CALAVERAS PUBLIC UTILITY DISTRICT

2024 WATER MASTER PLAN UPDATE

JUNE 2024

PREPARED BY:

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CALAVERAS PUBLIC UTILITY DISTRICT

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2024 WATER MASTER PLAN UPDATE

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EXECUTIVE SUMMARY

The Calaveras Public Utility District (District) is assembling a water master plan update for its water system to support the development of a 5-year Capital Improvement Program (CIP) and 20-year Asset Management Program (AMP) to ensure adequate funding for future improvements. The CIP incorporates input from District's staff based on institutional knowledge of the water system, along with the results of a computerized hydraulic model of the distribution system. The District retained the services of Peterson Brustad, Inc. to develop this master plan for their water system. The water master plan includes an evaluation of the water system's water supply, water demands, water treatment facilities, transmission system, distribution system, and storage facilities.

The water system currently serves approximately 2,040 service connections in the communities of San Andreas, Mokelumne Hill, Paloma, and portions of Glencoe and Rail Road Flat. The Jeff Davis Reservoir and Water Treatment Plant (WTP) treats Mokelumne River water. The District's maximum allowed diversion is 6,656 acre-feet per year (AFY). Raw water is pumped from the South Fork of the Mokelumne River to the Jeff Davis Reservoir and flows by gravity from the reservoir to the WTP. The reservoir capacity is 2,300 acre-feet (AF), and the WTP's design capacity is 6 million gallons per day (MGD). The plant was constructed to allow expansion to 12 MGD capacity.

The District provided historical water usage records and number of active connections (or accounts) at the end of each calendar year for the past 12 years. The 12 years of data indicated an average daily demand to be 753 gallons per minute (gpm) or 1.1 MGD. Future 20-year projected demands were predicted utilizing a 1% growth rate to coincide with Calaveras County's General Plan projected population growth rate of 0.7%.

The District's InfoWater® hydraulic model was used to analyze different water supply and demand scenarios throughout the distribution system, clearwell and storage tanks, and pressure reducing valves. The scenarios created for this master planning effort include average day demand (ADD), maximum day demand (MDD) with fire flow demand, and peak hour demand (PHD). The scenarios were created for the existing distribution system (2023 system with historical demands), and for the projected future distribution system (2043 system with 2043 demands including future anticipated development). The safe yield of the water right at the South Fork Pump Station is more than adequate to supply the 1,482 AF of annual water demands expected in 2043. At the current 1% growth rate, the annual water demand will reach 6,656 AF in 150 years. At an increased growth rate of 2% per year, the annual water demand would reach 6,656 AF in the year 2098.

The future water system analysis results in a capacity that is more than adequate to serve the projected growth of 1% per year in the District. The results from the system analysis identify that fire flow capacity is the governing factor for recommended piping improvements. It is assumed that all pipes will be at the end of their useful life within the next 50 years and will need replacement. The recommended 20-year AMP is to replace 2% of the distribution system piping per year as part of an annual infrastructure program. Additionally, inspection of condition of existing facilities identify a number of recommended high priority rehabilitation projects at the South Fork Pump Station, all hydro stations, and storage tanks.

Overall, the District's system generally meets all performance criteria with exception of fire flow capacity at maximum day demand and some locations of low and high pressure. The low and high pressure areas are anticipated considering the wide range in terrain across the service area and are not expected to pose a concern to the system. Much of the District's distribution piping is smaller than the District's minimum size criteria so the fire flow capacities can be largely addressed by upsizing pipe over time. It is also recommended that the District implement a flushing program to address the low velocities throughout the distribution system.

Projects recommended to improve fire flow capacity, rehabilitate existing pump station and storage tank facilities, or replace existing aging infrastructure are included in a 5-year CIP and 20-year AMP. The total recommended CIP includes 19 projects for a total planning cost estimate of approximately $16 million, in 2024 dollars plus an annual pipeline replacement of $2.9 million each year as part of the 20-year AMP.

The 19 projects on the recommended CIP include:

- Replacing the 20-inch raw water pipeline to Jeff Davis Reservoir (in three phases)
- South Fork Pump Station –
  - Repair undercutting of the dam
  - Repair broken river gate and add a catwalk
  - Address intake plugging and a safe mechanism to raise and lower the intake pump station gates
  - Replace soft starters with VFDs and remove hydropneumatic tank
  - Repair valve in sump
  - Add flow new meter
  - Upgrade electrical and add SCADA controls for remote operation
- Glencoe Pump Station – renovate pump station to improve operability, address fire flows, and provide meters and SCADA for monitoring
- Ponderosa Hydro #1 – Provide isolation valves for station, structural upgrades, and upgrade electrical equipment and add SCADA

- Main Control Valve Hydro #2 – Provide isolation valves for station and structural upgrades, and add SCADA
- Mokelumne Hill Tank – Recoat tank interior and exterior, upgrade ladder for OSHA, add meters, and provide backup power
- Paloma Tank – Replace or upgrade tank and provide SCADA and add meter
- Garamendi Hydro #3 – Provide isolation valves for station, structural upgrades and upgrade electrical equipment, and add SCADA
- Golden Hills Tank – Upsize the piping in the road in order to allow the Golden Hills tank to be abandoned.
- San Andreas Tank – Recoat tank interior and exterior, upgrade ladder for OSHA, modify overflow to provide airgap, provide meters and SCADA for monitoring and provide backup power
- Jeff Davis WTP – Replace piping in building and add backwash reclaim system
- Jeff Davis Clearwell #1 – Recoat tank interior and exterior including structural repairs, and add baffling to match the new tank

The total cost of the CIP and AMP is $74 million, in 2024 dollars, over the next 20 years.

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CHAPTER 1 - INTRODUCTION

This document represents the findings and recommendations of the 2024 update to the Calaveras Public Utility District's (District) Water Master Plan (WMP). The previous WMP was prepared by Peterson Brustad Inc. (PBI) in 2008.

1.1 Purpose of the Master Plan Update

The purpose of this 2024 WMP Update is as follows:

- Review the existing Water Master Plan and identify and complete the necessary updates to the plan.
- Review water demands and supply and provide recommendations for meeting existing and ultimate water demands, including during drought and emergency scenarios.
- Evaluate the capacity of the existing water system such as raw water storage, raw water conveyance, water treatment plant, distribution piping, pumping, and storage facilities with respect to meeting existing and ultimate water demands, including current and future fire flow capabilities.
- Update and calibrate the District's current hydraulic model.
- Provide detailed recommendations for Water Treatment Plant Improvements that consider capacity, regulations, and maintenance costs.
- Determine the most cost-effective improvements for the water treatment plant, raw water storage, raw water conveyance, distribution system including the pipelines, storage facilities and pump stations.
- Prepare a list of recommended capital facilities improvements including estimated costs and implementation schedule for a 5-year CIP and a 20-year Asset Management Program.

1.2 Background Documents & Data Collection

This 2024 WMP Update primarily relies on the following documents for information regarding the District's water use and potential infrastructure improvements:

- Water Master Plan (PBI, October 2008)
- Jeff Davis Water Treatment Plant Evaluation (Mead & Hunt, April 2015)
- 2014 Initial Study Update - Middle Fork Ditch Pipeline And Hydroelectric Power Feasibility Study (KASL, June 2015)

- Calaveras County General Plan (Calaveras County, November 2019)
- Distribution System Feasibility Study (California Rural Water Association, December 2022)
- Maintenance Inspection – Clearwell Tank (CSI Services, July 2023)
- Maintenance Inspection – Golden Hills Reservoir (CSI Services, November 2023)
- Maintenance Inspection – Mokelume Hill Reservoir (CSI Services, November 2023)
- Maintenance Inspection – Paloma Reservoir (CSI Services, November 2023)
- Maintenance Inspection – Railroad Flat Tank (CSI Services, November 2023)
- Maintenance Inspection – San Andreas Reservoir (CSI Services, November 2023)

1.3 Abbreviations

AC	Asbestos-Cement
ADD	Average Day Demand
AF	Acre-Feet
AFY	Acre-Feet per Year
CCWD	Calaveras County Water District
cfs	Cubic Feet per Second
CIP	Capital Improvement Program
CMLC	Cement Mortar Lined and Coated
CRWA	California Rural Water Association
DBP	Disinfection By-Product
DDW	State Water Resources Control Board, Division of Drinking Water
DEM	Digital Elevation Model
District	Calaveras Public Utility District
ES	Emergency Storage
FF	Fire Flow
FSR	Fire Storage Reservation
Ft	Feet
ft/s	Feet per Second
gpm	Gallons per Minute
HAA5	Haloacetic Acids
HDPE	High-Density Polyethylene
HGL	Hydraulic Grade Line
Hp	Horsepower
kW	kilowatt
LF	Linear Feet

MCL	Maximum Contaminant Level
MDD	Maximum Day Demand
MG	Million Gallons
MGD	Million Gallons per Day
PBI	Peterson Brustad Inc.
PHD	Peak Hour Demand
PRV	Pressure Reducing Valve
psi	Pounds per Square Inch
PVC	Polyvinyl Chloride
SF	Square Foot
SFPS	South Fork Pump Station
SPS	System Peaking Storage
SWTR	Surface Water Treatment Rule
TDH	Total Dynamic Head
TTHM	Total Trihalomethane
ug/L	micrograms per liter or parts per billion
USGS	United States Geological Survey
WMP	Water Master Plan
WTP	Water Treatment Plant

1.4 Report Organization

Following this introductory Chapter, the 2024 WMP Update includes the following chapters:

- Chapter 2 – Existing Water System: Describes the District's existing water service area and provides background information on the District's existing water system including water supply, storage and transmission/distribution facilities.
- Chapter 3 – Water Demands: Presents the existing water demands, population projections and projected future water demands
- Chapter 4 – Water Supply: Summarizes the District's current water supply, future water supply needs, and future water supply alternatives
- Chapter 5 – Water Treatment Plant Process Evaluation: Assesses the WTP's current treatment process and its ability to meet projected future demands and drinking water regulations
- Chapter 6 – Hydraulic Model Development: Discusses the process of updating and calibrating the current hydraulic model
- Chapter 7 – Distribution System Criteria: Presents the system design criteria used to evaluate the water system

- Chapter 8 – Distribution System Analysis: Presents results of hydraulic model evaluation of the existing and future water distribution system under the existing and projected future water demands
- Chapter 9 – Facility Condition Assessment: Summarizes information gathered from separate studies that assessed the condition of the distribution system piping, WTP and all District storage tanks
- Chapter 10 – Recommended Capital Improvement Program and Asset Management Plan: Recommends projects based on the analysis of the existing and future water system and presents planning cost estimates and timelines for implementation of the recommended projects
- Appendices

CHAPTER 2 – EXISTING WATER SYSTEM

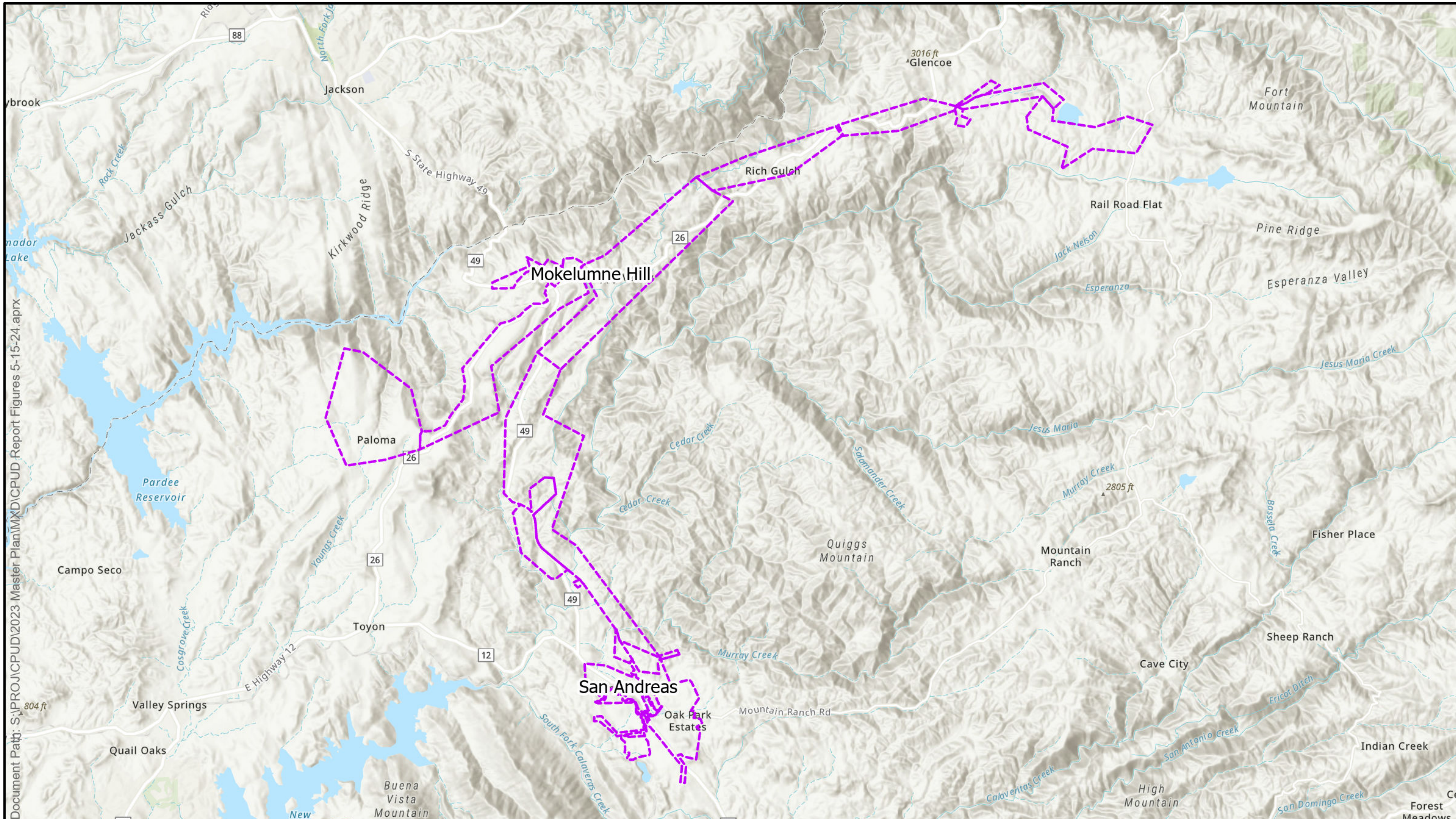
The Calaveras Public Utility District (District) was formed in 1934 by an election held on January 16, 1934 under the California Public Utilities Code. At the time of the election, the District did not own any facilities. In 1937, the District purchased the Mokelumne River Power and Water Company's water system of reservoirs, ditches, and flumes. The Jeff Davis WTP and Reservoir, storage tanks, pipelines, and other associated improvements were constructed in 1973. Water rights used by the District were obtained January 19, 1939 from the Mokelumne River Power and Water Company. The same rights have been transferred between individuals and entities since 1852.

The District's existing water system serves approximately 2,040 service connections in the communities of San Andreas, Mokelumne Hill, Paloma, and portions of Glencoe and Rail Road Flat. Figure 2-1 presents District's existing water service area.

Raw water is pumped from the South Fork Mokelumne River to the Jeff Davis Reservoir. Raw water then flows by gravity from the Jeff Davis Reservoir to the Jeff Davis WTP, located north of Ridge Road in the Rail Road Flat area, to treat the Mokelumne River water.

Treated water is currently delivered by gravity from the WTP's Clearwell to the transmission main, which traverses westward serving the communities of Mokelumne Hill, San Andreas, Glencoe, and Paloma. Treated water is also pumped from the WTP Clearwell to the Rail Road Flat Storage Tank to serve the community of Rail Road Flat.

The District has a unique operational strategy that is controlled from the bottom of the system starting at the San Andreas CLA Valve. When the San Andreas CLA Valve opens, the PRV at Hydro #3 also opens which then begins to draw down the Mokelumne Hill Tank. As the level in the Mokelumne Hill Tank drops, the PRVs at Hydro #1 and #2 are opened which then draws down the Clearwells at the Water Treatment Plant (WTP) and activates the WTP.



