Dear Vard;

The following observations were made upon our inspection of the above referenced tank on June 19, 2014.

**Tank Site**
Tank is in a rural area easily accessed from a paved road with sufficient parking and staging area with no overhead obstructions. Tank site is not fenced but to roadway is secured by an electric gate. Surrounding vegetation and hardscaped areas are well maintained. Tank provides potable water, irrigation and fire protection to nine properties.

**Inspection Access**
Tank was visually inspected through a dilapidated 24” square roof manway with homemade wooden cover. Manway is accessible by an OSHA caged manway with locking cage cover. Tank is also equipped with a 24” X 46” flush side-shell manway with bolt-on cover.

**Tank Foundation**
Tank is self-anchored to a gravel foundation. The grade band and base materials appear to be in satisfactory condition. No structural or seismic related
damage was noticed but the tank appears to have settled about ½” below the top of the grade band and portions of the bottom chime are covered with gravel.

Figure 1: View of Grade Band and Rock Covered Chime

**Tank Construction**
Tank dimensions are 26’1” diameter by 16’0” shell ht. The tank full capacity is 60,000 nominal gallons. Tank was manufactured by Columbian Steel Tank and purportedly installed by BH Tank Works in the early 1990’s. Tank design is based on API 12B principals; 10-12 gauge powder coated carbon steel sheet, fastened with ½” polyencapsulated galvanized hardware and sealed with neoprene strip gaskets.

**Visual Inspection Observations**

1. From the exterior, the tank appears to be properly installed and in fairly good condition except for some notable corrosion near the high water-line on eleven of the seventeen top row sheets. Tank appears to be constructed in accordance with manufacturer’s and engineer’s design specifications. No leakage was observed with the water level at 12.5 feet.
Figure 2: View of Tank from Northwest

Figure 3: View of Tank from Northeast
2. Visual inspection of tank exterior reveals numerous rust stains from leakage of water from tank interior. The rust colored “run marks” have the appearance of typical iron oxidation were caused by water from roof condensation running through large corroded areas at the top of the upper shell panel.

3. Corrosion to tank upper chime and freeboard area (top 6”) was extensive on eleven (11) of seventeen (17) panels. Several (>5) of the top chimes exhibited structural failure at the roof to shell connection points.
Figure 6: Numerous areas of severe corrosion in the freeboard or air gap area of the tank.

Figure 7: Close-up of top chime and roof panel seam corrosion
4. Of notable concern was the failure of the top chime and roof panel seam connections. This level of corrosion could also affect the roof rafter, rafter connectors to the shell creating life-safety and roof structural issues.

Figure 8: Minor shell distortion from structural failure of seam
5. Exterior tank roof and manway are in very poor condition with major corrosion and structural defects.
The roof panels exhibit severe corrosion, likely emanating from tank interior due to naturally occurring sulfur gases and chlorine gas injection to treat the well water. Also, a portion of the tank roof appears to be deformed suggesting possible roof support structural failure.

Of significant importance is the lack of proper tank ventilation. Lack of a free air vent in a fully sealed roof environment can trap corrosive gases and create pressure and vacuum conditions that can cause severe tank damage, including complete structural failure.
6. Tank interior was visually inspected from top shell manway with about 12.5' of water. Interior tank roof components exhibit areas of severe corrosion. Rafters and connectors closer to the water inlets will likely be in worse condition. The clear-span deck support beam appears to be slightly deformed, possibly due to eccentric loading (i.e. trickle-filter) or vacuum conditions.
7. Tank original powder coating has been re-coated with a white epoxy which exhibits numerous areas of blistering and adhesion failure. Roof rafters original epoxy powder coating has completely failed.
8. Interior tank shell coating failure is evident, especially on interior panel edges. The degree of corrosion is sufficiently severe that seam integrity may be compromised. Tear-out stresses are dependent on water column height so there is less chance of tensile failure on the upper portions of the stave. The bottom sidewall staves are double row bolted which will reduce the likelihood of total catastrophic failure due to vertical seam degradation.

