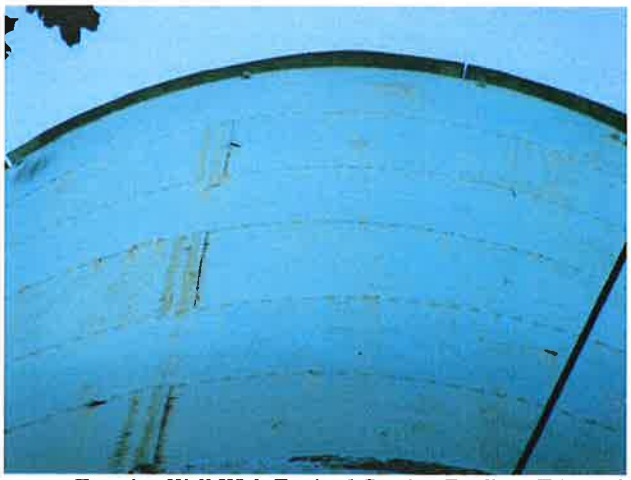
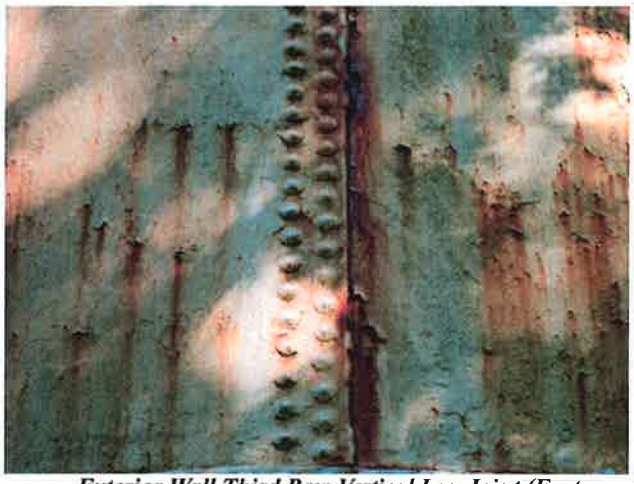
17 *Exterior Wall With Expired Coating/Peeling, Exposed Underlying Steel, Blotch Rusting, Mild To Moderate Surface Corrosion, Corrosive Staining, Rust Staining And Mildew*



18 *Exterior Wall With Expired Coating/Peeling, Exposed Underlying Steel, Blotch Rusting, Mild To Moderate Surface Corrosion, Corrosive Staining, Rust Staining And Mildew*

19 *Exterior Wall With Expired Coating/Peeling, Exposed Underlying Steel, Blotch Rusting, Mild To Moderate Surface Corrosion, Corrosive Staining, Rust Staining And Mildew*

20 *Exterior Wall With Expired Coating/Peeling, Exposed Underlying Steel, Blotch Rusting, Mild To Moderate Surface Corrosion, Corrosive Staining, Rust Staining And Mildew*



21 *Exterior Wall Third Row Vertical Lap Joint (East Side) Found Appearing Damp And Moist*

22 *Exterior Wall With A Support Cable*

23 *Exterior Wall With A Support Cable*

24 *Support Cable Secured To A Turn Buckle*

25 *Support Cable Secured To A Turn Buckle*

26 *Support Cable Turn Buckle Secured To A Pad Eye*

27 *Support Cable Turn Buckle Secured To A Pad Eye Drilled Into A Large Granite Boulder*

28 *Secure Manway With Chalking*

29 *Granite Block And Stone Foundation*

30 *Granite Block And Stone Foundation*

31 *Secure Anchor Bolt With Coating Loss*

32 *Secure Anchor Bolt With Coating Loss*

33 *Ladder With Coating Loss (Nearing Expiration), Exposed Underlying Steel And Mild Corrosion*

34 *Ladder With Coating Loss (Nearing Expiration), Exposed Underlying Steel And Mild Corrosion*