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CALAVERAS PUBLIC UTILITY DISTRICT

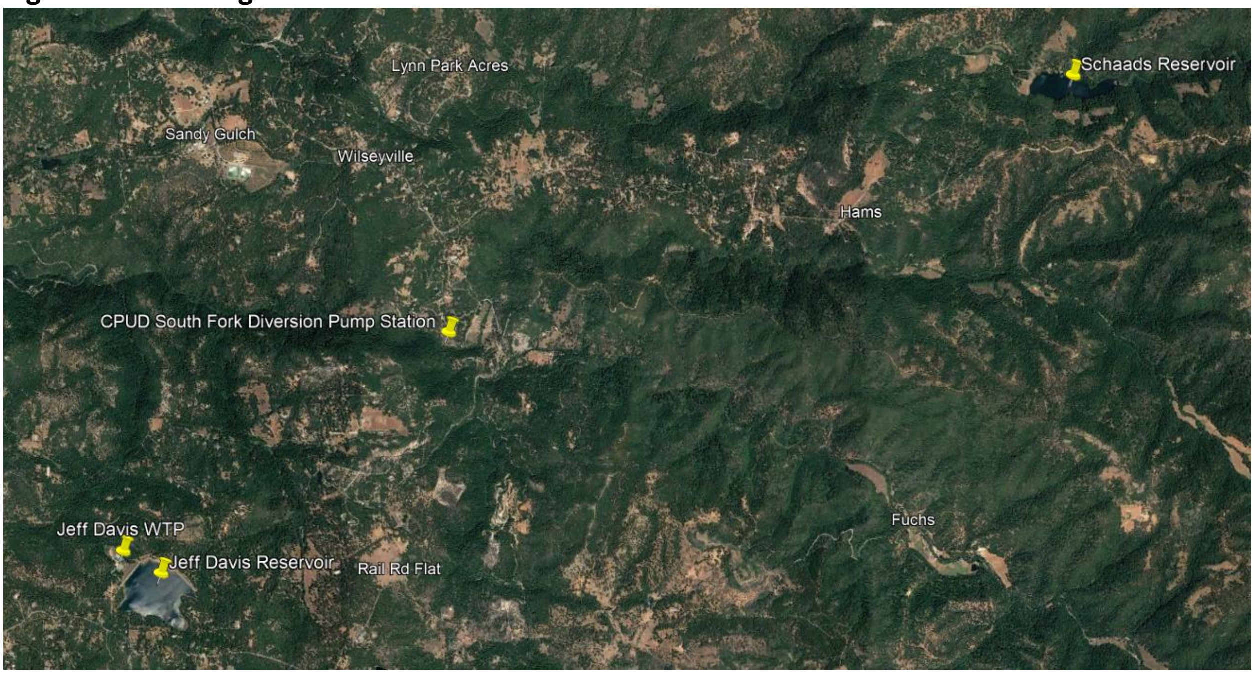
Water Service Area

FIGURE 2-1

2.1 Existing Raw Water Facilities

The District's existing raw water facilities include the Mokelumne River Pump Station, raw water pipelines, Jeff Davis Reservoir, and Schaads Reservoir. Figure 2-2 presents the location of the District's raw water facilities.

Figure 2-2. Existing Raw Water Facilities



2.1.1 *South Fork Pump Station*

A diversion dam on the Mokelumne River, just downstream of the confluence of the South and Licking forks of the Mokelumne River, diverts flow to the South Fork Pump Station (SFPS). The SFPS consists of two 400 HP Floway vertical turbine pumps that were installed in 1972. Each pump has 9 stages and was designed to produce 2,000 gallons per minute (gpm) at 650 feet total dynamic head (TDH). The combined operation of both pumps produces approximately 3,300 gpm. The SFPS pumps raw water into a 2-mile long, 20-inch diameter steel raw water transmission pipeline that extends to the Jeff Davis Reservoir.

2.1.2 *Jeff Davis Reservoir*

The Jeff Davis Reservoir covers approximately 66 acres and has a capacity of approximately 2,300 acre-feet (AF). The Jeff Davis Reservoir is located in a local watershed of approximately 200 acres and was formed by the construction of an earthen dam. Raw water is delivered from the Jeff Davis Reservoir to the Jeff Davis WTP via a 500-feet long, 24-inch diameter pipeline. The District typically pumps from the Mokelumne River during the winter and spring months and stores the raw water in the Jeff Davis Reservoir prior to treatment year-round.

2.1.3 *Schaads Reservoir*

The Schaads Reservoir is located along the Middle Fork of the Mokelumne River and has a capacity of approximately 1,800 AF. Schaads Reservoir is not currently connected (hydraulically) to the raw water facilities at the Jeff Davis Reservoir. Historically, water from Schaads Reservoir moved through a diversion canal to the Licking Fork of the Mokelumne River and ultimately to the South Fork of the Mokelumne River. From this point, the existing SFPS downstream of the Schaads diversion was used to pump this water from the South Fork of the Mokelumne River.

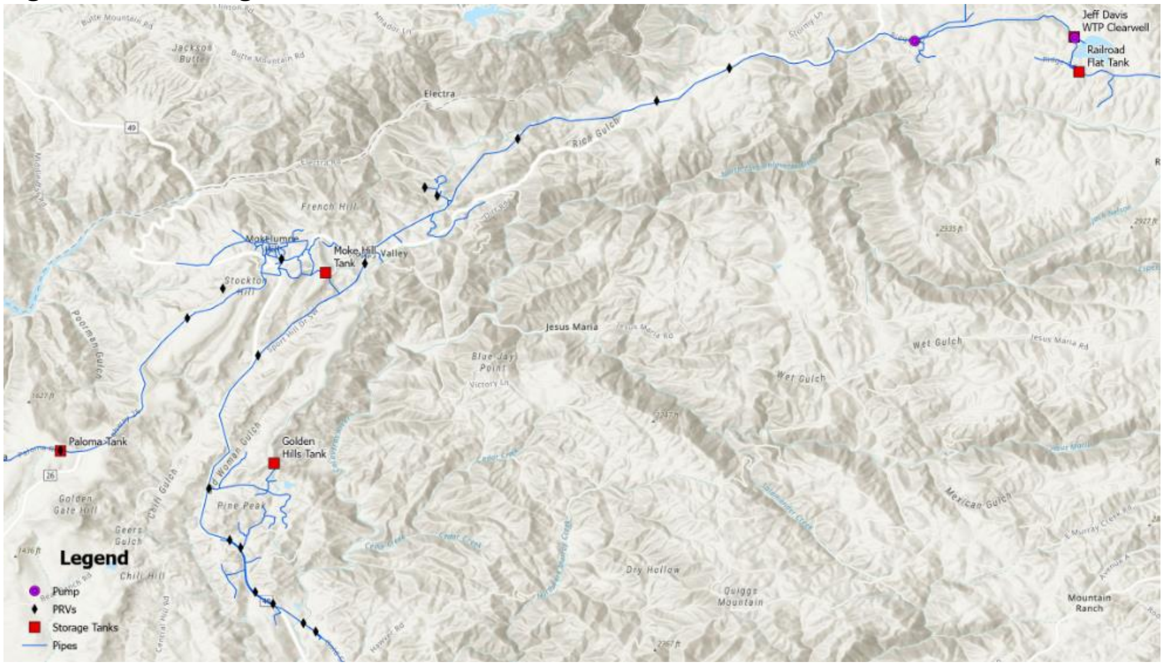
The District currently uses the raw water in Schaads Reservoir to supply the Calaveras County Water District (CCWD) with up to 200 AF per year by releasing the water into the Middle Fork of the Mokelumne River. CCWD pumps this water from the Middle Fork of the Mokelumne River to their West Point Water Treatment Plant.

In addition, the District uses the raw water in Schaads Reservoir to generate power. The District owns a hydropower generating pressure reducing station to capture the available head on the releases from Schaads Reservoir.

2.2 Existing Treated Water Facilities

The District's existing treated water facilities include the Jeff Davis WTP, pressure reducing stations, transmission main and distribution piping, pump stations and water storage tanks. Figure 2-3 presents the location of the District's existing treated water facilities.

Figure 2-3. Existing Treated Water Facilities



2.2.1 *Jeff Davis Water Treatment Plant*

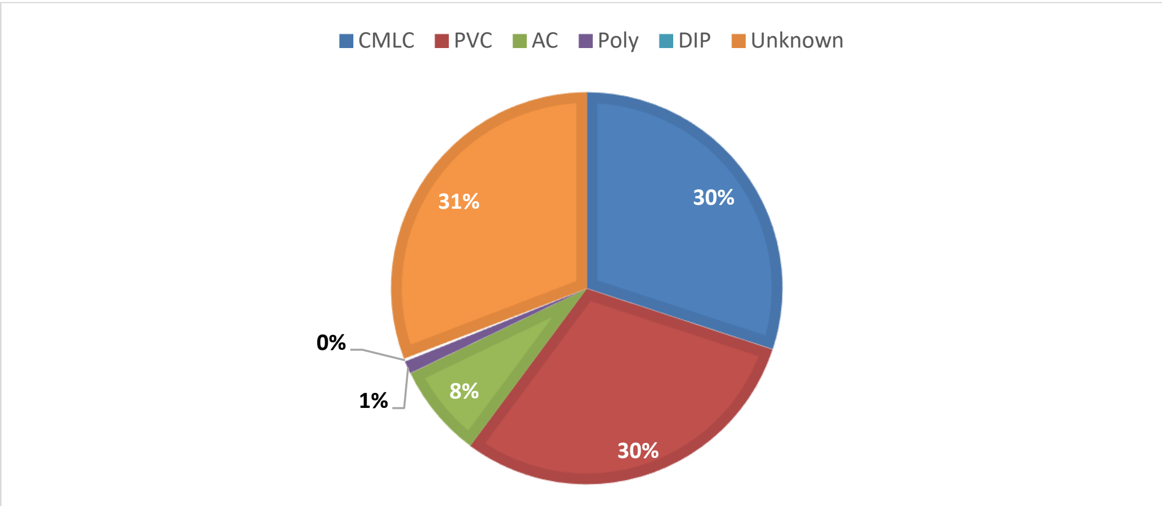
The Jeff Davis WTP consists of six dual media pressure filters, each capable of producing 1 million gallons per day (MGD) of treated water for a total capacity of 6 MGD. Chlorine and polymer are added to the raw water prior to entry into the filters for oxidation and coagulation. Zinc orthophosphate is fed at the common filter effluent line for distribution system corrosion control. Chlorine is also added again before the Clearwell for disinfection. The WTP was designed to allow for expansion to 12 MGD capacity with the addition of six pressure filters.

The Jeff Davis WTP weas originally constructed in 1971. In 2005, all filter vessels were inspected and recoated. In addition, all of the filter media was replaced in 2005. In 2011, the top 6" of filter media was replaced as a result of fouling from leafy plant growth in Jeff Davis Reservoir. In 2015, the District performed an evaluation of the Jeff Davis WTP (Mead & Hunt, 2015). The recommendations of this evaluation are presented in Chapter 5 – WATER TREATMENT EVALUATION. In the spring of 2023, the District hired a contractor to add additional filter media to all filter vessels.

2.2.2 *Transmission Main and Distribution Piping*

Transmission main piping delivers water from the Jeff Davis WTP Clearwell to Mokelumne Hill, Paloma and San Andreas. The District's existing transmission main system contains approximately 18 miles of 16-inch to 27-inch diameter cement mortar lined and coated (CMLC) steel pipe. Distribution system piping delivers the water from the transmission main to the District's customers. There are approximately 20 miles of 2-inch to 12-inch diameter pipelines in the District's distribution system. The distribution system piping consists mostly of CMLC steel pipe, polyvinyl chloride (PVC) pipe, and some limited lengths of asbestos-cement (AC) pipe and ductile iron pipe. Figure 2-4 below shows the various types of pipes within the District's distribution and transmission main systems.

Figure 2-4. District Pipe Material Types



2.2.3 *Pressure Reducing Stations*

Significant drops in elevation in the District's transmission main and distribution system piping require pressure reducing stations to maintain water pressures at reasonable levels. There are three main pressure reducing stations used to regulate the pressure along the transmission main. These pressure reducing stations use hydroelectric turbines to generate electricity while reducing pressure. Table 2-1 presents the characteristics of the three transmission main pressure reducing stations.

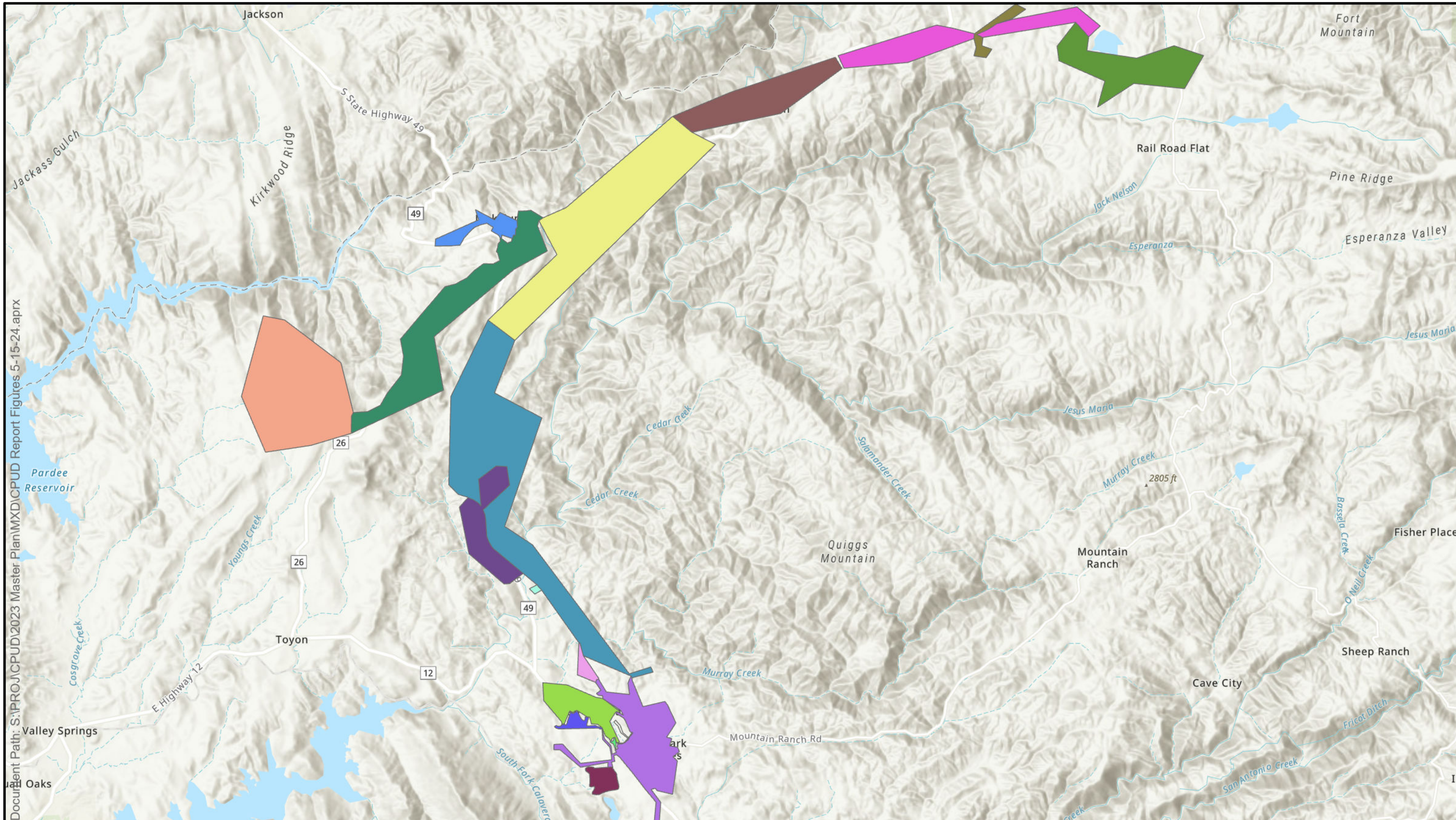
Table 2-1. Transmission Main Pressure Reducing Stations (Hydroelectric Turbines)

Pressure Reducing Station	Inlet Pressure Range (psi)	Turbine Outlet Pressure (psi)	Turbine Flow Capacity (gpm)	Operational Conditions
Ponderosa Hydro #1	250-255	45	1,500[A]	Only when the Mokelumne Hill Tank is filling
Main Control Valve Hydro #2	175-195	20	1,500[A]	Only when the Mokelumne Hill Tank is filling
Garamendi's Hydro #3	265-270	85	1,500[A]	Only when the San Andreas Tank is filling
[A] A 6-inch bypass pressure reducing valve is provided for water demands when the turbines are not operation				

In addition, there are 12 smaller pressure reducing stations that use pressure reducing valves to reduce the pressure in the distribution system (see Table 2-2). All of the District's pressure reducing stations are described in detail in Chapter 6 – HYDRAULIC MODEL DEVELOPMENT. The use of these pressure reducing stations (along with pump stations and water storage tanks) creates the 17 existing pressure zones in the District's transmission main and distribution piping system. Figure 2-5 presents a map of these pressure zones in the District's transmission main and distribution piping system.