Figure 15: Float Control Penetration, Blistered & Peeling Coating, Edge Corrosion
Figure 16: Close-up of Interior Panel Edge Coating Failure

Figure 17: Note Severe Corrosion of C4 Rafter(s)
9. Tank accessories are in fair to poor condition. The roof manway curb is severely dilapidated, roof ventilation is absent, there is no overflow or dedicated drain, the original ladder brackets have rotted out but been adequately replaced, the flush shell manway curb is corroding, the 8” valve is non-operational, tank inlets are functional but not braced to tank shell and the float switch tank support pipe is broken. The homemade level gauge is operational. Condition of outlet valves is uncertain.
Figure 19: Primary Inlet

Figure 20: Corrosion at Bottom Chime Near Flush Shell Access Manway
Conclusions
Subject tank is in poor condition. The roof support structure is failing and over 50% of the top ring horizontal bolt chimes that support the deck (roof sheets) materials are in a severe state of material degradation. The top ring vertical seams indicate moderate corrosion along the panel edges that could impact structural integrity of the shell in a few years. The interior tank bottom panels and bottom ring staves were not visually inspected and would be expected to be in better condition since there is less exposure to corrosive effects of sulphur and chlorine gases.

Tank structure and interior coating is in serious dilapidated condition. Cause of coating and structural failure is likely due to lack of ventilation allowing accumulation of chlorine gas concentrations in the non-submerged portions of the storage tank. Chlorine is being added to well water at a concentration of 1.0-1.5 ppm and then it is distributed to the water storage tank. Chlorination levels in the storage tank should be monitored to avoid over-chlorination. A certified water treatment professional is recommended to properly manage this water system.

Proper and sufficient ventilation in addition to periodic inspection of tank could have prevented this level of degradation.

Tank is in repairable condition but replacement of the roof structure and possibly the top ring is urgently needed. Under current operating conditions, this tank has an estimated remaining service life of 3-6 years. Life expectancy of a properly vented new bolted steel tank is 30-40 years. A partial component replacement/repair may not be as cost effective in the long-term as replacing the entire tank. Although there is some uncertainty of the condition of the interior lower staves and tank bottom, replacement of the top half of the tank could extend the service life an additional 10-20 years. An alternative repair method using a less expensive, non-AWWA/API roof and internal tank liner may extend the service life of this tank and additional 10-30 years.

Based on these observations and discussions with members of the water system, the following scope of repairs/replacements is recommended:

Recommendations
1. Replace the entire tank structure:
2. Replace top ring and roof structure.
3. Repair top ring, replace roof with non-AWWA/API roof, and install polyvinyl tank liner.
4. Repair roof support, patch holes in tank shell and existing roof and install polyvinyl tank liner.
1. **Replace Entire Tank Cost Estimate**: $95,000.00

   **Scope of Estimated Costs:**
   - Temporary storage installation and removal ($10K) (by others)
   - Demolition and removal of existing tank ($10K)
   - Furnishing and installation of new bolted steel tank ($65K)
   - Re-plumbing to new tank and disinfection ($10K) (by others)

   **Exclusions:** Building Permits which would likely require foundation replacement. Estimated adder: $25,000.

   **System Down-time:** 2-3 weeks

2. **Replace Top Ring and Roof Structure with AWWA D-103 Bolted Tank Components Cost Estimate**: $65,000.00

   **Scope of Estimated Costs:**
   - Temporary storage installation and removal ($10K) (by others)
   - Demolition and removal of deck and top ring ($5K)
   - Clean & touch-up epoxy on bottom and bottom ring ($3K)
   - Furnishing and installation of new bolted steel tank components ($45K)
   - Re-plumbing to new tank and disinfection ($2K) (by others)

   **System Down-time:** 6-8 days

3. **Repair Top Ring and Replace Roof Structure with BH Tank Roof Components and Install Tank Liner Cost Estimate**: $45,000.00

   **Scope of Estimated Costs:**
   - Roof inlet piping removal ($2K) (by others)
   - Demolition and removal of deck and structural components ($5K)
   - Furnishing and installation of prefabricated NSF tank liner ($25K)
   - Furnish and Install epoxy coated center-pole with redwood rafters ($10K)
     - Furnish and install stainless steel roof sheeting (22 GA 304 2B) and accessories
     - Replace dilapidated chimes with angle iron/Patch existing top ring panels
   - Re-plumbing and disinfection ($3K) (by others)

   **System Down-time:** 2-3 days

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*The above cost estimates are based on current costs with non-union labor, plus or minus 15%. Pricing “by others” has not been verified.*

*Please contact American Tank Co., Inc. Sales Department for a firm price quotation.*
American Tank Company, Inc. does not warranty or guarantee that these observations or estimates are 100% correct or complete. Observations and estimations are subjective in nature based on experience and product knowledge. We believe these observations to be useful in ascertaining the condition and value of the tank(s) in question. American Tank Company, Inc. will not accept any liability or consequential damages for any opinions derived from these observations.

Sincerely,

Bob Harasta

BH Tank Works
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VP Metal Tank Division