35 *Secure Overflow Pipe Screen*

36 *Roof Panel Joints Sealant Found Deteriorating*

37 *Roof Panel Joints Sealant Found Deteriorating*

38 *Roof Panel Joints Sealant Found Deteriorating*

39 *Roof Panel Joints Sealant Found Deteriorating*

40 *Roof Panel Joints Sealant Found Deteriorating*

41 *Roof Panel Joints Sealant Found Deteriorating*

42 *Secure Vent Cap*

43 *Vent Screen Found Torn*

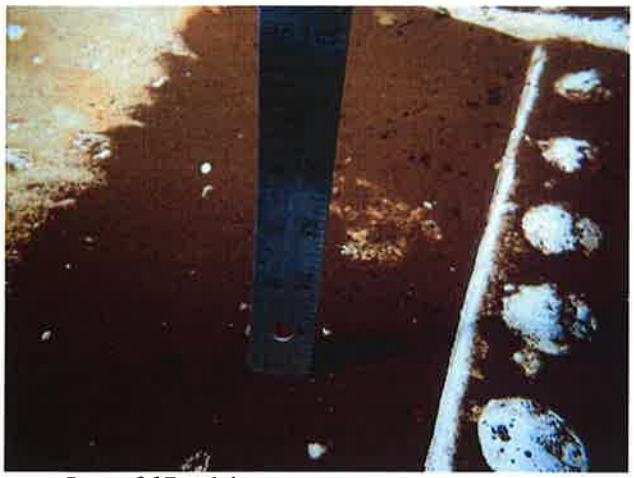
44 *Open Access Hatch*

45 *Closed Access Hatch*

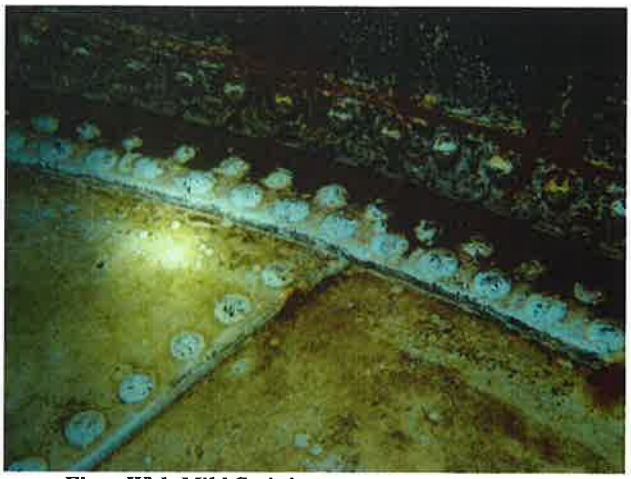
46 *Secure Access Hatch*

47 *Layer Of Precipitate*

48 *Layer Of Precipitate*



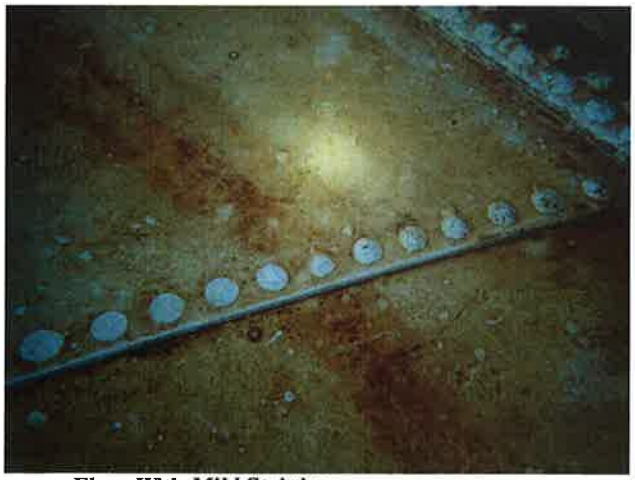
49 ***Layer Of Precipitate***



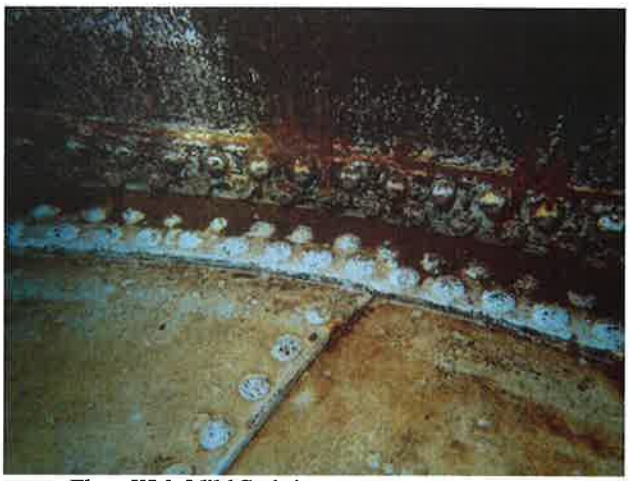
50 ***Floor With Mild Staining***

51 ***Floor With Mild Staining***

52 ***Floor With Mild Staining***



53 ***Floor With Mild Staining***



54 ***Floor With Mild Staining***

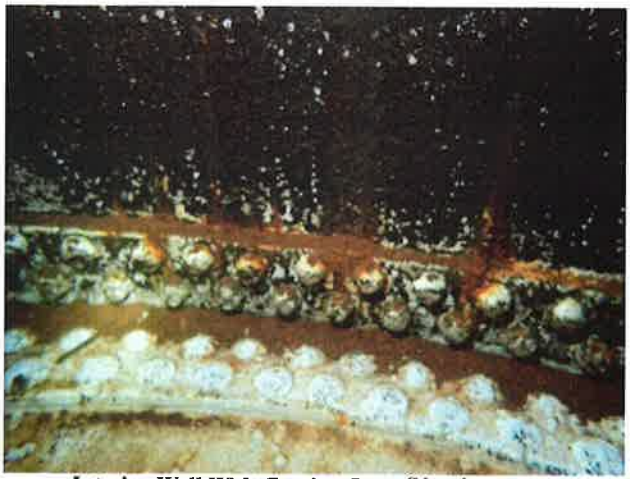
55 *Floor With Mild Staining*

56 *Manway Rivets With Coating Loss And Mild Corrosion*

57 *Manway Steel Support Laying On The Tank Floor*

58 *T-Fitting Inlet/Outlet Pipe Penetrating The Tank Floor*

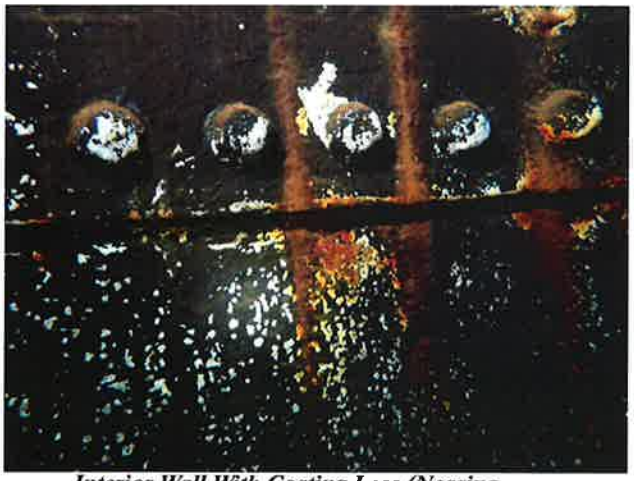
59 *Inlet/Outlet Pipe With 12" Inside Diameter Penetrations*



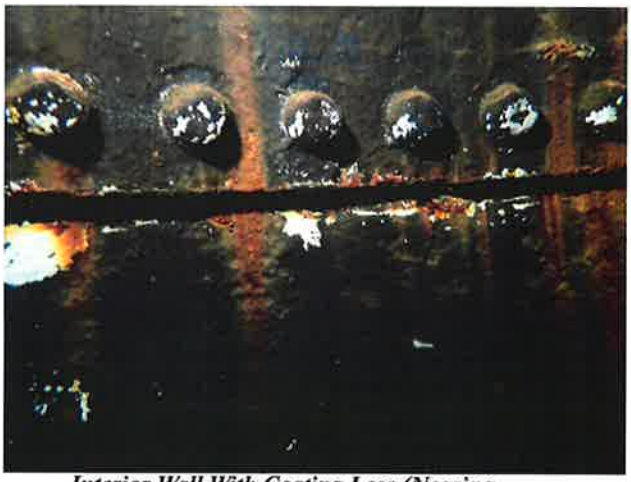
60 *Interior Wall With Coating Loss (Nearing Expiration), Blotch Rusting, Exposed Underlying Steel, Moderate Surface Corrosion And Heavy Staining*

61 *Interior Wall With Coating Loss (Nearing Expiration), Blotch Rusting, Exposed Underlying Steel, Moderate Surface Corrosion And Heavy Staining*

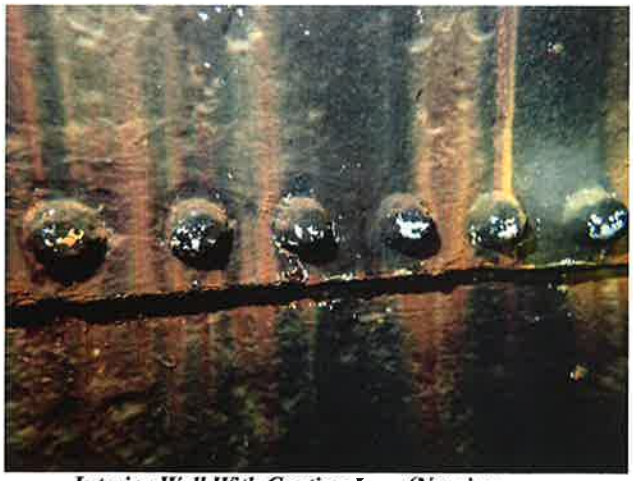
62 *Interior Wall With Coating Loss (Nearing Expiration), Blotch Rusting, Exposed Underlying Steel, Moderate Surface Corrosion And Heavy Staining*



63 *Interior Wall With Coating Loss (Nearing Expiration), Blotch Rusting, Exposed Underlying Steel, Moderate Surface Corrosion And Heavy Staining*



64 *Interior Wall With Coating Loss (Nearing Expiration), Blotch Rusting, Exposed Underlying Steel, Moderate Surface Corrosion And Heavy Staining*



65 *Interior Wall With Coating Loss (Nearing Expiration), Blotch Rusting, Exposed Underlying Steel, Moderate Surface Corrosion And Heavy Staining*