Table 2-2. Small PRVs in System

Location	Main Valve Size	Downstream Pressure Setting (psi)	Pressure Zones	PRV Elevation	PRV HGL (ft)
Ponderosa PRV Station	6"	50	Jeff Davis to Ponderosa	2182.38	2297.88
Ponderosa PRV Station	2"	110	Jeff Davis to Ponderosa	2182.38	2436.48
MCV PRV Station	10"	30	Ponderosa to MCV	1805.15	1874.45
Garamendi PRV Station	6"	95	MCV to Garamendi	1237.83	1457.28
Mokelumne Hill (MH Fire PRV 2)	12"	25	Mokelumne Hill to Mokelumne Hill Fire Station	1538.33	1596.08
Golden Hills PRV	6"	150	Garamendi to Golden Hills South	965.24	1311.74
Golden Strike Road PRV	6"	65	Garamendi to Mobile Home	813.33	963.48
Leonard Road PRV	12"	120	Garamendi to Murray Creek	843.58	1120.78
Forestry	4"	33	San Andreas West to San Andreas	1090.70	1166.93
Ken James	8"	70	San Andreas West to San Andreas	1055.82	1217.52
Cemetery/Churchill 1	8"	35	Church Hill to San Andreas	1168.39	1249.24
Cemetery/Churchill 2	10"	7	San Andreas West to San Andreas	1166.46	1182.63
Angels Road PRV	2"	70	Angels Road to San Andreas	1085.04	1246.74
Tscornia Field PRV	10"	40	Tscornia Field to San Andreas	1069.72	1162.12



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Legend

- Angels Road
- Church Hill
- Garamendi
- Glencoe
- Golden Hills South
- Jeff Davis
- MCV
- Mobile Home
- Mokelumne Hill
- Mokelumne Hill Fire Station
- Murray Creek
- Paloma
- Ponderosa
- Rail Road Flat
- San Andreas
- San Andreas West
- Tscornia Field

0 1.25 2.5 Miles

CALAVERAS PUBLIC UTILITY DISTRICT

District Pressure Zone Map

FIGURE

2-5

2.2.4 *Pump Stations*

There are two pump stations in the District's distribution system:

- Rail Road Flat Pump Station – pumps water from the Jeff Davis WTP Clearwell to the Rail Road Flat Water Storage Tank
- Glencoe Pump Station – maintains the water pressure in the Glencoe hydropneumatic tank

Table 2-3 presents the characteristics of the District's two existing pump stations

Table 2-3. Pump Stations

Pump Station	Pump Number	Design Capacity	Motor Size
Rail Road Flat	1	250 gpm at 255 ft Head	25 HP
	2	245 gpm at 255 ft Head	25 HP
Glencoe	1	210 gpm at 310 ft Head	25 HP
	2	210 gpm at 310 ft Head	25 HP

2.2.5 *Water Storage Tanks*

The District operates five water storage tanks along with the two Clearwells at the Jeff Davis WTP to meet daily water demands and provide emergency fire flow requirements. These water storage tanks are located throughout the District's distribution system. Table 2-4 presents the characteristics on the District's existing water storage tanks.

Table 2-4. Water Storage Tanks

Water Storage Tank	Nominal Capacity (gal)	Diameter (ft)	Height (ft)
Jeff Davis WTP Clearwell #1	500,000	70	18
Jeff Davis WTP Clearwell #2	500,000	70	18
Rail Road Flat Tank	500,000	47	40
Mokelumne Hill Tank	1,500,000	80	45
Golden Hills Tank	40,000	20	16
Paloma Tank	125,000	30	24
San Andreas Tank	3,000,000	110	43
TOTAL STORAGE	**6,165,000**		

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CHAPTER 3 – WATER DEMANDS

3.1 Existing Water Demand

The District provided 12 years of historical water usage data from 2011 to 2022 to use for the basis for determining the existing water demand. The average day demand (ADD) was determined by dividing the annual usage for each year by 365 days. The maximum day demand (MDD) for each year represents the highest usage day of the year. Table 3-1 presents a summary of the historical water usage.

Table 3-1. Historical Water Usage

Year	Annual Usage (AFY)	Average Day Demand (gpm)	Maximum Day Demand (gpm)
2011	1,268	786	1,661
2012	1,432	887	2,397 [A]
2013	1,519	942	1,730
2014	1,160	719	1,629
2015	1,033	641	1,521
2016	1,342	832	1,611
2017	1,268	786	1,648
2018	1,181	732	1,426
2019	1,181	732	1,594
2020	1,096	679	1,250
2021	1,068	662	1,289
2022	1,021	633	1,187
Average Annual Usage	**1,214**		
	Average ADD	**753**	
		Maximum MDD	**1,730** [A]

[A] The 2012 MDD is significantly higher than the other years and is considered an outlier. Therefore, the 2012 MDD was not used to determine the Maximum MDD.

To determine the existing ADD to be used for analysis in this WMP Update, the average ADD over the last 12 years was determined. Table 3-1 shows that the existing ADD is 753 gpm.

To determine the existing MDD to be used for analysis in this WMP Update, the maximum MDD over the last 12 years was determined. Table 3-1 shows that the existing MDD is 1,730 gpm.

The ADD to MDD peaking factor based on these results is 2.3.

The existing peak hour demand (PHD) represents the demand during the peak hour on the maximum day. To be consistent with the diurnal curve pattern for the District's water system (discussed in Section 3.3 Diurnal Demand Curve), the MDD to PHD peaking factor is 2; therefore, the existing peak hour demand is estimated to be 3,460 gpm.

3.2 Future Demand

The *Calaveras County General Plan* (November 2019) lists the 2019 population of Calaveras County as 41,277. The General Plan projects that the population in Calaveras County will reach 48,035 in 2040 using California Department of Finance population projections. This growth can be represented as a 0.72% average annual growth rate per year, or 1% to be conservative. Projecting demands for the future expansion of the system will consist of applying a 1% annual growth rate in demand, compounded annually from 2023 through 2043. Table 3-2 presents a comparison of the District's existing and future water demands in 2043.

Table 3-2. Estimated Future Water Demands

Water Demand Scenario	Annual Usage (AFY)	ADD (gpm)	MDD (gpm)	PHD (gpm)
2023 (Existing)	1,215	753	1,730	3,460
2043 (future)	1,482	918	2,111	4,222

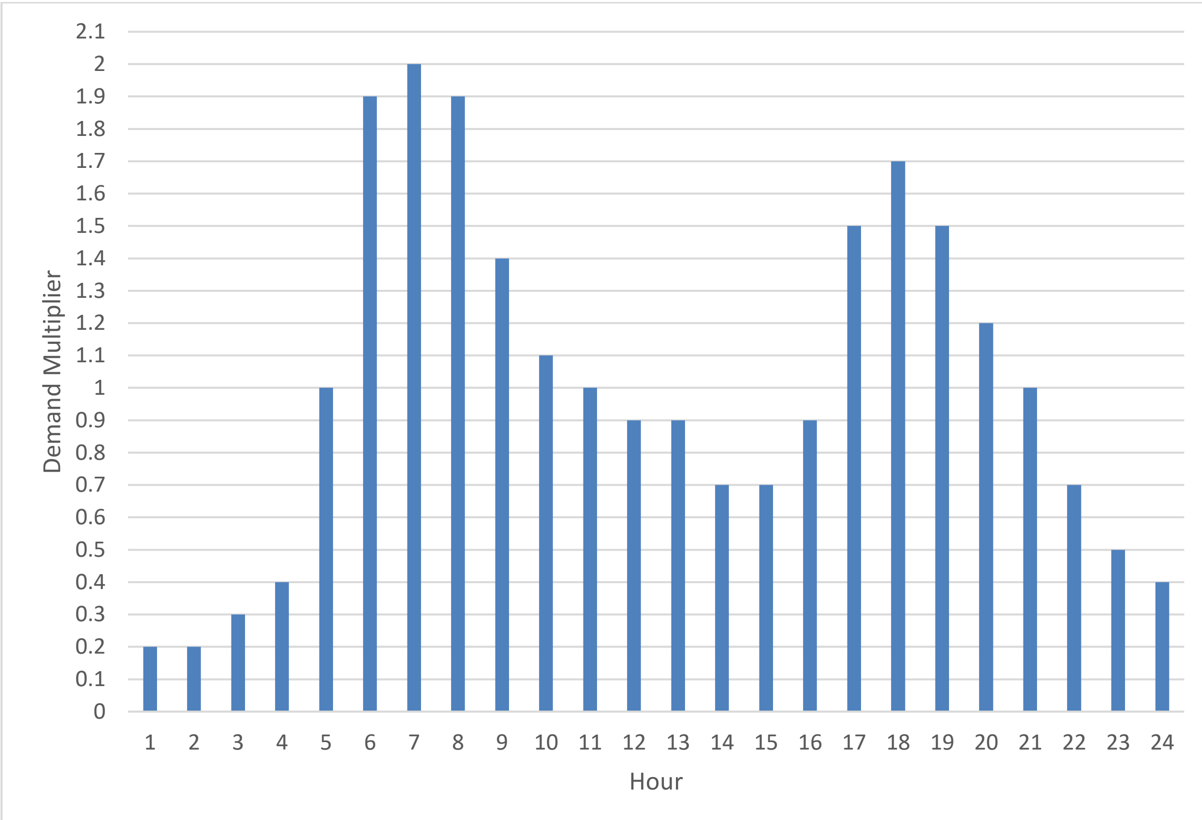
3.3 Diurnal Demand Curve

A diurnal demand curve was created by the California Rural Water Association (CRWA) for their hydraulic model for the Calaveras Public Utility District Distribution System Feasibility Study (December 2022). This diurnal demand curve will be used in the analyses developed for this WMP Update. Table 3-3 presents the daily demand multipliers for this diurnal demand curve and Figure 3-1 shows this curve over a 24 hour period.

Table 3-3. Diurnal Demand Curve Multipliers

Hour	Daily Demand Multiplier		Hour	Daily Demand Multiplier		Hour	Daily Demand Multiplier
1	0.2		9	1.4		17	1.5
2	0.2		10	1.1		18	1.7
3	0.3		11	1		19	1.5
4	0.4		12	0.9		20	1.2
5	1		13	0.9		21	1
6	1.9		14	0.7		22	0.7
7	2		15	0.7		23	0.5
8	1.9		16	0.9		24	0.4

Figure 3-1. Diurnal Demand Curve



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CHAPTER 4 – WATER SUPPLY

4.1 Existing Water Rights

The District obtains its water from the South Fork of the Mokelumne River at its South Fork Pump Station (SFPS) that moves water via the raw water pipeline to the Jeff Davis Reservoir. The water right was obtained from the Mokelumne River Power and Water Company as deeded on January 19, 1939[1]. The State Water Resources Control Board requested a title search from an attorney documenting the paper trail to the origin of the water rights, which was discovered to have originated on March 21, 1853, as a water right originally obtained by Allen Cadwalader and Charles Cadwalader for the Mokelumne Hill Canal and Mining Company, for use in damming and mining. These individuals the first with interest of the water rights that the District uses today on the Mokelumne River[2].

The water right is defined clearly in an August 16, 1940 agreement with East Bay Municipal Utility District, which stated that the District has a right to a flow of natural and stored water of up to 15 cubic feet per second (cfs), up to a claimed amount of approximately 9,125 AFY. Schaads Reservoir storage, 1,800 AFY, is included in that amount. However, the South Fork Pump Station has a safe yield established in Water Right Order 16338 limits the maximum diversion to 6,656 AFY.

The safe yield of the water right at the South Fork Pump Station is more than adequate to supply the 1,482 AF of annual water demands expected in 2043. At the current 1% growth rate, the annual water demand will reach 6,656 AF in 150 years. At an increased growth rate of 2% per year, the annual water demand would reach 6,656 AF in the year 2098.

4.2 Water Supply Storage

The only raw water supply storage currently available to the District is the Jeff Davis Reservoir. The capacity of the Jeff Davis Reservoir is 2,300 AF, which provides nearly 2 years supply at the current ADD. At the 2043 ADD, the Jeff Davis Reservoir provides 1.5 years supply.

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[1] "Book 6 of Official Records at Page 194", presumably of the County of Calaveras Recorder.

[2] Water Right Permit for Diversion and Use of Water No. 16338

4.3 Schaads Reservoir

Schaads Reservoir is not currently connected to either the Jeff Davis Reservoir or the Jeff Davis WTP. The District has previously studied the feasibility of piping water from their storage facility at Schaads Reservoir, located on the Middle Fork of the Mokelumne River, to Jeff Davis Reservoir. These previous studies are listed below:

- 1988 Middle Fork Ditch Pipeline Feasibility Study (1988, Weber Associates)
- 2001 Initial Study – Middle Fork Ditch Pipeline and Hydroelectric Power Feasibility Study (2001, KASL)
- 2014 Initial Study Update – Middle Fork Ditch Pipeline and Hydroelectric Power Feasibility Study (2015, KASL)

Currently, water is discharged from Schaads Reservoir through the District's Schaads Hydroelectric Facility into the Middle Fork of the Mokelumne River.

4.3.1 *1988 Middle Fork Ditch Pipeline Feasibility Study*

This study proposed to install a 16-inch transmission pipeline between Schaads Reservoir and the SFPS. The existing SFPS and pipeline would be used to deliver the water to the Jeff Davis Reservoir. The cost of this facility was estimated at $2,145,200 (in 1988 dollars).

4.3.2 *2001 Initial Study*

This study proposed to install a 24-inch transmission pipeline between Schaads Reservoir and the SFPS along with a 1 Megawatt hydroelectric facility. The hydroelectric facility is proposed to take advantage of the 694 to 720 ft elevation difference between Schaads Reservoir and the South Fork Mokelumne River. The cost of these pipeline and hydroelectric facility improvements were estimated at $6,925,630 (in 2001 dollars). The potential savings from the hydroelectric facilities and reduced pumping at the SFPS were estimated to be $140,000 per year (in 2001 dollars). The study did not recommend installation of the proposed equipment until a funding source could be identified.

4.3.3 *2014 Initial Study Update*

This study updates the 2001 study and proposes installing a 30-inch transmission pipeline between Schaads Reservoir and the SFPS along with a 1 Megawatt hydroelectric facility. The study updated the project hydrology, pipeline alignments, power generating equipment, project costs and net annual revenues. Per the study, the project includes the following items:

- 26,000 feet of 30-inch PVC or HDPE pipe

- 3,000 feet of 30-inch ductile iron pipe (where pressure is greater than 150 psi)
- Hydroelectric facility with 1 megawatt capacity
- 1.1 miles of easement across 9 different private parcels

The cost of constructing these pipeline and hydroelectric facility improvements were estimated at $10,780,890 (in 2015 dollars) and include a 10% construction contingency. The potential savings from the hydroelectric facilities and reduced pumping at the SFPS were estimated to be $406,000 per year (in 2015 dollars). The study concluded that the project was economically viable if the District could obtain low interest loans (1% for 40 years) and grant funding.

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CHAPTER 5 – WATER TREATMENT EVALUATION

5.1 WTP Capacity

The rated capacity of the Jeff Davis WTP is 6 MGD and was designed to be expandable to 12 MGD. This capacity is compared to the existing and future MDDs to determine if the WTP is sized adequately. Note that PHDs are met with distribution system storage tanks, not with the WTP's capacity.

Table 5-1. Available and Required WTP Capacity

Available WTP Capacity (MGD)	Demand Condition	Maximum Day Demand		WTP Capacity Used
		(gpm)	(MGD)	
6	2023 (Existing)	1,730	2.5	42%
	2043 (future)	2,111	3.0	50%

5.2 2015 WTP Process Evaluation

Since the District's last Water Master Plan, the Jeff Davis WTP and associated facilities were evaluated (Mead & Hunt, 2015).Following the recommendations of this evaluation, the District has made the following improvements:

- Installed polymer feed system
- Filters
  - Replaced all filter media
  - Repaired filter #4 underdrain
  - Repaired Filter #1 surface washer
- Filter Effluent Valve replaced with a butterfly vale equipped with a 4-20ma actuator to control flow
- Chlorine system was replaced with an onsite generation unit
- Installed sample pumps to Clearwell Tanks 1 and 2 effluent for water quality monitoring when tank levels are low
- Installed SCADA system to access all WTP controls by remote PLC

5.3 WTP Direct Filtration Evaluation

The WTP was assessed to determine the need to update the current direct filtration treatment process by looking at the following items:

- Current State Water Resources Control Board, Division of Drinking Water (DDW) regulations for direct filtration facilities

- Current WTP Filter Performance

5.3.1 *Current DDW Regulations*

The DDW regulations relative to direct filtration facilities include the following:

- Design Standards
    - Provide for future addition of pretreatment facilities
- Operating Criteria
    - Filtration rates shall not exceed 3 gpm/SF
    - Continuously monitor individual and combined filter effluent turbidities

The Jeff Davis WTP currently operates within these operating criteria.