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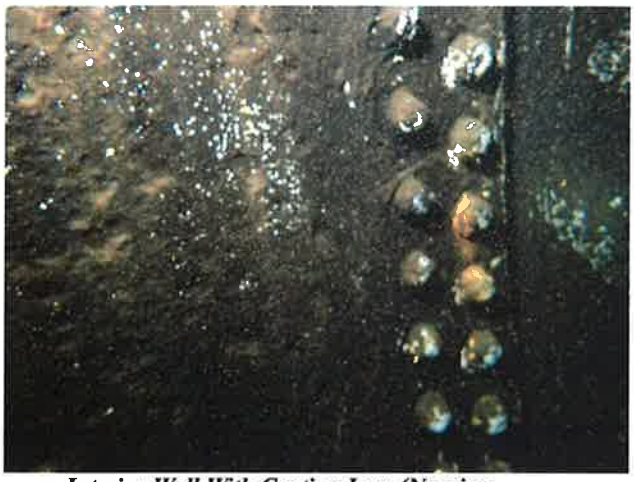
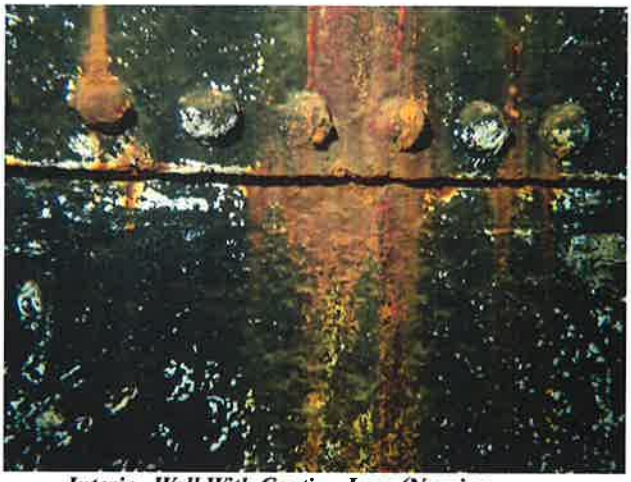
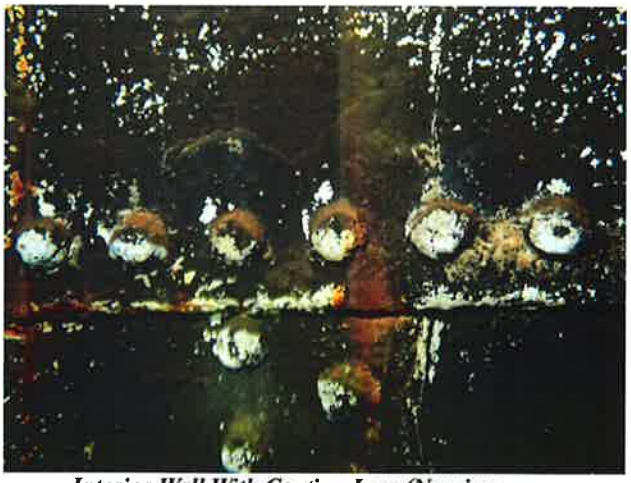


67 *Interior Wall With Coating Loss (Nearing Expiration), Blotch Rusting, Exposed Underlying Steel, Moderate Surface Corrosion And Heavy Staining*



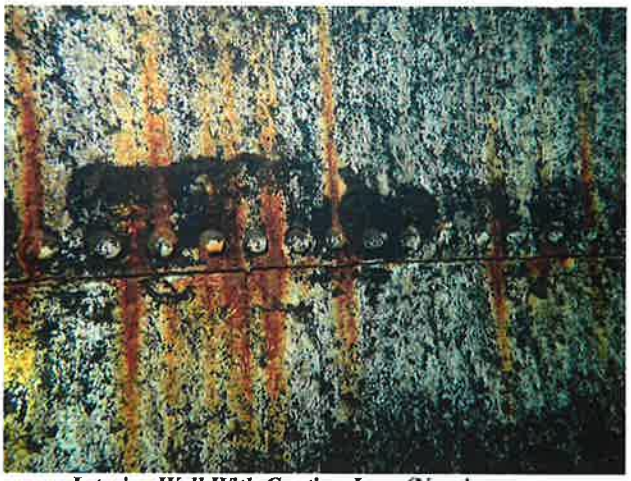
68 *Interior Wall With Coating Loss (Nearing Expiration), Blotch Rusting, Exposed Underlying Steel, Moderate Surface Corrosion And Heavy Staining*

69 *Interior Wall With Coating Loss (Nearing Expiration), Blotch Rusting, Exposed Underlying Steel, Moderate Surface Corrosion And Heavy Staining*



70 *Interior Wall With Coating Loss (Nearing Expiration), Blotch Rusting, Exposed Underlying Steel, Moderate Surface Corrosion And Heavy Staining*

71 *Interior Wall With Coating Loss (Nearing Expiration), Blotch Rusting, Exposed Underlying Steel, Moderate Surface Corrosion And Heavy Staining*



72 *Interior Wall With Coating Loss (Nearing Expiration), Blotch Rusting, Exposed Underlying Steel, Moderate Surface Corrosion And Heavy Staining*

73 *Interior Wall With Coating Loss (Nearing Expiration), Blotch Rusting, Exposed Underlying Steel, Moderate Surface Corrosion And Heavy Staining*

74 *Interior Wall With Ruptured Coating Blisters, Exposed Underlying Steel, Mild To Moderate Surface Corrosion And Heavy Staining*

75 *Interior Wall With Ruptured Coating Blisters, Exposed Underlying Steel, Mild To Moderate Surface Corrosion And Heavy Staining*

76 *Interior Wall With Ruptured Coating Blisters, Exposed Underlying Steel, Mild To Moderate Surface Corrosion And Heavy Staining*

77 *Overhead*

78 *Overhead With Daylight Showing Through The Panel Joints*

79 *Overhead With Daylight Showing Through The Panel Joints*

80 *Overhead With Daylight Showing Through The Panel Joints*

81 *Overhead Spider Supports With Mild Surface Corrosion*

82 *Overhead Spider Supports With Mild Surface Corrosion*

83 *Overflow*

84 *Discharge During Cleaning*

UNDERWATER SOLUTIONS INC.

INSPECTION AND INTERIOR CLEANING (SEDIMENT REMOVAL) OF THE LONG HILL 600,000-GALLON CONCRETE WATER STORAGE TANK

TOWN OF RAYMOND WATER DEPARTMENT
RAYMOND, NEW HAMPSHIRE

MAY 22, 2018

INSPECTION AND INTERIOR CLEANING (SEDIMENT REMOVAL) OF THE LONG HILL 600,000-GALLON CONCRETE WATER STORAGE TANK

TOWN OF RAYMOND WATER DEPARTMENT
RAYMOND, NEW HAMPSHIRE

MAY 22, 2018

SCOPE:

On May 22, 2018, Underwater Solutions Inc. inspected the Long Hill 600,000-gallon concrete potable water storage tank to provide information regarding the overall condition and integrity of this pre-cast concrete structure and removed the sediment accumulation found on the floor.

EXTERIOR INSPECTION:

The entire exterior of this water storage tank was inspected to include walls and coating, manway, ladder, overflow, roof, vent and hatch.

The exterior of this potable water storage tank was found having similar conditions as were found during a previous inspection completed by Underwater Solutions Inc. on July 24, 2015.

Walls And Coating

The exterior shotcrete coated concrete walls were inspected and found appearing mostly sound, however tight shrinkage cracks were observed throughout approximately 5% of the exterior walls and throughout all elevations of the tank.

Efflorescence has accumulated within less than 5% of these cracks due to moisture penetration.

These cracks were sounded and appeared to be limited to the surface of the shotcrete cover coating and remain free of obvious voids or spalls at this time.

The protective coating applied to the exterior walls remains having good adhesion value, yet no longer seals the shrinkage cracks found throughout these surfaces.

A mild, non-uniform accumulation of mildew throughout the exterior walls, and spray-painted graffiti throughout the lower 8' of the exterior walls, causes declined aesthetics.

Manway

One, 24-1/2" inside diameter stainless-steel manway penetrates the tank wall on the westernmost side of the tank, located approximately 23" above the ground, and is securely installed and free of obvious leakage.

The operating mechanism for this manway was found secured with locks, preventing unwanted opening.

Ladder

An aluminum ladder extends from approximately 11' above the ground up to the roof dome and is supported to the tank wall with four sets of bolted standoffs. A stainless steel cable-type fall prevention device is installed throughout the length of this ladder, providing safe access to the roof.