5.3.2 *Current Filter Performance*

DDW uses turbidity as the measure of filter performance under three rules implemented over the past 30 years:

- Surface Water Treatment Rule (SWTR) - requires the turbidity level in 95% of the combined filter effluent samples be 0.3 NTU or less
- Long Term 1 SWTR (LT1SWTR) - requires turbidity level in 95% of the combined filter effluent to be 0.1 NTU or less
- Long Term 2 SWTR (LT2SWTR) - adds provisions for Cryptosporidium testing and removal that do not apply to the Jeff Davis WTP because it serves a population less than 10,000 people

Per the 2020 Watershed Sanitary Survey for the Upper Mokelumne River (PBI, 2021), 99.6% of the time the filter effluent measured less than 0.1 NTU. This performance is significantly greater than the filter performance required under the SWTR and LT1SWTR.

The only risk associated with keeping the direct filtration pressure filters is when the WTP serves a population greater than 10,000 people and Cryptosporidium is detected in the raw water at a level that would require additional treatment. For reference, the Cryptosporidium levels at the Calaveras County Water District's West Point WTP, which treats water from the same upper Mokelumne River watershed as the Jeff Davis WTP, are below the level that requires additional treatment.

5.3.3 *Recommendations*

It is recommended that the existing direct filtration pressure filters be kept and operated as they are today for the following reasons:

- Direct filtration, while not conventional, is an approved DDW technology
- The existing pressure filters are being operated to significantly exceed the DDW treatment requirements
- Any option to upgrade the filtration process will require pumping between treatment processes
- Upgrading the plant to conventional treatment will require increased Operator Certification Licensing for Chief and Shift Operators which would increase operational staffing expenses for the District

5.4 Regulatory Compliance

Under the most recent version of the SWTR, the Long-Term 2 Enhanced SWTR, Cryptosporidium, Giardia and virus removal credits are a function of the treatment process. The removal credits are divided into two processes: filtration and disinfection. Compliance with the Long-Term 2 Enhanced SWTR is predicated on compliance with combined and individual filter effluent turbidity standards and disinfection “CT” requirements.

Based on the good raw water quality (low turbidity and low total coliform counts), the treatment requirements for the Jeff Davis WTP are set at 3-log Giardia removal and 4-log virus removal. The “alternative” filter technology used at the Jeff Davis WTP is granted 2-log removal credits for Giardia and 1-log removal credit for viruses. The remainder of the treatment requirements are met through disinfection: 1-log Giardia and 3-log virus removal. Table 5-2 summarizes these treatment requirements.

Table 5-2. WTP SWTR Treatment Requirements and Removal Credits

Condition	Giardia Removal	Virus Removal
Total Treatment Requirements	3-log	4-log
Granted Filter Removal Credits	2-log	1-log
Disinfection Removal Requirements	1-log	3-log

The only potential limitation on the WTP’s capacity is the ability to provide disinfection. The disinfection removal requirements for Giardia and viruses are based on the disinfectant concentration (C) and the contact time (T) – or “CT.” Required CT values are a function of water temperature, pH, and disinfectant concentration. The worst case disinfection requirements usually occur during the spring, when water temperatures are low and water demand can be high. CT values for these conditions are about 60 min-mg/L. Based on a chlorine residual level of 1.5 mg/L, the required contact time is 40 minutes.

At the future MDD of 2,111 gpm (3 mgd), the available contact time is 10 minutes total in each clearwell (assuming 7 ft minimum tank level). In addition, there is contact time in the 3500-feet of 27-inch pipeline from the clearwells to the first customer. The contact time available in this pipeline at the future MDD is 49 minutes. The total contact time available (assuming both clearwells are in service) at the future MDD is 68 minutes. Therefore, the WTP's capacity is not limited by disinfection at the future MDD.

CHAPTER 6 – HYDRAULIC MODEL DEVELOPMENT

6.1 Background

California Rural Water Association (CRWA) developed the InfoWater® version of the District's hydraulic model in 2022. The model was used for the *2022 Distribution System Feasibility Study* to address distribution system deficiencies faced by the District.

6.2 Approach

The approach for updating the hydraulic model included:

- Updating the distribution network to include replacements/modifications in the system.
- Incorporating updated demand scenarios for existing and buildout conditions based on the updated demand projections.
- Verifying all control settings in the model with District operations staff.
- Calibrate the model based on field fire flow tests provided by the District.

6.3 Topography

Elevations of the nodes in the hydraulic model were updated based on a Digital Elevation Model (DEM) from the United States Geological Survey (USGS) website. Using ArcMap's "Math" tool, the DEM was converted from units of meters to feet. The Elevation Extractor tool within InfoWater® was used to automatically assign elevations to new nodes based on the DEM from USGS. The elevations on nodes for hydrants and laterals were then cross referenced with Google Earth elevations to ensure accuracy.

6.4 Hydraulic Model Scenario Development

The existing hydraulic model only included one base scenario for existing conditions. To differentiate existing facilities from buildout facilities, a year was assigned to the existing facilities in the model. This was done by assigning every existing facility with the year 1975 if a year was not already assigned. Buildout facilities were assigned with the year 2023 using the same method to allow for different facility selections depending on the scenario.

6.5 Fire Flow Calibration

The District provided previously collected field fire flow tests that were used as a basis for model calibration. The following sections describe how the field fire flow data was utilized and compared to the model.

6.5.1 *Adding Existing Facilities*

The existing model did not originally include any of the District's hydrants or laterals. These hydrants were added in the model as nodes using the fire hydrant GIS shapefile provided by the District. These newly added nodes were given the same Facility ID as the District's Hydrant ID.

Hydrant laterals were drawn in the model to connect the hydrant nodes to the existing pipes. These laterals were given 6-inch diameters with roughness values of 140 according to District standards. These newly added laterals were given the same Facility ID as the Hydrant ID of the connecting node.

6.5.2 *Prior Field Fire Flow Tests*

KASL Consulting Engineers completed field fire flow tests of 34 hydrants throughout the District's system over three days in February 2021 as part of CRWA's model calibration effort. Each test consisted of a flow hydrant and two static/residual hydrants. The configuration of some of the tests provided inconclusive information for calibration use. Fire flow test results were discarded if there was no static pressure result recorded for a hydrant or if there was no flow test conducted. Fire flow test results were discarded if the hydraulic grade line (HGL) of the two static/residual tested hydrants were over 1% difference between each other or if the residual pressure drop at the static hydrant did not exceed 25% (per NFPA guidelines). PBI reviewed the raw data of the 2021 field fire flow tests and identified locations where supplemental tests should be performed by the District. The results from both these field tests can be viewed in Appendix A.

A model fire flow test was conducted on the static/residual test hydrants to compare the model results to the various field fire flow tests. These hydrants were assigned a fire flow of 1,500 gpm and an available flow pressure of 20 psi. Static pressure results were obtained for the hydrants and can be viewed in Appendix D.

The field fire flow tests were extrapolated to 20 psi to compare to the fire flow results from the model. Static pressure and available fire flow results in the model within 10% difference from field results were assumed to be accurately reflecting field conditions per AWWA M32.

6.5.3 *Comparing Static Pressure and Available Fire Flow*

The static pressures from the field tests were also utilized to calibrate the model. Modeled static pressures at the respective fire hydrants were compared to the field tests and results within 10% were considered acceptable.

Investigating the static pressure test results with greater than 10% difference revealed several locations where piping and Pressure Reducing Valve (PRV) adjustments could be made in the model to better reflect field conditions. The model was calibrated and all static pressures were within 10% of those from the field tests.

The available fire flow at 20 psi was compared to the field tests. Investigating the available fire flow results with greater than 10% difference revealed several pressure zones where c-factors could be modified to better reflect field conditions. The model was calibrated, and all available fire flow was within 10% of those from the field tests.

6.5.4 *Adjusting Existing Facilities*

Adjustments to existing PRV settings were made in the model to get the model static pressure results within 10% difference from the field static pressure results. These PRV settings are summarized in Table 6-1.

Table 6-1. PRV Setting Calibration

Valve ID	Valve Location	Original Downstream Pressure Setting	Updated Downstream Pressure Setting
V8080	Mokelumne Hill (MH) Fire PRV 2	25 psi	40 psi
V8024	Golden Strike Road PRV	65 psi	55 psi

In talks with the District, it was determined that the Mokelumne Hill Fire Station PRV in the model set to 40 psi sufficiently represents the system conditions based on the static pressure calibration performed.

For zones that were not within 10% of the field fire flow tests, adjustments to c-factors were made. The original model designated a global c-factor of 120 for all existing facilities; however, much of the District's distribution system is PVC which typically has a higher c-factor ranging from 140-150. The adjustments to c-factors in the model are summarized in Table 6-2. The utilized field fire flow tests and calibration results are summarized in Appendix A.

Table 6-2. C-Factor Calibration

Pressure Zone Name	Pipe Material	Original C-Factor	Updated C-Factor
Railroad Flat	PVC	120	150
Moke Hill FS	CMLS	120	150
Golden Hills	PVC	120	150
Garamendi	PVC	120	140
Tscornia Field	PVC	120	150

It was also discovered that the CRWA model had the dead-end piping along Andreas Vista Drive attached to the outlet piping of the San Andreas Tank instead of the inlet piping as shown on the District's Diamond Maps. This resulted in static pressure discrepancies on test hydrant 7H-70. The dead-end piping was redrawn in the model to connect with the tank inlet piping and the static pressure at the hydrant fell within the 10% difference compared to the field test.

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CHAPTER 7 – DISTRIBUTION SYSTEM CRITERIA

7.1 Evaluation Criteria

The District's *Improvement Standards for Water Systems* (August 2016) established the system evaluation criteria presented in Tables 7-1 to 7-6.

7.1.1 *Flow Requirements*

Table 7-1 presents the flow requirements established in the District's standards. In addition, the 2022 California Fire Code (CFC), Section B105, lists the minimum fire flow for single family dwellings as 1,000 gpm and the minimum fire flow for buildings other than single family dwellings as 1,500 gpm.

Table 7-1. District's Flow Definitions

<table>
<tr><th>Flow Type</th><th colspan="2">Definition</th></tr>
<tr><td>Average Daily Demand (ADD)</td><td colspan="2">(Design Population) * (Average per capita daily flow requirement) + (any commercial, industrial, school demand)</td></tr>
<tr><td>Maximum Daily Demand (MDD)</td><td colspan="2">(ADD) * 2</td></tr>
<tr><td>Peak Hour Demand (PHD)</td><td colspan="2">(ADD) * 3</td></tr>
<tr><td rowspan="5">Fire Flow (FF)</td><td colspan="2">Fire Protection Districts set FF requirements. Minimum requirements listed below:</td></tr>
<tr><td>Single Family/Duplex Residential Areas</td><td>500 gpm</td></tr>
<tr><td>Townhouse/ Multiple Residential</td><td>1,000 gpm</td></tr>
<tr><td>Commercial</td><td>2,500 gpm (or 1,500 gpm with sprinklers)</td></tr>
<tr><td>Industrial</td><td>To be determined</td></tr>
</table>

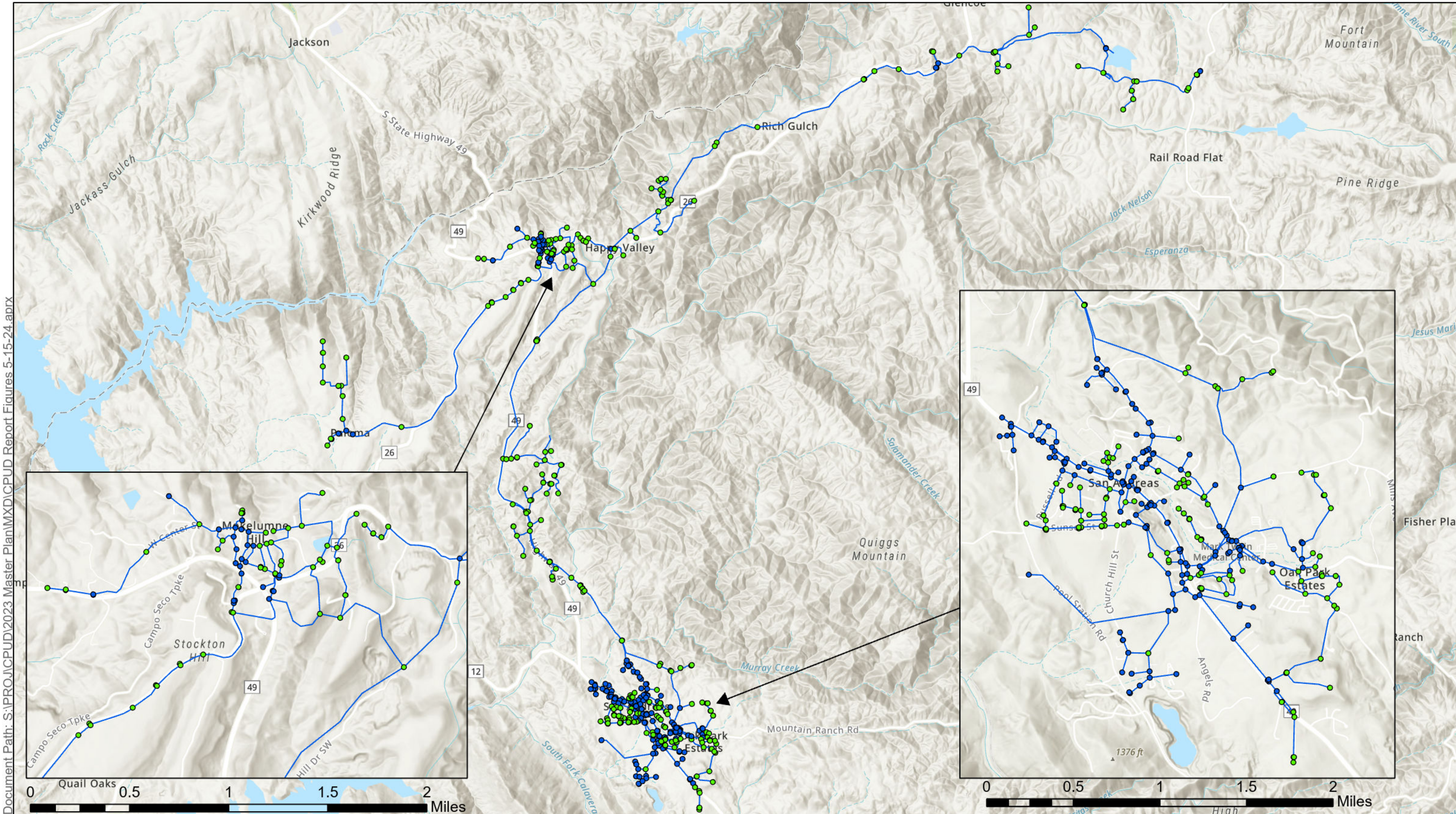
Table 7-2. California Fire Code Minimum Fire Flows

Flow Type	Minimum Requirement
Single Family	1,000 gpm
Buildings other than Single Family Dwellings	1,500 gpm

Since the CFC fire flows exceed the minimum fire flow in the District's standards, the CFC fire flows identified in Table 7-2 will be used as the criteria to evaluate the model results.

Land uses from the 2019 Calaveras County General Plan were imported into the model by downloading land-use shapefiles from the Calaveras County online GIS database. Nodes nearest to the parcels designated as Commercial, Commercial Recreation, Community Center, Historic Center, Industrial, Public/Institutional, Residential High Density, and Residential Medium Density land uses were assigned a fire flow demand of 1,500 gpm. Nodes nearest to the parcels designated as Residential Low Density, Rural Residential, Rural Transition A, and Rural Transition B land uses were assigned as fire flow demand of 1,000 gpm.

The fire flow demands for each node in the hydraulic model are shown in Figure 7-1.



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N

Legend
- Fire Flow Demand = 1,000 gpm
- Fire Flow Demand = 1,500 gpm
- Pipe Network

0 0.5 1 1.5 2 Miles

CALAVERAS PUBLIC UTILITY DISTRICT

Fire Flow Demand Map

FIGURE 7-1

7.1.2 *Piping Requirements*

Table 7-3 presents the District's standard transmission line requirements.

Table 7-3. District's Transmission Line Requirements

Design Component	Requirement
Design Flow Rate	Size line to pass the MDD.
Design Pressure	Enough to maintain the design flow rate to supply water from the source to the storage facility.

The District's standards also describe distribution line requirements. Table 7-4 presents the distribution line requirements for design pressures. For distribution line design flows, lines shall be sized for the higher of the two conditions at the design pressures: PHD or FF + MDD.