Overflow

An 8" inside diameter overflow pipe exits the ground located approximately 50' east of the tank and extends approximately 10" and terminates at ground level.

This pipe was free of obvious obstructions and a galvanized steel screen installed at the end of this pipe remains secure, preventing access to the interior of the pipe/tank.

Roof

The pre-cast concrete-paneled roof dome was inspected, and the pre-cast concrete roof panels were found appearing sound and remain free of obvious concrete fatigue, while tight surface cracks were observed throughout approximately 25% of the length of the concrete-filled joints between each pre-cast concrete panel.

These cracks were sounded and appeared to be limited to the surface of the concrete used to fill these joints and remain free of obvious voids or spalls at this time.

The protective coating applied to these surfaces remains with good adhesion value, yet no longer seals the cracks within the concrete-filled roof panel joints.

An accumulation of mildew throughout the roof dome also causes declined aesthetics.

The 40" tall aluminum safety railings around the perimeter of the interior access hatch were found securely bolted in-place and free of obvious fatigue or failures at this time.

Vent

The vent is located within the center of the roof dome, having a 24" inside diameter and stands 24" tall.

A 42" outside diameter fiberglass cap and associated stainless steel screen remains securely installed over this vent, preventing access to the interior of the tank.

Hatch

One, 41" by 41" aluminum hatch provides good access to the tank interior through the roof dome.

This hatch remains in good working condition and was secured with a lock, preventing unwanted access to the tank interior.

After completing the interior inspection and interior cleaning (sediment removal) a new lock provided by Raymond Water Department was installed on this hatch.

INTERIOR INSPECTION:

The entire interior of this water storage tank was inspected to include sediment accumulations, floor, manway, piping, walls, overhead, overflow and aesthetic water quality.

The interior of this potable water storage tank was found having similar conditions as were found during a previous inspection completed by Underwater Solutions Inc. on July 24, 2015.

Sediment Accumulations

A uniform layer of accumulated precipitate was found throughout the floor, having depths no greater than 1/16" deep.

After completing this inspection, all precipitate was vacuumed from the floor.

Floor

After removing the accumulated precipitate, the concrete floor was inspected and found to be un-coated, appearing very sound and remaining free of obvious cracks, spalls or settlement.

Mild staining remains throughout the floor due to the accumulation of precipitate.

Manway

One, 24-1/2" inside diameter stainless-steel manway penetrates the tank wall on the westernmost side of the tank, located approximately 72" above the floor, and is securely installed and free of obvious leakage.

An aluminum ladder extends from the floor up to the manway and is supported to the wall with one set of bolted standoffs and to the floor with a second set of bolted standoffs.

Mild to moderate corrosion was observed throughout approximately 30% of the surfaces of this ladder and fatigue (pitting) of the aluminum, having depths from barely detectable levels to 1/32" deep, was found within these areas of corrosion. However, this ladder remains sound and secure, providing good access and egress.

Piping

Two pipes were inspected within this potable water storage tank.

The first pipe inspected penetrates the floor of a 24" by 24" by 6" deep sump in the tank floor, and is located approximately 24" in from the wall on the westernmost side of the tank. This pipe has a 14" inside diameter and stands 12" tall.

This pipe was free of obvious obstructions and was without flow at the time of this inspection.

The protective coating applied to this metal pipe is blistering throughout approximately 30% of these surfaces causing metal exposure and corrosion, however this pipe remains sound and free of obvious metal fatigue/deterioration at this time.

The second pipe inspected penetrates the floor of a 24" by 24" by 6" deep sump in the tank floor, and is located approximately 30" in from the wall on the westernmost side of the tank.

This 12" inside diameter metal pipe extends up 20" through a 90° elbow that directs a 12" inside diameter P.V.C. pipe across the tank floor to a second 90° metal elbow encased in a 30" by 18" by 30" tall concrete thrust block that is located 7" from the easternmost side of the tank and is supported to the floor with five, 20" diameter by 26" tall concrete supports.

This P.V.C. pipe continues upward approximately 8' through two metal coupling and penetrates the base of an 18" by 24" concrete box formed to the tank wall. The 12" inside diameter metal pipe extends from the top of this box approximately 12" through a 22° metal elbow and terminates approximately 10" below the junction of where the roof and walls meet.

This pipe was free of obvious obstructions and was without flow at the time this inspection was completed.

The P.V.C. pipes that form this pipe are not coated and appeared sound at this time.

The protective coating applied to the metal elbows, flanges, couplings and associated hardware that secures this pipe together was found to be blistering throughout approximately 30-40% of these surfaces causing metal exposure and corrosion, however these metal pipe components remain sound and free of obvious fatigue/deterioration at this time.

Walls

The interior walls were inspected beginning at the floor and by spiraling the circumference of the tank up to the water surface.

These pre-cast concrete wall panels and the concrete-filled wall slot joints between panels were found to be uncoated, yet appeared sound and remain free of cracks, spalls or other obvious fatigue of the concrete at this time.

The 12" tall by 7" wide formed in-place concrete curb stop, located at the base of the walls and spanning the entire circumference of the tank, is not coated and appeared sound and remains free of obvious concrete fatigue at this time.

Mild staining exists throughout the interior walls, beginning approximately 36" below overflow level and extending down to the floor.

Overhead

The entire overhead was inspected from the water surface.

These pre-cast concrete panels and concrete-filled joints are not coated and were found appearing sound, and although efflorescence has accumulated within approximately 5% of the panel joints/edges, no obvious fatigue of the concrete was evident at this time.

Overflow

The overflow consists of an 8" inside diameter pipe cast within an 18" by 21" concrete box formed to the tank wall that begins approximately 12" below the junction of where the roof and walls meet, extends down and terminates approximately 8' above the floor of the tank.

An 8" inside diameter P.V.C. pipe exits the base of the concrete box, extends down through a series of two metal couplings and penetrates the floor of a 20" by 20" by 6" deep sump formed in the tank floor.

The concrete overflow box is not coated and appeared sound and free of obvious fatigue of the concrete at this time.

The 8" inside diameter pipe cast within this box was free of obvious obstructions at the time of this inspection.

The P.V.C. pipe that extends down from the base of the concrete overflow box is not coated and appeared sound at this time.

The protective coating applied to the two couplings for the 8" inside diameter pipe that extends from the base of the overflow box was found having poor adhesion value and has expired, resulting in exposure of the underlying metal throughout all surfaces of each metal coupling. However, no obvious fatigue/deterioration of these metal surfaces was evident at this time.

Aesthetic Water Quality

The aesthetic water quality was very good throughout this entire tank, allowing unlimited visibility for this inspection.

RECOMMENDATIONS:

It is the opinion of Underwater Solutions Inc. that this concrete potable water storage tank appeared mostly sound and remains free of obvious leakage at this time.

EXTERIOR:

The tight shrinkage cracks found throughout all elevations of the exterior walls were sounded and appeared to be limited to the surface of the shotcrete cover coating and remain free of obvious voids or spalls at this time.

The protective coating applied to the exposed exterior walls remains having good adhesion value, yet no longer seals the shrinkage cracks found throughout these surfaces.

A mild, non-uniform accumulation of mildew throughout all elevations of the exterior walls, and spray-painted graffiti throughout the lower 8' of the exterior walls, causes declined aesthetics.

The pre-cast concrete roof panels appeared sound and remain free of obvious concrete fatigue, while tight surface cracks exist throughout approximately 25% of the length of the joints between the pre-cast concrete roof panels. These cracks were sounded and appeared to remain limited to the surface of the concrete used to fill these joints, while no obvious voids within these joints or spalling of the concrete used to fill these joints was evident at the time this inspection was completed.

The protective coating applied to all roof dome surfaces remains having good adhesion value, yet no longer seals the cracks found within the joints between the pre-cast concrete roof panels.

An accumulation of mildew throughout the roof dome also causes declined aesthetics.

It is our recommendation to pressure-wash the exterior wall and roof surfaces at 3,500 P.S.I. and at 3.5 G.P.M. to remove the accumulated mildew from these surfaces, to remove the accumulated efflorescence from the cracks and to prepare the substrate.

We then recommend re-coating the exterior wall and roof surfaces using an epoxy/polyurethane flexible coating to seal all cracks, to seal and protect the concrete and to improve the overall aesthetics.

All components affixed to this tank were found properly installed at this time.

The fiberglass cap and associated stainless steel screen remains securely installed over the vent penetration in the roof dome, and a galvanized steel screen installed at the end of the overflow pipe remains secure, preventing access to the interior of the tank.

The aluminum interior access hatch located on the roof dome remains in good working condition and is secured with a lock, and a new replacement lock, provided by Raymond Water Department, was installed on this hatch at the completion of this project.

INTERIOR:

The interior concrete floor surfaces appeared sound and remain free of obvious cracks, spalls or settlement and require no remedial action at this time.

The interior pre-cast concrete wall panels appeared sound and remain free of cracks, spalls or other obvious fatigue of the concrete and require no remedial action at this time.

The concrete-filled wall slot panel joints were also found appearing sound and free of obvious concrete fatigue and require no remedial action at this time.

The pre-cast concrete overhead panels appeared sound and free of obvious fatigue, while efflorescence has accumulated within approximately 5% of the panel joints/edges, however no obvious fatigue of the concrete was evident at this time.

It is our recommendation to monitor the accumulated efflorescence observed throughout the panel joints/edges through future scheduled inspections to ensure that concrete spall does not occur and result in exposure of the underlying reinforcement steel.

The aluminum manway access ladder was found having mild to moderate corrosion throughout approximately 30% of its surfaces and fatigue (pitting) of the aluminum, having depths from barely detectable levels to 1/32” deep, was found within these areas of corrosion. However, this ladder remains sound and secure, providing good access and egress.

It is our recommendation to monitor the surfaces of this ladder through future scheduled inspections to ensure that the depth of fatigue does not increase and cause the ladder to fail.

The protective coating applied to the metal effluent pipe and metal components of the influent pipe, including the two metal couplings associated with the interior overflow pipe, has lost adhesion and no longer provides protection for these metal surfaces.

It is our recommendation that the next time this tank is removed from service and de-watered that these metal surfaces be power tool cleaned to remove all corrosion and to prepare the substrate. We then recommend re-coating these metal surfaces using an A.N.S.I./N.S.F.61 approved coating for use in structures containing potable water to halt corrosion, to prevent metal fatigue/deterioration and to provide good protection for these metal surfaces.

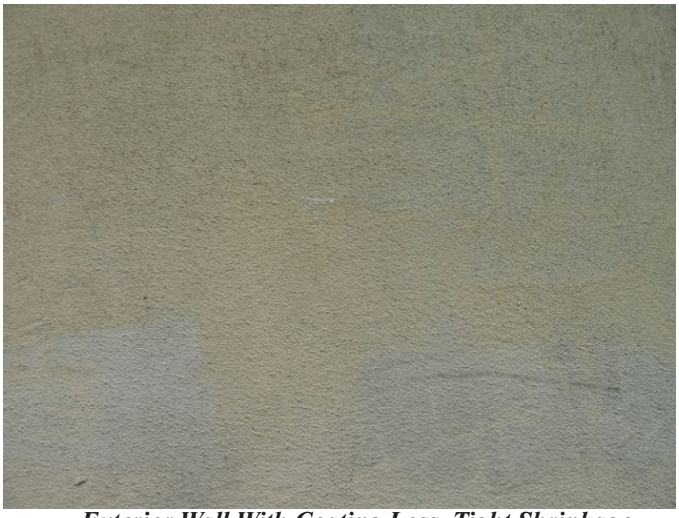
As always, we recommend that re-inspection and cleaning of all water storage facilities be performed in accordance with state and federal mandates, A.W.W.A. standards, and completed by an experienced and authorized inspection corporation.

UNDERWATER SOLUTIONS INC.
Christopher A. Cole, Project Manager

This report, the conclusions, recommendations and comments prepared by Underwater Solutions Inc. are based upon spot examination from readily accessible parts of the tank. Should latent defects or conditions which vary significantly from those described in the report be discovered at a later date, these should be brought to the attention of a qualified individual at that time. These comments and recommendations should be viewed as information to be used by the Owner in determining the proper course of action and not to replace a complete set of specifications. All repairs should be done in accordance with A.W.W.A. and/or other applicable standards.

1 *Exterior Wall With Spray-Painted Graffiti*

2 *Exterior Wall With Coating Loss, Tight Shrinkage Cracks, Efflorescence And Mildew*



3 *Exterior Wall With Coating Loss, Tight Shrinkage Cracks, Efflorescence And Mildew*

4 *Exterior Wall With Coating Loss, Tight Shrinkage Cracks, Efflorescence And Mildew*

5 *Exterior Wall With Mild Mildew*

6 *Exterior Wall With Mild Mildew*

7 ***Exterior Wall With Mild Mildew***

8 ***Exterior Wall With Mild Mildew***

9 ***Exterior Wall With Mild Mildew***

10 ***Exterior Wall With Mild Mildew***

11 ***Exterior Wall With Mild Mildew***

12 ***Exterior Wall With Mild Mildew***

13 *Exterior Wall With Mild Mildew*

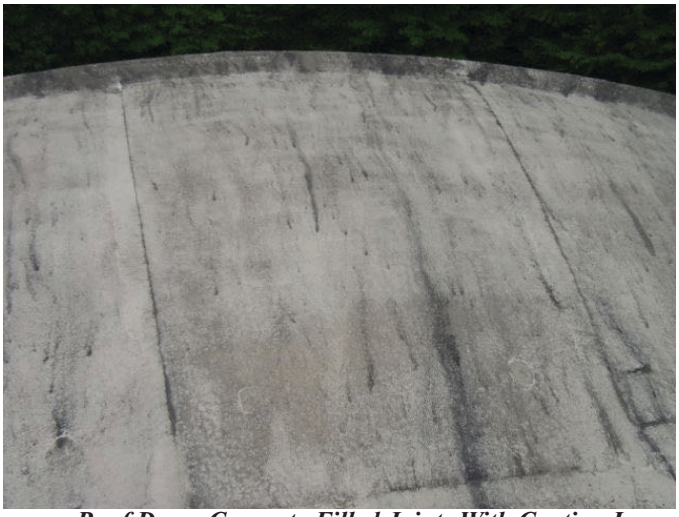
14 *Secure Manway*

15 *Ladder With A Fall Prevention Device*

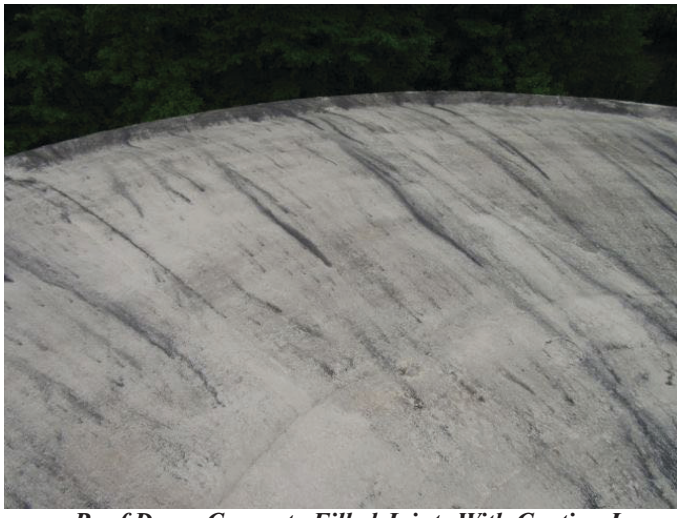
16 *Secure Overflow Pipe Screen*

17 *Roof Dome With Mildew*

18 *Roof Dome Concrete Filled Joints With Coating Loss, Tight Cracks And Mildew*



19 ***Roof Dome Concrete Filled Joints With Coating Loss, Tight Cracks And Mildew***