Table 7-4. District's Distribution Line Design Pressure Requirements

Design Component	Requirement
Minimum Pressure	35 psi at highest point of lot to be served.
Maximum Pressure	115 psi at lowest point of lot to be served.
FF + MDF	20 psi

Table 7-5 presents the District's allowable distribution pipe velocity ranges for the design flow range. Water industry standard criteria for pipe velocity is to maintain a minimum velocity that will not generate sedimentation and a maximum velocity that will not erode the pipe walls. The California Title 22 Requirements identify 2.5 ft/s as the minimum velocity for pipes and anything below this criterion would require a flushing program. Table 7-6 presents the velocity criteria that were used for the hydraulic model's pipe velocity system analysis to evaluate the model results. Distribution pipes with velocities below 2.5 ft/s will require a flushing program to remove sediment accumulation. Distribution pipes with velocities above 5 ft/s may require replacement to meet minimum pressures and fire flows.

Table 7-5. District's Allowable Distribution Line Velocity Ranges

Pipe Size (in)	Minimum (ft/s)	Maximum (ft/s)
4"	3.0	12
6"	2.5	10
8"	2.5	10
10"	2.5	8

Table 7-6. Velocity Criteria

Velocity	Requirement
Minimum Velocity	2.5 fps
Maximum Velocity	5 fps

Table 7-7 presents the minimum distribution line sizes for different areas in the District's system.

Table 7-7. Minimum Distribution Line Sizes

Area	Minimum Pipe Size (in)	
Single Family Residential/Duplex	6"	
Multiple Residential/Townhouse	Looped System: 6"	Dead-end System: 8"
Commercial	8"	

7.2 Average Day Demand

The average day demand scenario was simulated for existing and 2043 systems to evaluate the worst case scenario high system pressures and water age. System pressures are the highest during low demand periods.

7.3 Maximum Day Demand

The maximum day demand scenario was simulated for existing and 2043 systems to evaluate the supply facilities, pump station capacities, and distribution system performance.

7.4 Peak Hour Demand

Peak hour demand conditions are met by the combined flows from the system's water production facilities and storage reservoirs. A peak hour flow condition was simulated for both the existing and 2043 systems to evaluate the distribution facilities' capabilities and level of service provided. The peak hour demand will provide with worst case scenario for low system pressure.

7.5 Maximum Day Demand Plus Fire Flow

The industry standard is to simulate fire flow during the maximum day demand as a worst case scenario. To evaluate the system under a maximum day plus fire flow condition, the "Fireflow" analysis option in InfoWater was used which looks at each node in the model individually and assesses how much flow is available during a maximum day demand scenario when the node's pressure is set to 20 psi. The purpose of this simulation was to confirm the recommended fire flow improvements and verify that the fire flow standards are met in the proposed development areas.

7.6 Treated Water Storage and Pump Capacity Criteria

According to the District's standards, system storage capacity shall equal the sum of the fire storage reservation (FSR), plus the allowance for system peaking storage (SPS), plus an allowance for emergency storage (ES). The minimum size storage tank should be 250,000 gallons. Table 7-8 presents the District's individual component storage requirements.

Table 7-8. District's Storage Requirements

Storage Type	Requirement
Fire Storage Reservation (FSR)	(FF) * (Fire duration) The minimum design fire duration shall be 4 hours
System Peaking Storage (SPS)	20% of the MDD, assuming 24-hr pumping rate
Emergency Storage (ES)	MDD for 4 hours minimum
Total Storage Required	FSR + SPS + ES

The following table summarizes all of the criteria used for the system analysis.

Table 7-9. Distribution System Analysis Criteria

Criterion	Requirement
Single Family	1,000 gpm
Buildings other than Single Family Dwellings	1,500 gpm
Minimum Pressure (PHD)	35 psi
Maximum Pressure (ADD)	115 psi
Minimum Velocity (PHD)	2.5 fps
Maximum Velocity (PHD)	5 fps

CHAPTER 8 – DISTRIBUTION SYSTEM ANALYSIS

The performance of the existing water system was simulated using the modeling software under three scenarios:

- Average Day Demand (ADD)
- Maximum Day Demand (MDD)
- Peak Hour Demand (PHD)

The modeled results were evaluated against the performance criteria discussed in Chapter 7– DISTRIBUTION SYSTEM CRITERIA. Much of the District's existing distribution system is smaller than the minimum size identified in Table 7-5. The 2043 conditions were simulated with revised facilities that are sized to meet system criteria and maintain the District's minimum pipe standards. Results of the analysis on the existing and 2043 system are presented in the following subsections.

8.1 System Pressures

System pressures are highest during the low demand periods represented by the ADD scenario, and lowest during the PHD scenario. High and low pressures are discussed below.

8.1.1 *High Pressure Areas*

High pressure areas exceeding the District standard of 115 psi maximum have been previously identified in the prior Master Plan. In many cases these high pressures are used by the Hydros to generate electricity. The modeled high-pressure areas of the system for existing and 2043 conditions are shown in Figure 8-1 and Figure 8-2. The high-pressure areas include the areas described below:

1. At the dead-end pipe along Simpson Road in Rail Road Flat, modeled pressure exceeds 130 psi.
2. At the dead-end piping along Independence Road in Glencoe after the Glencoe pump station, modeled pressure exceeds 150 psi.
3. Along the transmission main in Highway 26, prior to the Ponderosa Hydro modeled pressure exceed 230 psi.
4. Along the transmission main in Highway 26, prior to the MCV Hydro modeled pressures exceed 200 psi.
5. At the dead-end piping east of Jojoba Lan, modeled pressure exceeds 140 psi.

6. Along the transmission main towards the Mokelumne Hill Tank and prior to Garamendi's Hydro, modeled pressures exceed 150 psi.
7. Along the transmission main along SW Sport Hill Road, prior to Garamendi's Hydro modeled pressures exceed 250 psi.
8. Near the intersection of Easy Bird Road and Center Street in Mokelumne Hill, modeled pressures exceed 160 psi.
9. East of the intersection of Highway 49 and Highway 26, modeled pressures exceed 130 psi.
10. At the dead-end of Miwok Trail beyond Victor Court in Mokelumne Hill, modeled pressures exceed 125 psi.
11. Just prior to the closed valve along Main Street in Mokelumne Hill, modeled pressure exceed 140 psi.
12. Along Center Street and Highway 49 in Mokelumne Hill modeled pressures approach 150 psi at the westernmost end of the pipeline.
13. Along the pipeline along Highway 26 west of Howard Lane, modeled pressures exceed 130 psi.
14. At the end of Lawson Road in Paloma, modeled pressures exceed 120 psi.
15. At the dead-end pipe along Paloma Road in Paloma, modeled pressures exceed 130 psi.
16. Along Lombardi Drive, at the Golden Hills Subdivision entrance, and along Hallas Drive, modeled pressures approach 180 psi.
17. Along Highway 49 south of the Garamendi Hydro and onto Gold Strike Road near Leanoard Road, modeled pressures exceeded 250 psi.
18. Along Gold Strike Road north of Cemetery Avenue modeled pressure exceed 150 psi.
19. Along Lewis Ave south toward Pope Street, pressures exceed 150 psi.
20. The area encompassed by Toyon Court/Toyon Drive, and Mountain Ranch Road from Highway 49 to Park Drive, pressures exceed 130 psi.
21. The area encompassed by W St Charles Street, Gold Oak Road, and Pool Station Road, pressure exceeds 120 psi.

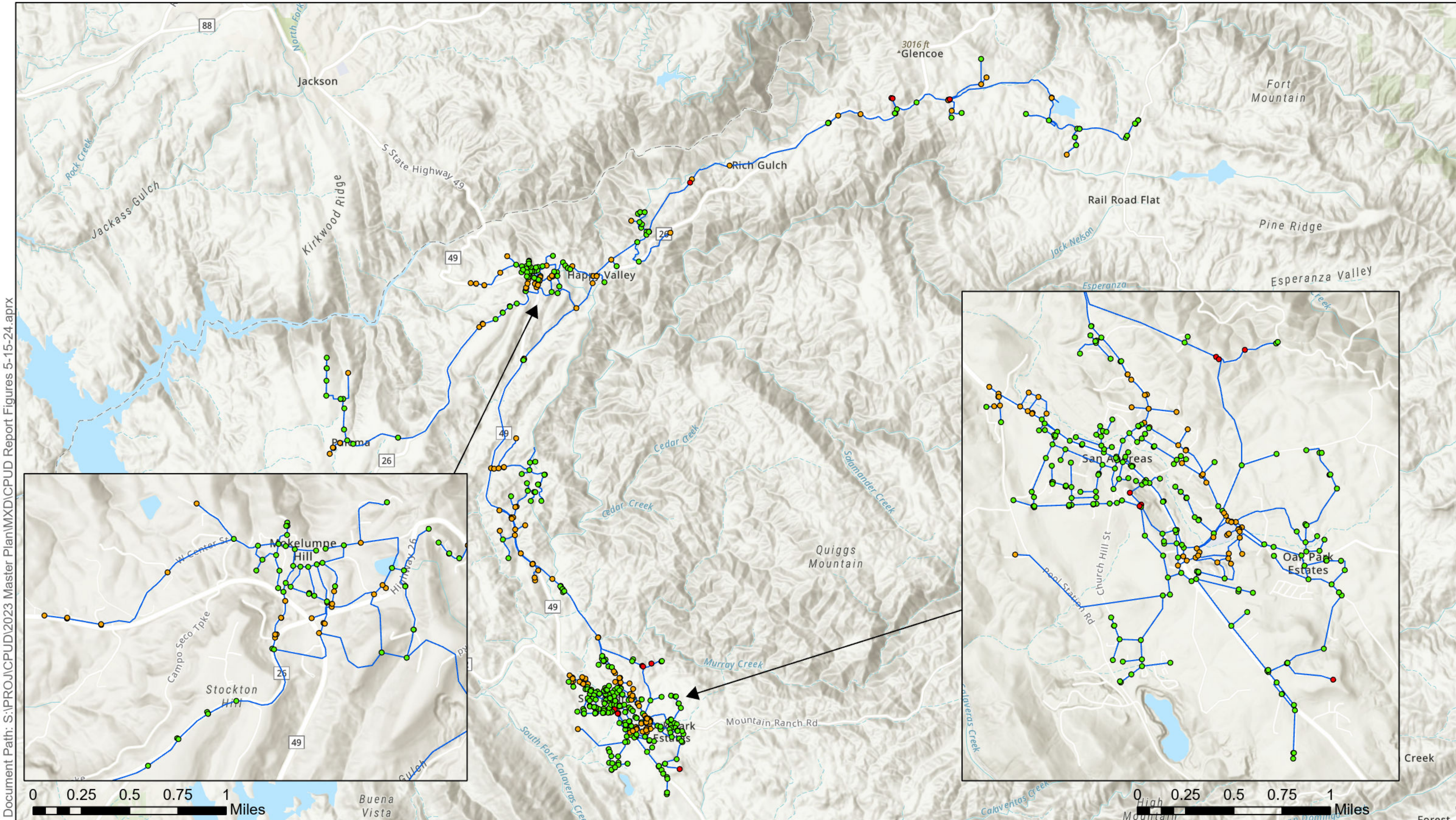
High pressure areas identified for the existing ADD scenario are tempered by the increase in ADD. Overall, the higher pressures drop by a few psi due to increased head losses due to the projected increase in ADD by approximately 25% through 2043. System demands are low compared to the fire flow demands, so there are insignificant head losses and an insignificant pressure difference between existing and future conditions.

Some of these high pressures have existed for many years and may pose no problem to the integrity of the transmission or distribution systems. The San Andreas Tank elevation requires the high pressures in the transmission main to fill the tank. Reducing pressures along the transmission route would not allow the storage tanks to fill and is not a feasible solution. High pressure areas in low-elevation valleys are expected and can be difficult to mitigate.

Reducing pressure into the Golden Hills subdivision would reduce the low residual pressure (modeled as approximately 6 psi) at the Golden Hills Tank that is already experienced during high demand periods. A similar low-pressure condition exists at the southern end of Saddleback Drive (approximately 29 psi during high demand). Reductions in the San Andreas Tank Zone pressure mains to reduce high pressure areas will result in a further reduction in the Saddleback Drive pressure.

PRVs can be installed in isolated areas that have high pressures to create new pressure zones and reduce high pressure levels. Pressure reducing stations that are installed to reduce pressures based on existing ADD can be adjusted in the future to increase pressure downstream due to head losses because of the increased ADD projected for 2043.

No improvements are recommended for high pressures in the vicinity of the hydro stations as high pressures are not anticipated to pose a problem to the transmission main. The remaining high pressure areas that are in isolated locations may be considered for additional PRVs to create new pressure zones.



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Legend
- Pressure > 115 psi
- Pressure < 35 psi
- Pressure between 35-115 psi
- Pipe Network

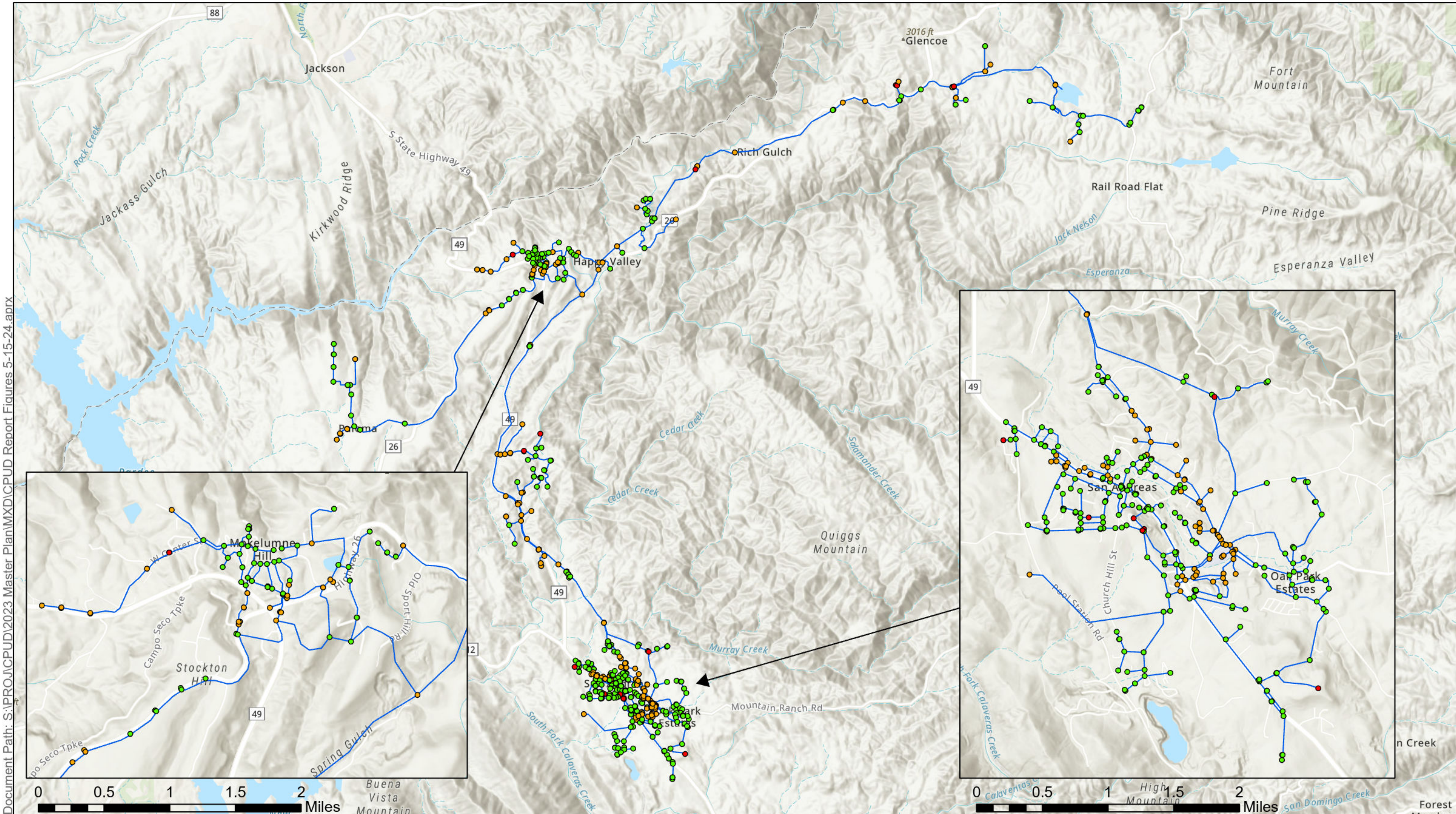
0 1 2 3 4 Miles

CALAVERAS PUBLIC UTILITY DISTRICT

Existing ADD Pressure Map

FIGURE

8-1



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Legend

- Pressure > 115 psi
- Pressure < 35 psi
- Pressure between 35-115 psi
- Pipe Network