20 ***Roof Dome Concrete Filled Joints With Coating Loss, Tight Cracks And Mildew***

21 ***Roof Dome Concrete Filled Joints With Coating Loss, Tight Cracks And Mildew***

22 ***Roof Dome Concrete Filled Joints With Coating Loss, Tight Cracks And Mildew***

23 ***Roof Dome Concrete Filled Joints With Coating Loss, Tight Cracks And Mildew***

24 ***Roof Dome Concrete Filled Joints With Coating Loss, Tight Cracks And Mildew***

25 ***Secure Safety Railing***

26 ***Secure Safety Railing***

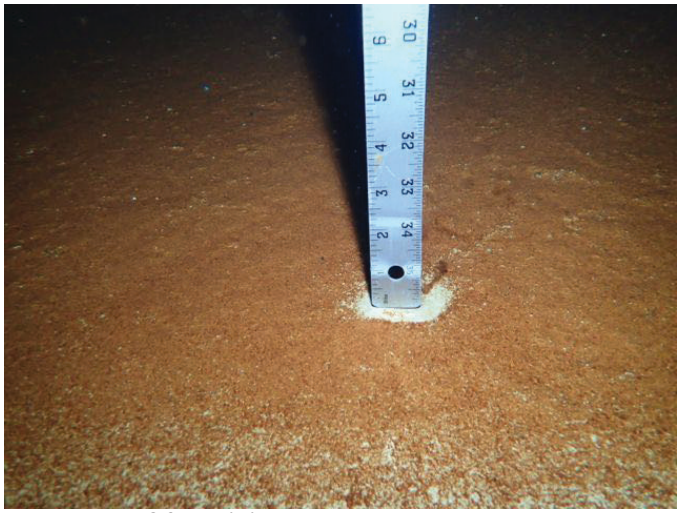
27 ***Secure Vent Cap***

28 ***Secure Vent Screen***

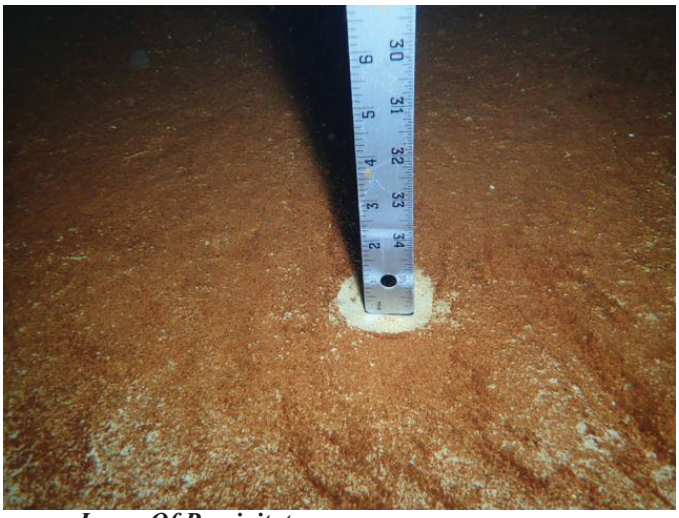
29 ***Open Access Hatch***

30 ***Closed Access Hatch***

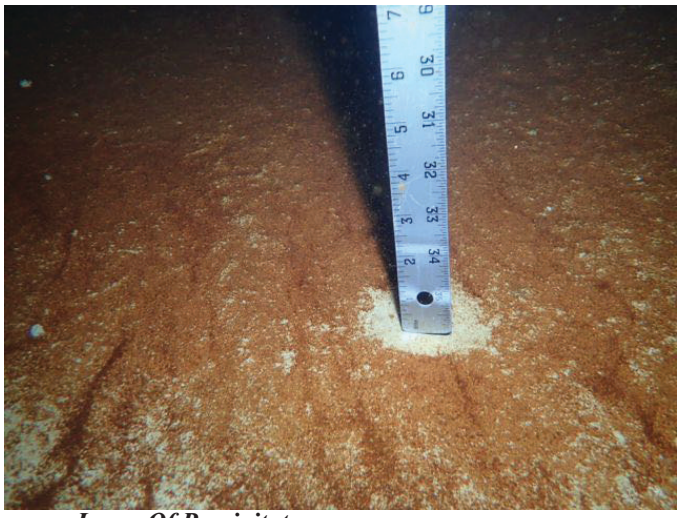
31 ***Secure Access Hatch***



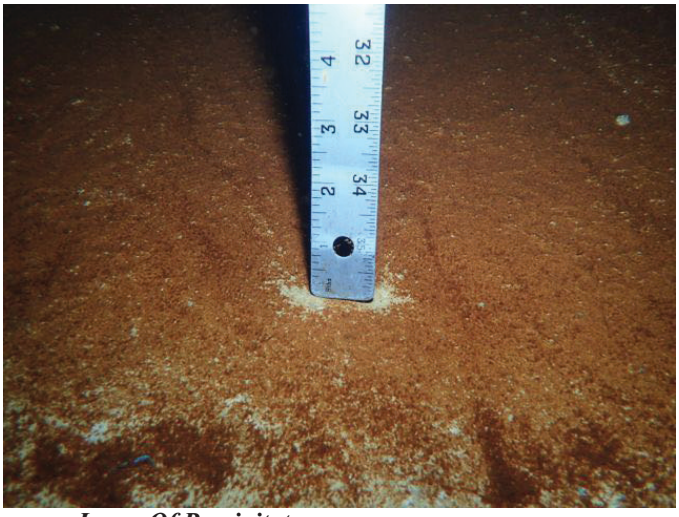
32 ***Layer Of Precipitate***



33 ***Layer Of Precipitate***



34 ***Layer Of Precipitate***



35 ***Layer Of Precipitate***

36 ***Floor With Mild Staining***

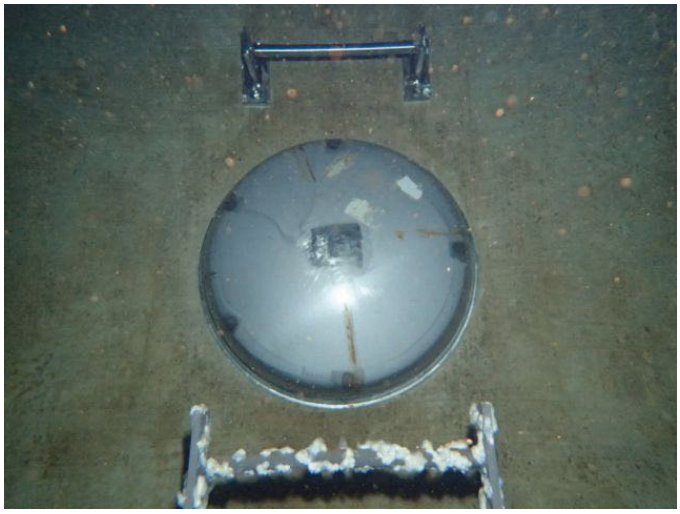
37 ***Floor With Mild Staining***

38 ***Floor With Mild Staining***

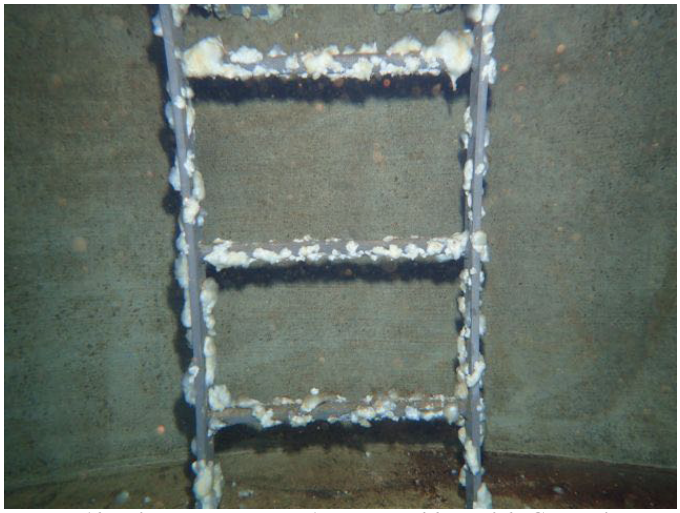
39 ***Floor With Mild Staining***

40 ***Floor With Mild Staining***

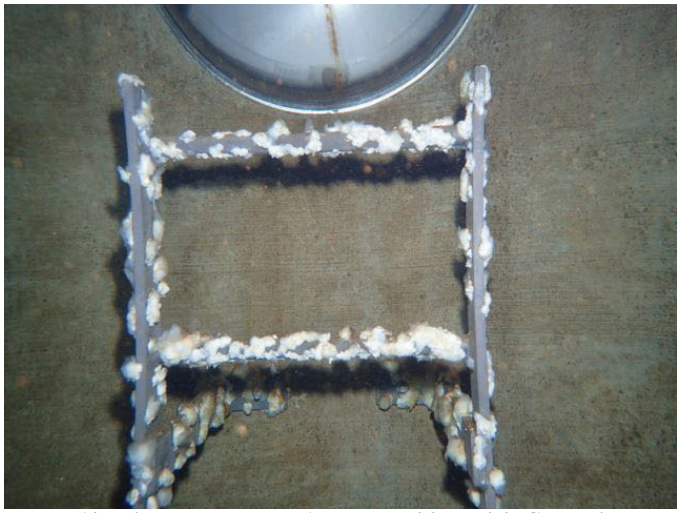
41 ***Floor With Mild Staining***



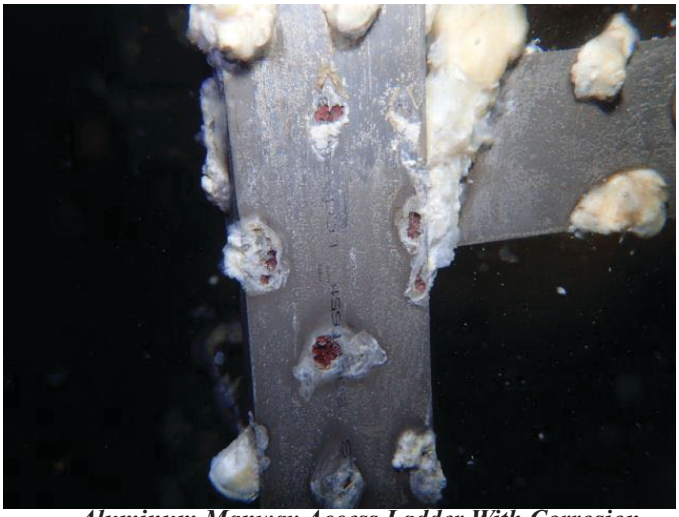
42 ***Manway***



43 *Aluminum Manway Access Ladder With Corrosion*



44 *Aluminum Manway Access Ladder With Corrosion*



45 *Aluminum Manway Access Ladder With Corrosion And Fatigue (Pitting)*

46 *14" Inside Diameter Pipe Penetrating The Tank Floor Within A Deep Sump With Coating Loss/Blistering, Exposed Metal And Corrosion*

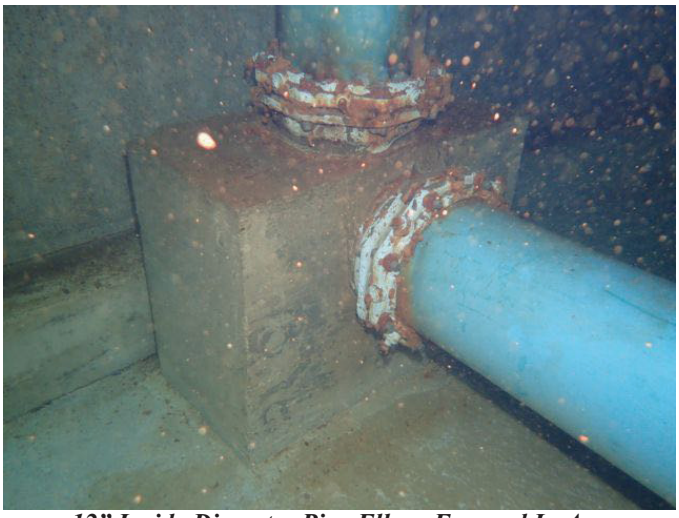
47 *12" Inside Diameter Pipe And Elbow With Coating Loss/Blistering, Exposed Metal And Corrosion*

48 *12" Inside Diameter P.V.C. Pipe Supported To The Tank Floor With Coating Loss/Blistering, Exposed Metal And Corrosion*

49 *12” Inside Diameter P.V.C. Pipe Supported To The Tank Floor With Coating Loss/Blistering, Exposed Metal And Corrosion*

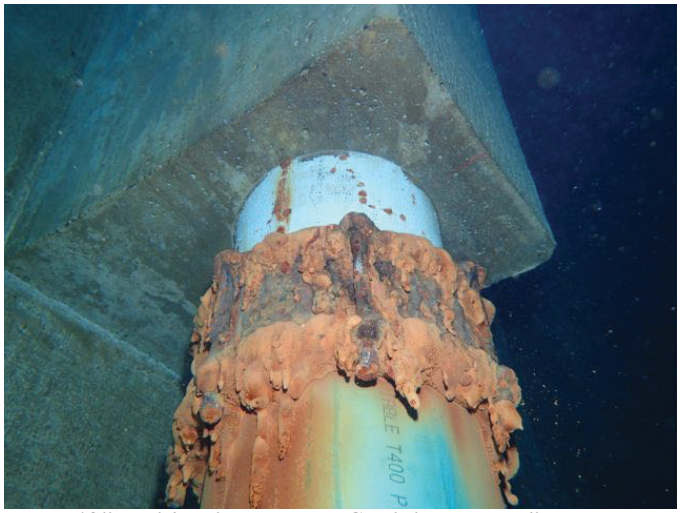
50 *12” Inside Diameter P.V.C. Pipe Supported To The Tank Floor With Coating Loss/Blistering, Exposed Metal And Corrosion*

51 *12” Inside Diameter P.V.C. Pipe Supported To The Tank Floor With Coating Loss/Blistering, Exposed Metal And Corrosion*