0 1 2 3 4 Miles

CALAVERAS PUBLIC UTILITY DISTRICT

2043 ADD Pressure Map

FIGURE

8-2

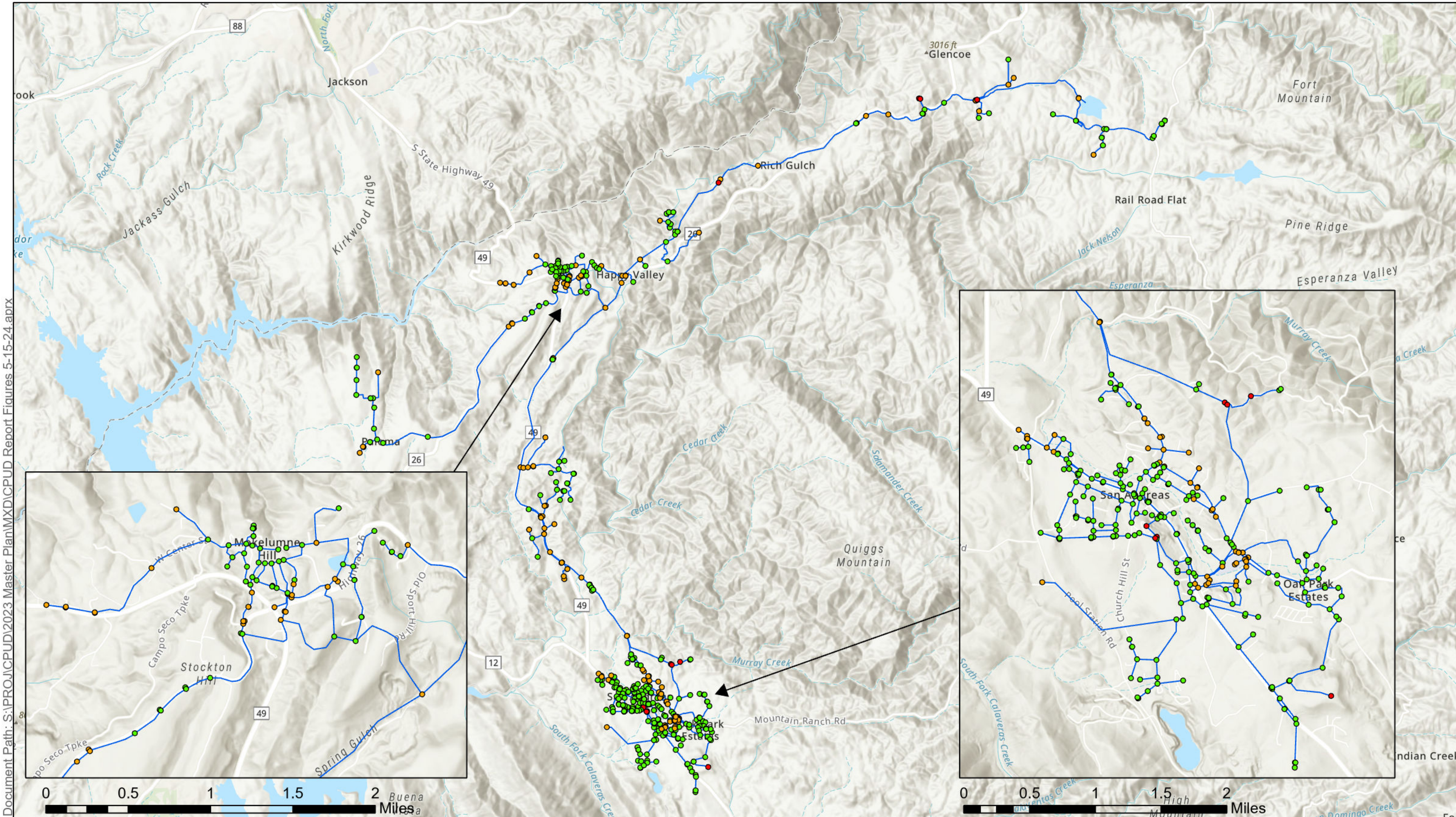
8.1.2 *Low Pressure Areas*

Areas of low pressure modeled in the PHD scenario include areas near the water tanks, and at higher elevations in the distribution system. The modeled low-pressure areas for existing and 2043 systems are shown in Figure 8-3 and Figure 8-4. The low-pressure areas include the areas described below:

1. The area on the discharge side of the Rail Road Flat Tank before the Rail Road Flat pump station, modeled pressures are less than 10 psi.
2. The area in the immediate vicinity of the suction side of the Glencoe pump station, model pressures are around 10 psi.
3. At the dead-end piping on Stormy Lane, model pressures are around 20 psi.
4. The transmission pipeline immediately downstream of the MCV hydro, modeled pressure is around 30 psi.
5. The immediate vicinity of the inlet side of the San Andreas tank, modeled pressures are around 20 psi.
6. The area downstream of the Cemetery/Church Hill PRV #2, modeled pressures are around 5 psi.
7. At the dead-end of Saddleback drive, modeled pressures are less than 25 psi.

The low pressures in the immediate vicinity of storage tanks are generally expected, and frequently accepted if there are no customer connections. However, the low inlet side pressure of the Golden Hill Tank causes concern, especially if future demands cause a further reduction in pressure, causing an inability to fill the tank for the subdivision. The 6 or 7 psi pressure is insufficient to fill the tank completely, especially during the hottest times of the year when water demand is highest. It is recommended that the Golden Hills tank be abandoned by upsizing the 2-inch connection to the transmission main at Lombardi Drive to an 8-inch pipe. The 2043 system was simulated considering the abandonment of the Golden Hills Tank and feeding the subdivision off the adjacent transmission main.

The preferred solution to low pressures is to upsize the pipe unless the pipeline is located at a dead end. Instead, dead-end pipelines could be equipped with hydropneumatics systems if low pressures are unacceptable. Customers near the dead-end piping on Stormy Lane and Saddleback Drive could be equipped with a customer owned hydropneumatic tank system because attempting to increase pressure in the pressure zone would lead to increased pressures in areas already experiencing high pressures.



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Legend

- Pressure > 115 psi
- Pressure < 35 psi
- Pressure between 35-115 psi
- Pipe Network

0 1 2 3 4 Miles

CALAVERAS PUBLIC UTILITY DISTRICT

Existing PHD Pressure Map

FIGURE

8-3

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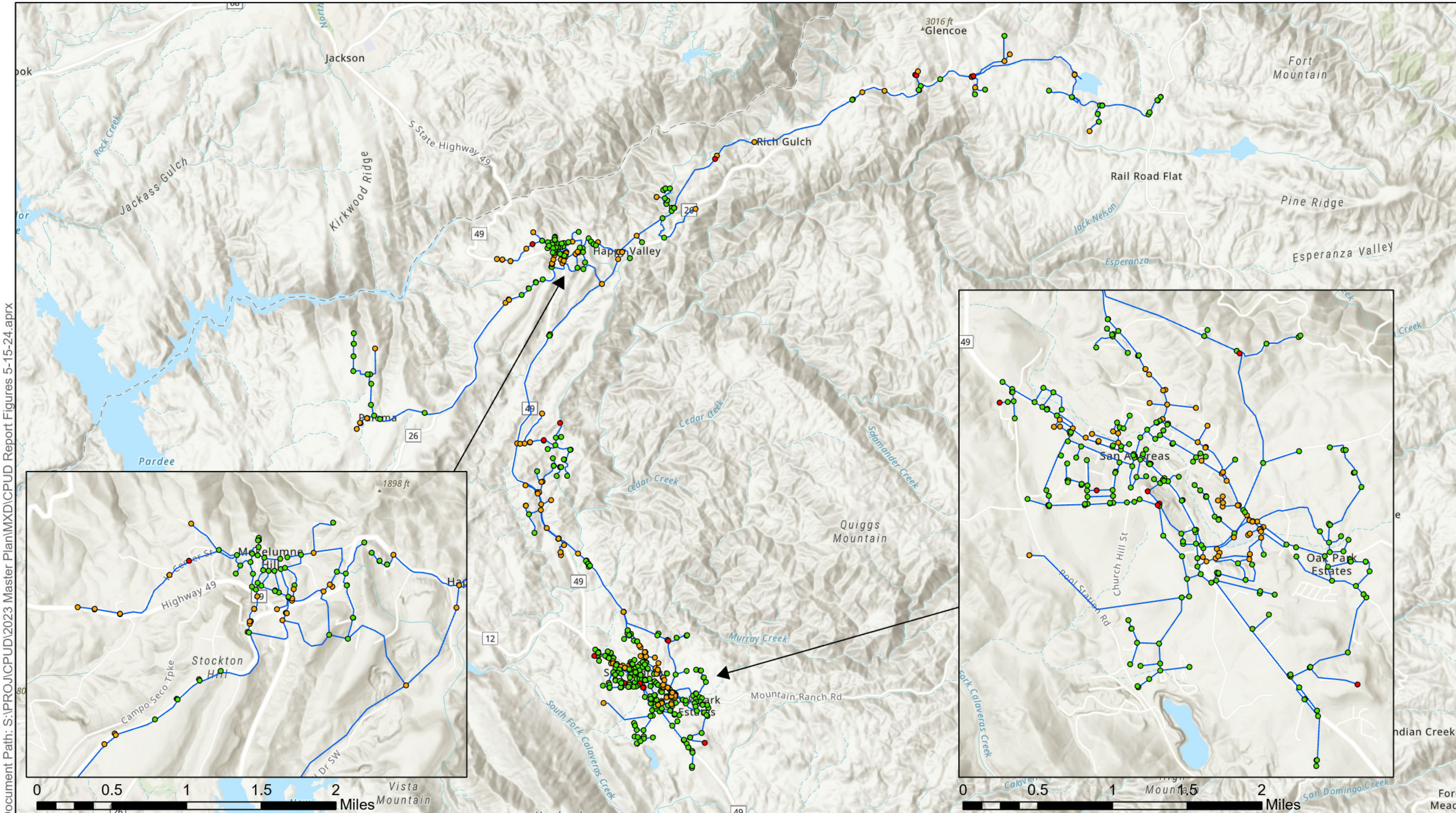

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- Pressure > 115 psi
- Pressure < 35 psi
- Pressure between 35-115 psi
- Pipe Network

0 1 2 3 4 Miles

CALAVERAS PUBLIC UTILITY DISTRICT

2043 PHD Pressure Map

FIGURE

8-4

Low pressures on the main transmission line between the WTP and the and the Ponderosa hydro, the Glencoe pump station area, are difficult to increase without making major modifications to the Jeff Davis Clearwells system (e.g., elevating the Clearwells). Individual hydropneumatic systems for local customers are appropriate for boosting the pressure off the transmission line near the Glencoe pump station.

The low pressures downstream of the Cemetery/Church Hill PRV #2 can be increased by raising the PRV setting from 7 psi to 27 psi to get the low-pressure nodes to a minimum of 20 psi.

8.2 Velocity in District Pipelines at PHD

Figure 8-5 and Figure 8-6 present the modelling results for pipeline velocities throughout the District's transmission and distribution system for existing and 2043 conditions.

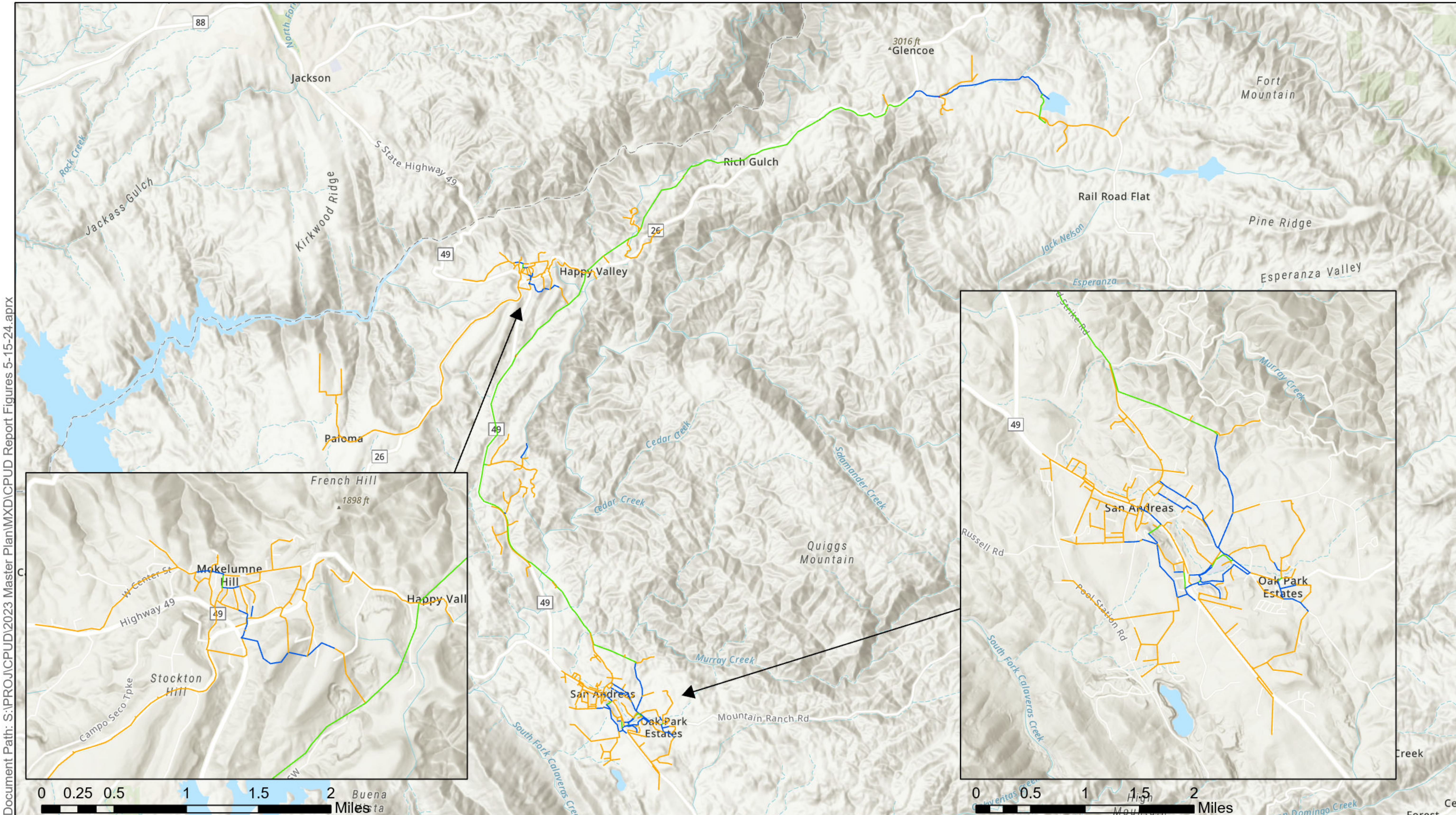
8.2.1 *Transmission Piping*

All transmission lines in the water system meet the criteria of passing the existing PHD with the velocity of the water at 5 ft/s or less for both existing and 2043 conditions. Flow velocity in the largest 27-inch diameter transmission lines is around 1.5 foot per second and in the 18-inch diameter transmission lines is around 3 feet per second during the existing PHD. The PHD flows rarely occur, and rarely require pipeline replacement to stay within a standard velocity. In this case, the velocity is less than the standard, so no replacement is recommended due to excessive velocity.

8.2.2 *Distribution Piping*

The only distribution pipelines that exceed the velocity of 5 ft/s during the future PHD in both existing and 2043 conditions is the 4-inch suction piping into the Glencoe pump station (15 ft/s), the 2-inch piping at the Ponderosa Hydro station that makes up the furthest south-eastern line at the hydro station (43 ft/s), and the 12-inch piping at the inlet and outlet of the 10" PRV at the Garamendi Hydro 3 station (6 ft/s). The suction piping at the Glencoe pump station is recommended to be upsized. No action is recommended at the hydro station locations as higher velocities are anticipated.

With the exception of the transmission mains, a vast majority of the distribution pipelines have velocities less than 2.5 ft/s. Therefore, all distribution pipelines are recommended to be placed on a flushing program by the District to ensure any sediment that settles under low-velocity conditions gets flushed out of the system.