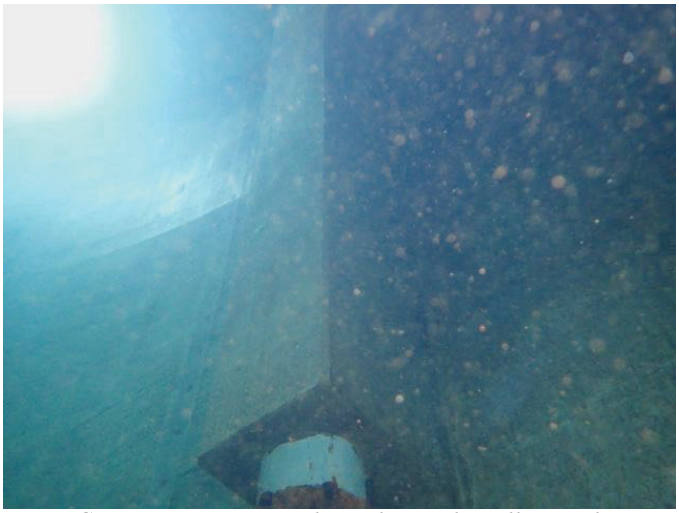


52 *12” Inside Diameter Pipe Elbow Encased In A Concrete Thrust Block*

53 *12” Inside Diameter P.V.C. Piping Extending Through A Coupling With Coating Loss/Blistering, Exposed Metal And Corrosion*



54 *12” Inside Diameter P.V.C. Piping Extending Through A Coupling And Penetrating A Concrete Box With Coating Loss/Blistering, Exposed Metal And Corrosion*



55 *Concrete Box Formed To The Tank Wall For The 12" Inside Diameter Pipe*

56 *12" Inside Diameter And Elbow Extending From The Top Of The Concrete Box*

57 *Interior Wall With Mild Staining*

58 *Interior Wall With Mild Staining*

59 *Interior Wall With Mild Staining*

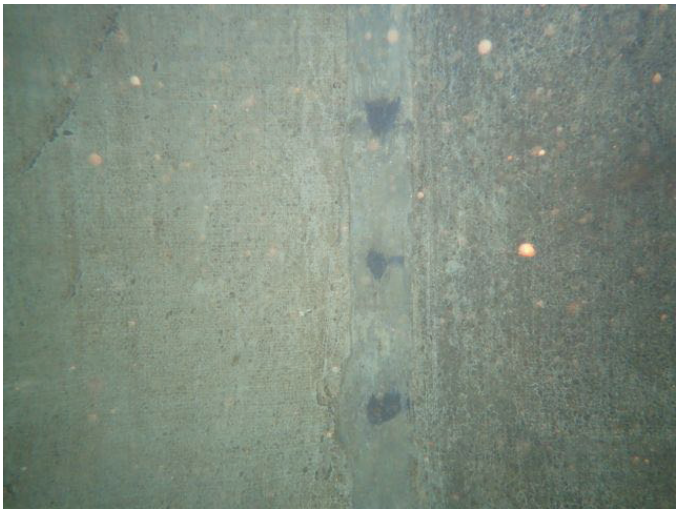
60 *Interior Wall With Mild Staining*

61 ***Interior Wall With Mild Staining***

62 ***Interior Wall With Mild Staining***

63 ***Interior Wall With Mild Staining***

64 ***Interior Wall With Mild Staining***

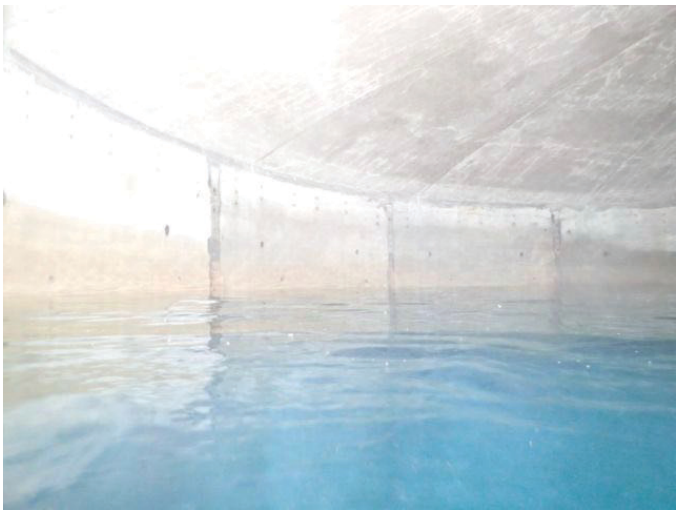


65 ***Interior Wall With Mild Staining***

66 ***Interior Wall With Mild Staining***

67 ***Interior Wall With Mild Staining***

68 ***Interior Wall With Mild Staining***



69 ***Interior Wall With Mild Staining***

70 ***Interior Wall With Mild Staining***

71 ***Interior Concrete Curb***

72 ***Interior Concrete Curb***

73 ***Interior Concrete Curb***

74 ***Interior Concrete Curb***

75 ***Overhead***

76 ***Overhead***

77 ***Overhead***

78 ***Overhead***

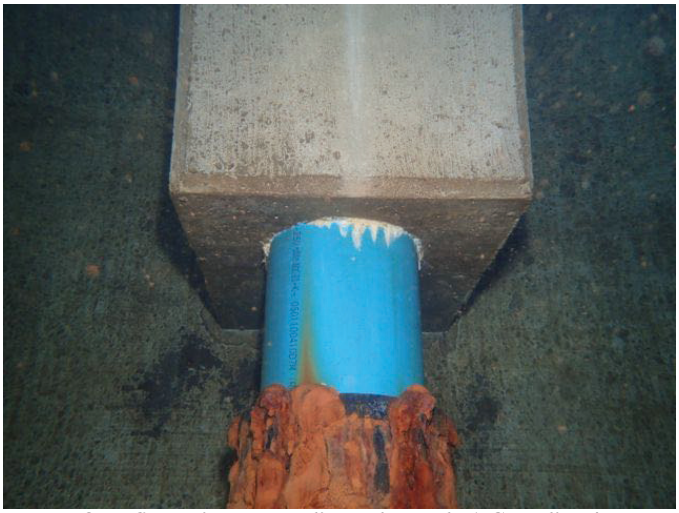
79 ***Overhead With A Vent Penetration***

80 ***Overhead With Panel Joints/Edges With Efflorescence***

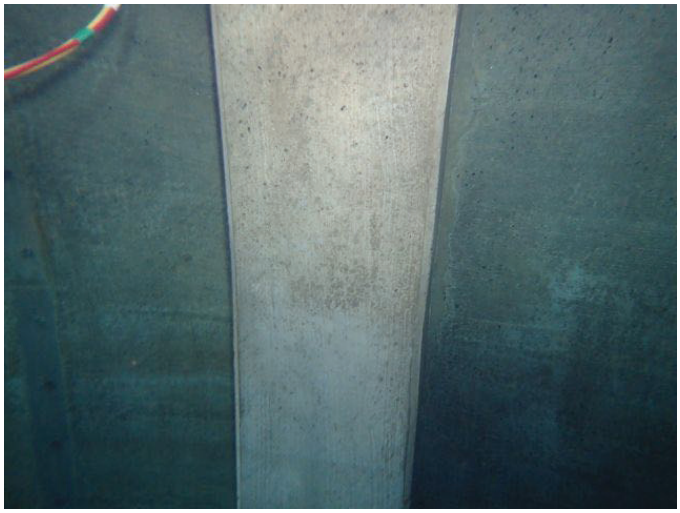
81 ***Overhead With Panel Joints/Edges With Efflorescence***

82 ***Overflow Pipe Penetrating The Tank Floor Within A Deep Sump***

83 ***Overflow Pipe Extending Through A Coupling With Expired Coating And Exposed Underlying Metal***



84 ***Overflow Pipe Extending Through A Coupling/ Penetrating A Concrete Box With Expired Coating And Exposed Underlying Steel***



85 ***Concrete Overflow Box***

86 ***Concrete Overflow Box***

87 ***Overflow Pipe***

88 ***Discharge During Cleaning***