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Legend

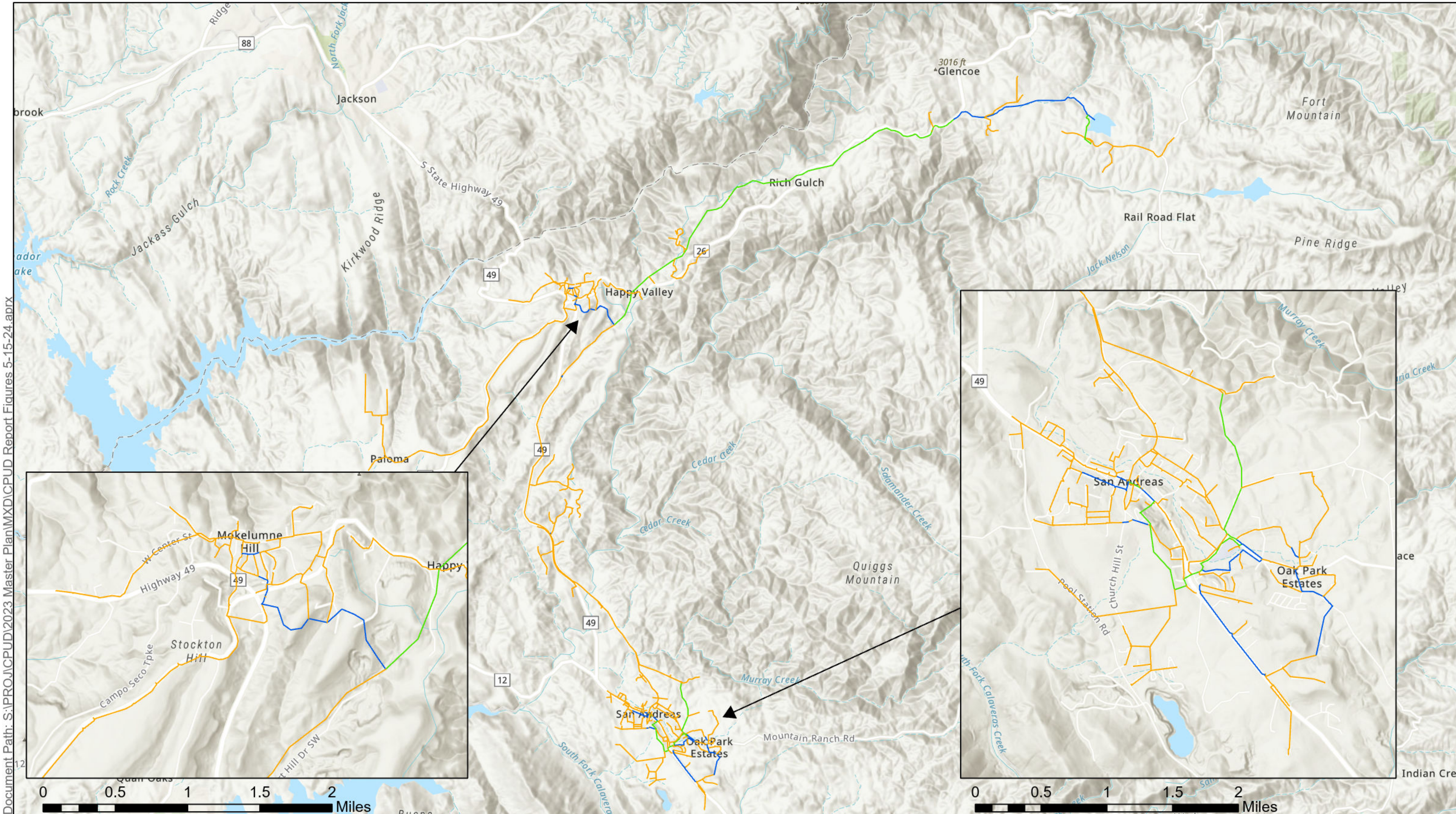
- Pipe Velocity between 1-2.5 ft/s
- Pipe Velocity between 2.5-5 ft/s
- Pipe Velocity < 1 ft/s
- Pipe Velocity > 5 ft/s

0 1 2 3 4 Miles

CALAVERAS PUBLIC UTILITY DISTRICT

Existing PHD Velocity Map

FIGURE 8-5



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Legend
- Pipe Velocity between 1-2.5 ft/s
- Pipe Velocity between 2.5-5 ft/s
- Pipe Velocity < 1 ft/s
- Pipe Velocity > 5 ft/s

0 1 2 3 4 Miles

CALAVERAS PUBLIC UTILITY DISTRICT

2043 PHD Velocity Map

FIGURE 8-6

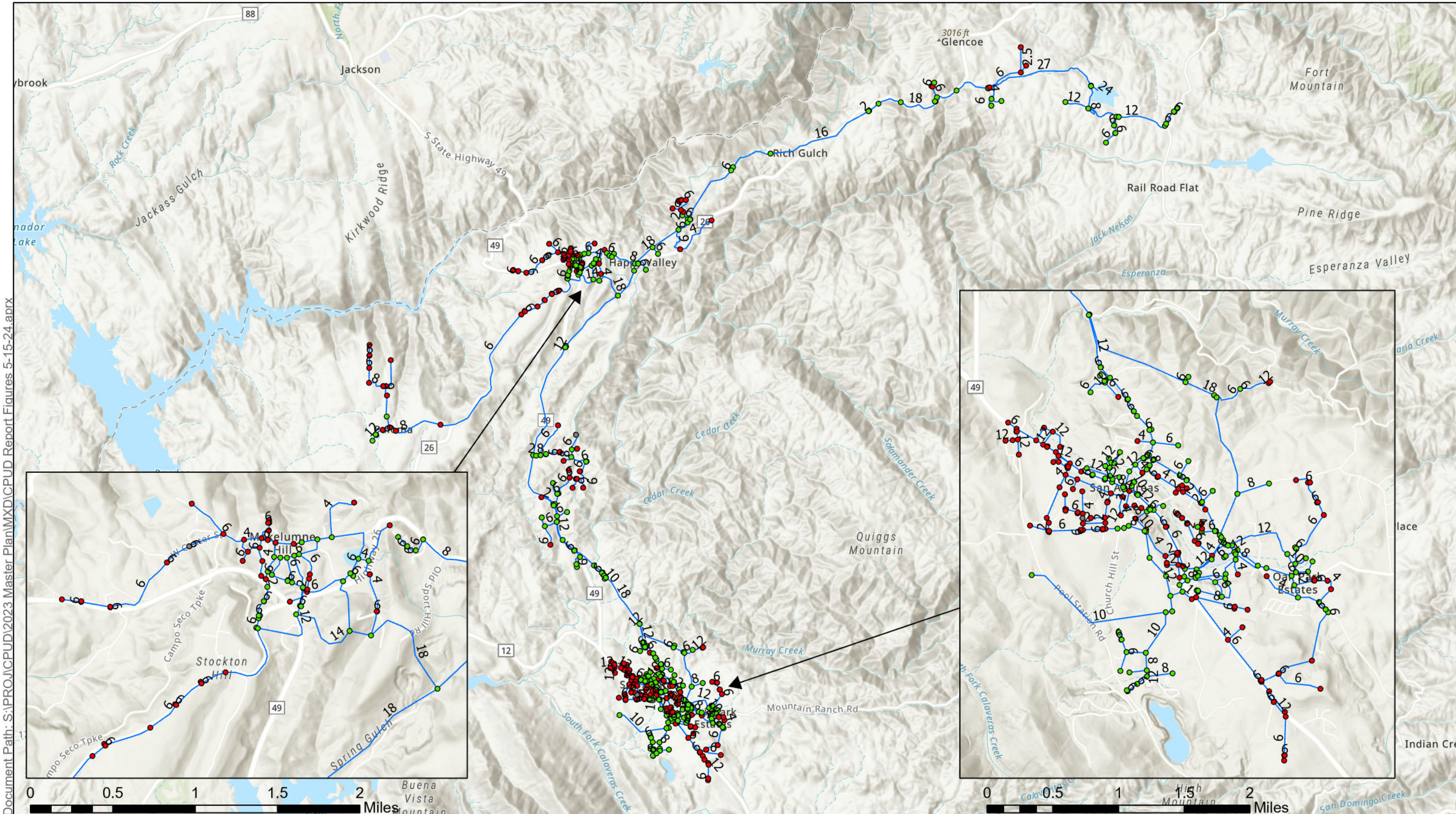
8.3 Fire Flow Analysis

A fire flow analysis was performed on the hydraulic model, calculating the available fire flow during MDD with a minimum residual pressure of 20 psi at the hydrant (node) and a minimum pressure of 20 psi anywhere in the system. The fire flow analysis ignored low pressure nodes near tanks and at extreme elevations, such as at the southern end of Saddleback Drive in San Andreas.

Figure 8-7 presents the available fire flow during 2043 MDD on the existing distribution system. The modelling results indicate that more than one-third of the nodes cannot serve their assigned fire flow demand without reducing pressure at the hydrant node or somewhere else in the system below 20 psi. A majority of the fire flow deficiencies are in areas that do not comply with the District’s minimum distribution main sizes.

Increasing the distribution piping can help mitigate the available fire flow through the system. Figure 8-9 shows the distribution system with upsized pipelines to comply with the District’s minimum distribution main sizes and address existing and future fire flow requirements. Figure 8-8 shows the updated available fire flow with the proposed piping improvements incorporated.

Note that the existing pipelines do not require immediate replacement as the system is otherwise performing adequately. These pipelines can be upsized to provide the required fire flow with the District’s pipeline replacement program over time. Appendix B includes a list of all recommended pipeline improvements to address available fire flow. The areas that currently have a majority of undersized 4-inch mains are within the San Andreas and San Andreas West pressure zones. Therefore, it is recommended that these pressure zones be prioritized over other pressure zone for annual pipeline replacement.



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N

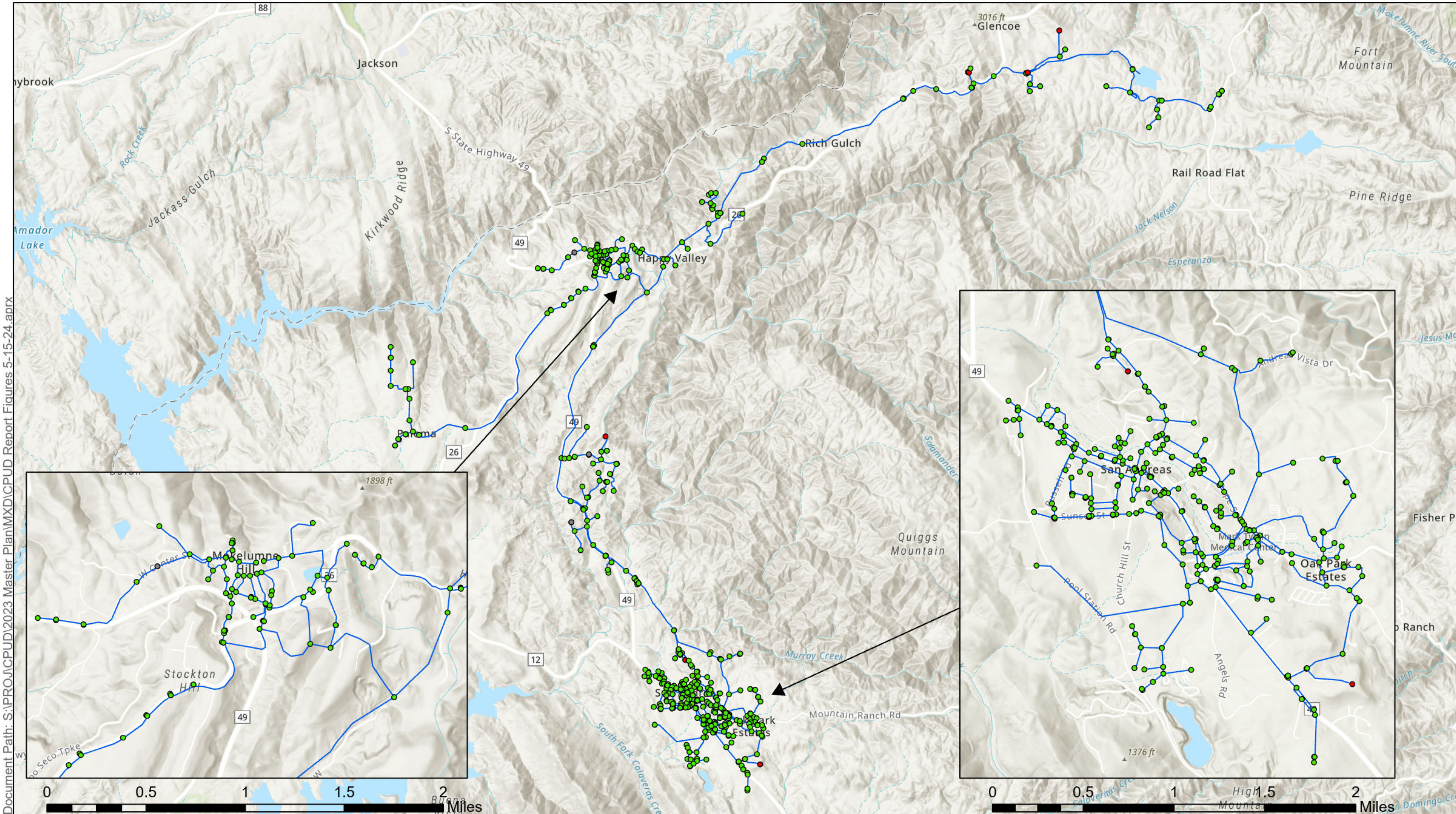
Legend
- Compliant
- Non-compliant
- Pipe Network

0 1 2 3 4 Miles

CALAVERAS PUBLIC UTILITY DISTRICT

2043 Fire Flow with Existing Facilities

FIGURE
8-7



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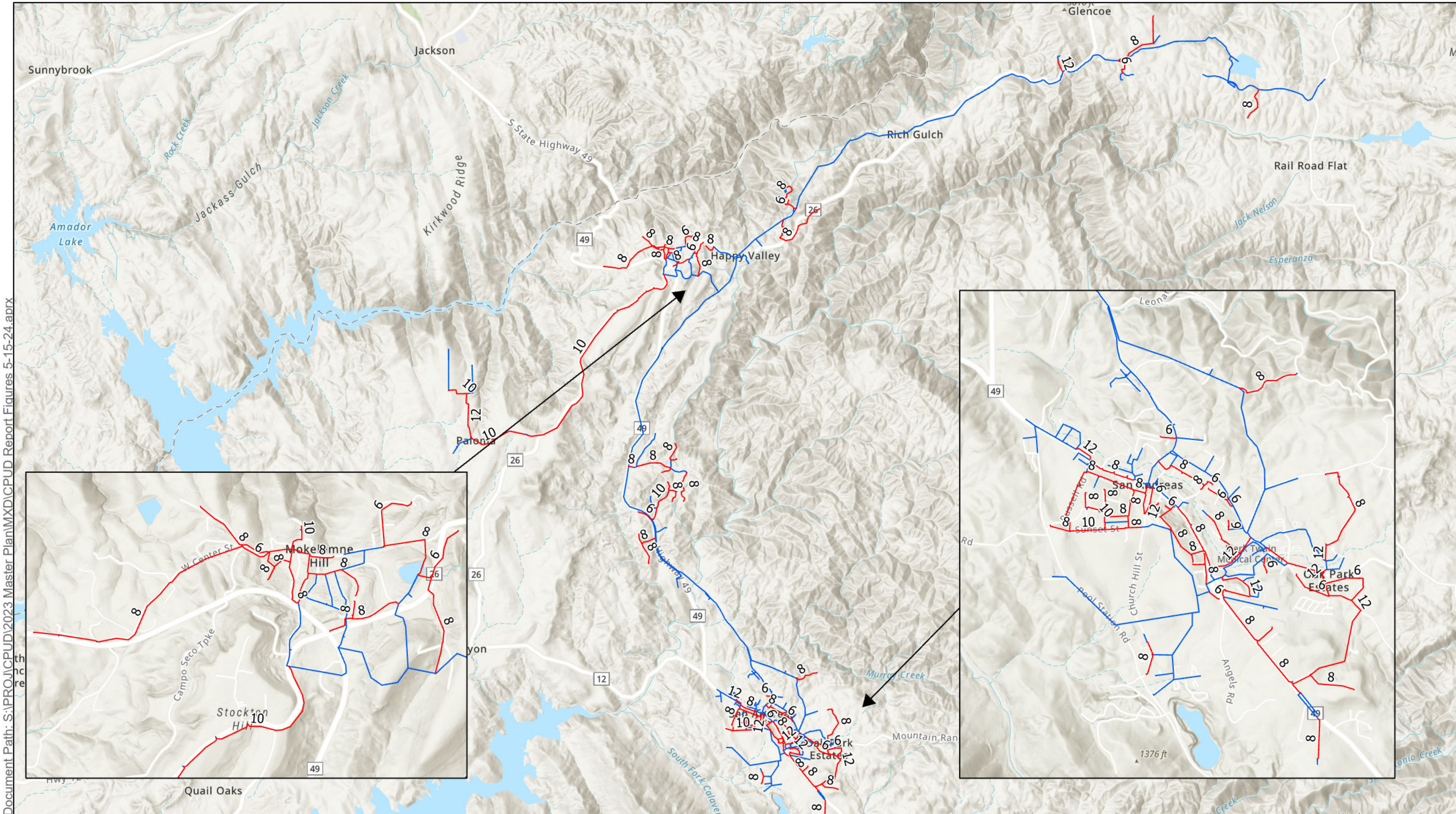
Legend
- Compliant
- Non-compliant
- Pipe Network

0 0.75 1.5 2.25 3 Miles

CALAVERAS PUBLIC UTILITY DISTRICT

2043 Fire Flow with Proposed Improvements

FIGURE 8-8



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Proposed Improvements

0 0.35 0.7 1.05 1.4
Miles

CALAVERAS PUBLIC UTILITY DISTRICT

FIGURE 8-9

Proposed Improvements

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8.4 Storage Tank Capacity

The storage tanks were evaluated for capacity in accordance with the District standards presented previously. The standards are:

- Fire Storage Reservation (FSR, gallons): Minimum volume of 4 hours times the largest fire flow requirement supplied by the tank.
- System Peaking Storage (SPS, gallons): 20% of the MDD applied to 24 hours.
- Emergency Storage (ES, gallons): 4 hours of MDD.

To calculate volumes for the storage requirements, the hydraulic model was run in the MDD scenario, and demands drawn from the storage tank were tabulated, and requirements calculated. The storage requirements for each of the tanks in the water system, excluding the Clearwells are provided in Table 8-1. The Golden Hills Tank is planned to be abandoned so the demand for this zone is accounted for in the calculation for the Mokelumne Hill Tank.

Table 8-1. Storage Tank Capacity Analysis

Storage Tank Name	Nominal Capacity (gallons)	Existing MDD (gpm)	2043 MDD (gpm)	Highest Fire Flow Requirement in the Tank's Zone (gpm)	Fire Storage Reservation (gallons)	System Peaking Storage (gallons)	Emergency Storage (gallons)	Total Storage Tank Volume Requirement (gallons)
Rail Road Flat Tank	500,000	47	58	1,500	360,000	16,704	13,920	390,624
Mokelumne Hill Tank	1,500,000	401	600	1,500	360,000	172,800	144,000	676,800
Golden Hills Tank[1]	40,000	90	N/A	1,000	240,000	N/A	N/A	N/A
Paloma Tank	120,000	67	84	1,500	360,000	24,192	20,160	404,352
San Andreas Tank	2,800,000	972	1,180	1,500	360,000	339,840	283,200	983,040
Total	4,960,000							2,214,816

[1]Golden Hills Tank is planned to be abandoned

The calculations reveal storage tank volume deficit of 404,352 gallons for the Paloma Tank; however, the Mokelumne Hill Tank is upstream of this tank in the distribution system. Therefore, the excess storage capacity in the Mokelumne Hill Tank can be allocated towards these storage volume deficits, leaving the Mokelumne Hill Tank with a remaining excess of 538,848 gallons. The storage capacity analysis for the future MDD demands indicates that storage volume requirements are met per the District standards. In addition, the District also has an additional 1,000,000 gallons of available upstream storage in the two Jeff Davis WTP Clearwells.

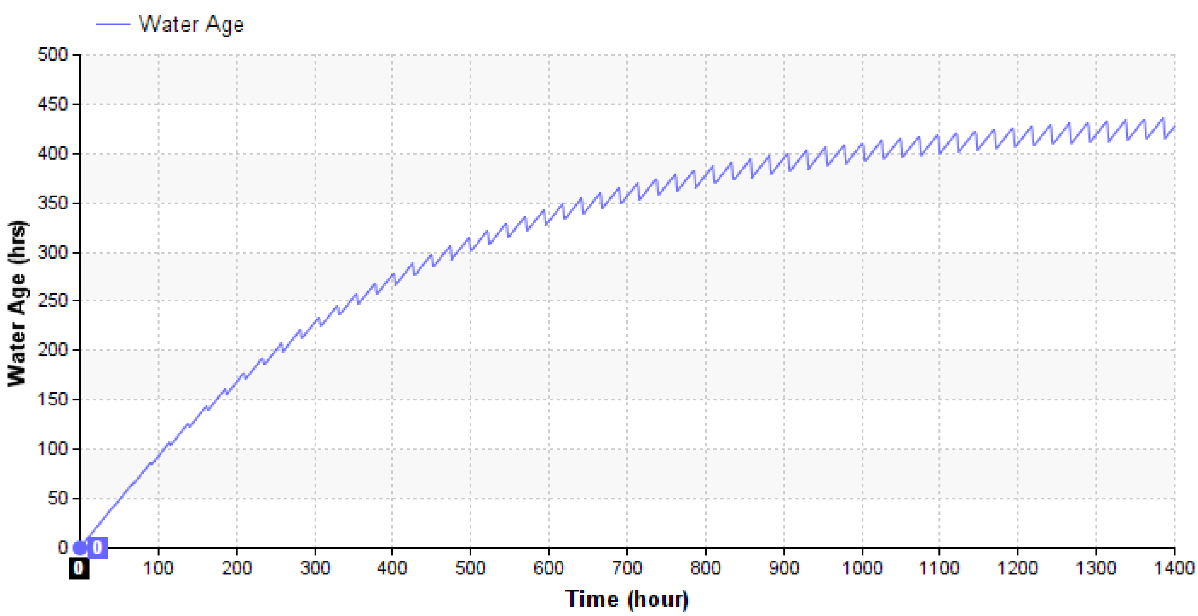
8.5 Water Age

Water age is a major factor in water quality deterioration within the distribution system. As water ages, there is a greater potential for Disinfection By-Product (DBP) formation. The EPA's "Effects of Water Age on Distribution System Water Quality" cites examples of "short" (less than 3 days) and "long" (greater than 3 days) water ages. The water age was evaluated for each storage tank during existing ADD conditions and combined for the overall distribution system. To analyze the water age, an extended period simulation was run up to 1,400 hours.

8.5.1 *Rail Road Flat Tank*

Figure 8-10 shows the existing water age at the Rail Road Flat Tank. The water age steadily increases over the 1,400 hour simulation. The water age at the end of the simulation is 427 hours, or about 18 days. This large water age does not stabilize due to the low water demand in the Rail Road Flat area.

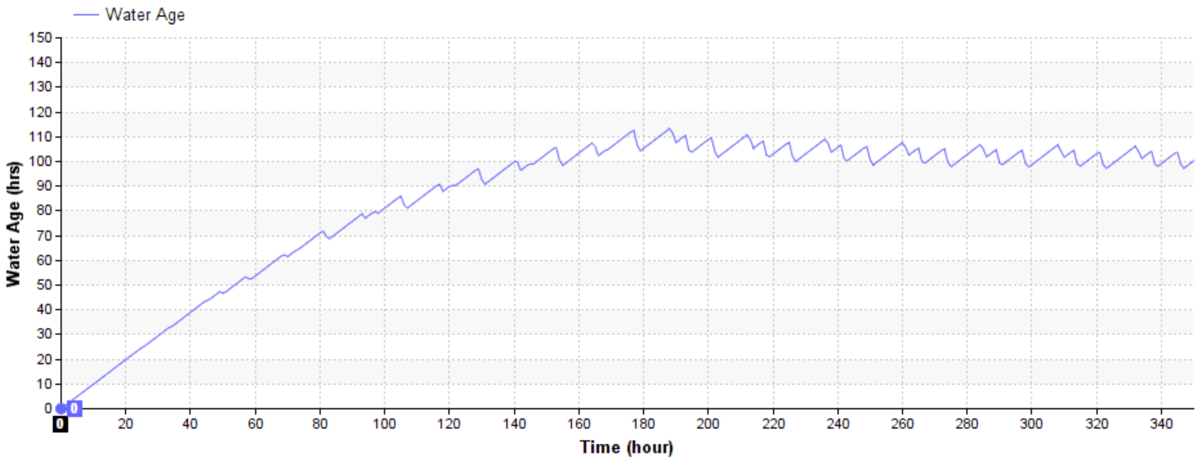
Figure 8-10. Rail Road Flat Tank Existing Water Age



8.5.2 *Mokelumne Hill Tank*

Figure 8-11. shows the existing water age at the Mokelumne Hill Tank. The water age stabilizes at a maximum peak of about 110 hours, or about 4.5 days, after 210 hours of simulation.

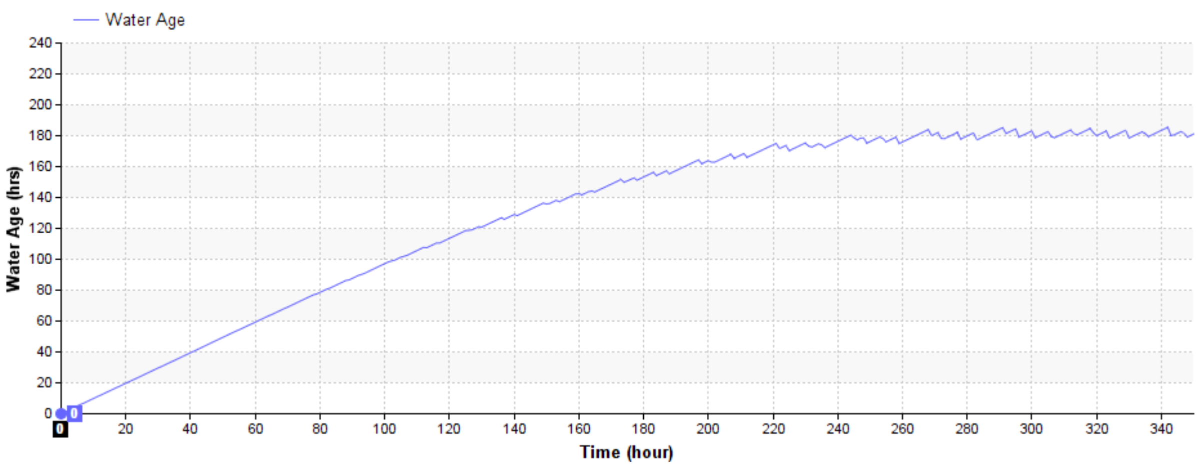
Figure 8-11. Mokelumne Hill Tank Existing Water Age



8.5.3 *Paloma Tank*

Figure 8-12 shows the existing water age at the Paloma Tank. The water age stabilizes at a maximum peak of about 180 hours, or about 7.5 days, after 300 hours of simulation.

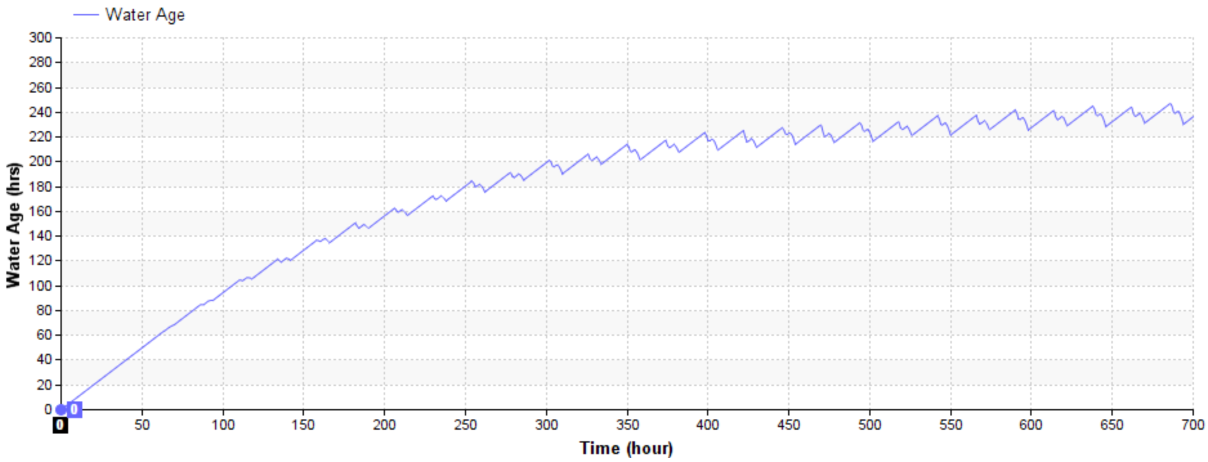
Figure 8-12. Paloma Tank Existing Water Age



8.5.4 *Golden Hills Tank*

Figure 8-13. shows the existing water age at the Golden Hills Tank. The water age stabilizes at a maximum peak of about 240 hours, or about 10 days, after 700 hours of simulation. However, the Golden Hills Tank is planned to be abandoned.

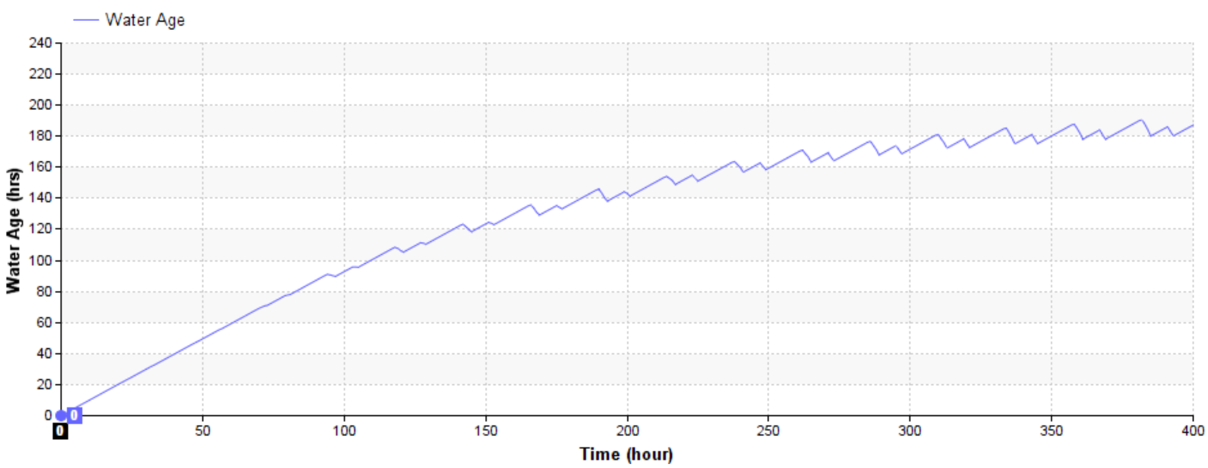
Figure 8-13. Golden Hills Tank Existing Water Age



8.5.5 *San Andrea Tank*

Figure 8-14 shows the existing water age at the San Andreas Tank. The water age stabilizes at a maximum peak of about 180 hours, or about 7.5 days, after 380 hours of simulation.

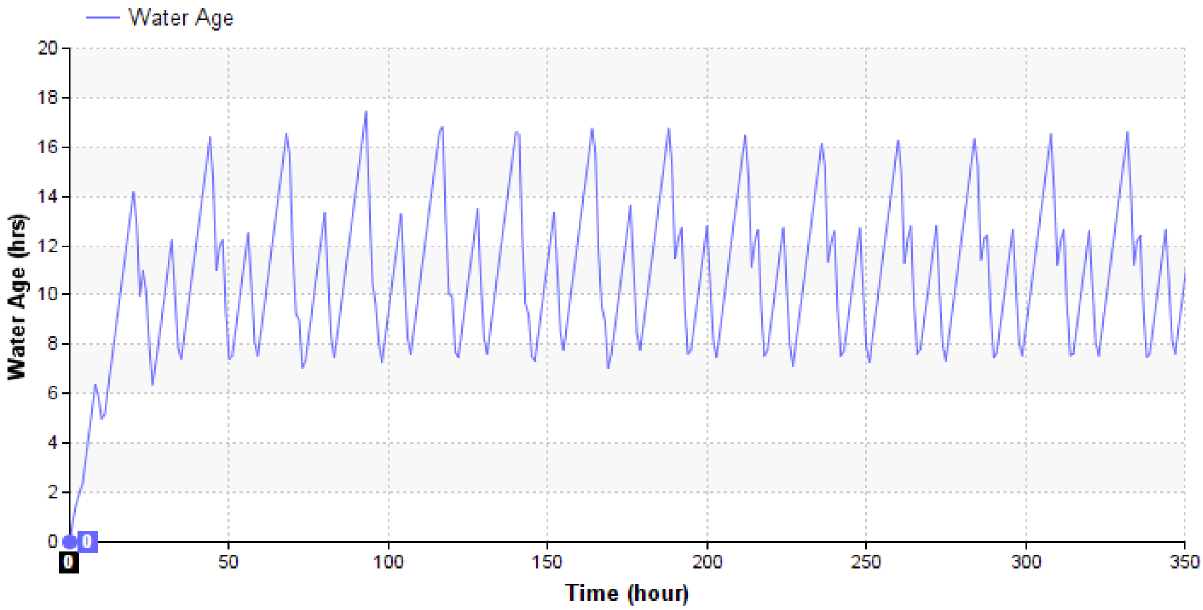
Figure 8-14. San Andreas Tank Existing Water Age



8.5.6 *Jeff Davis Clearwells*

Figure 8-15 shows the existing water age at one of the Jeff Davis Clearwells. The water age stabilizes at a maximum peak of about 17 hours, or 0.7 days, after 90 hours of simulation. This short water age is due to the Clearwell feeding the entire water system with a high turnover rate.

Figure 8-15 . Jeff Davis Clearwell Existing Water Age

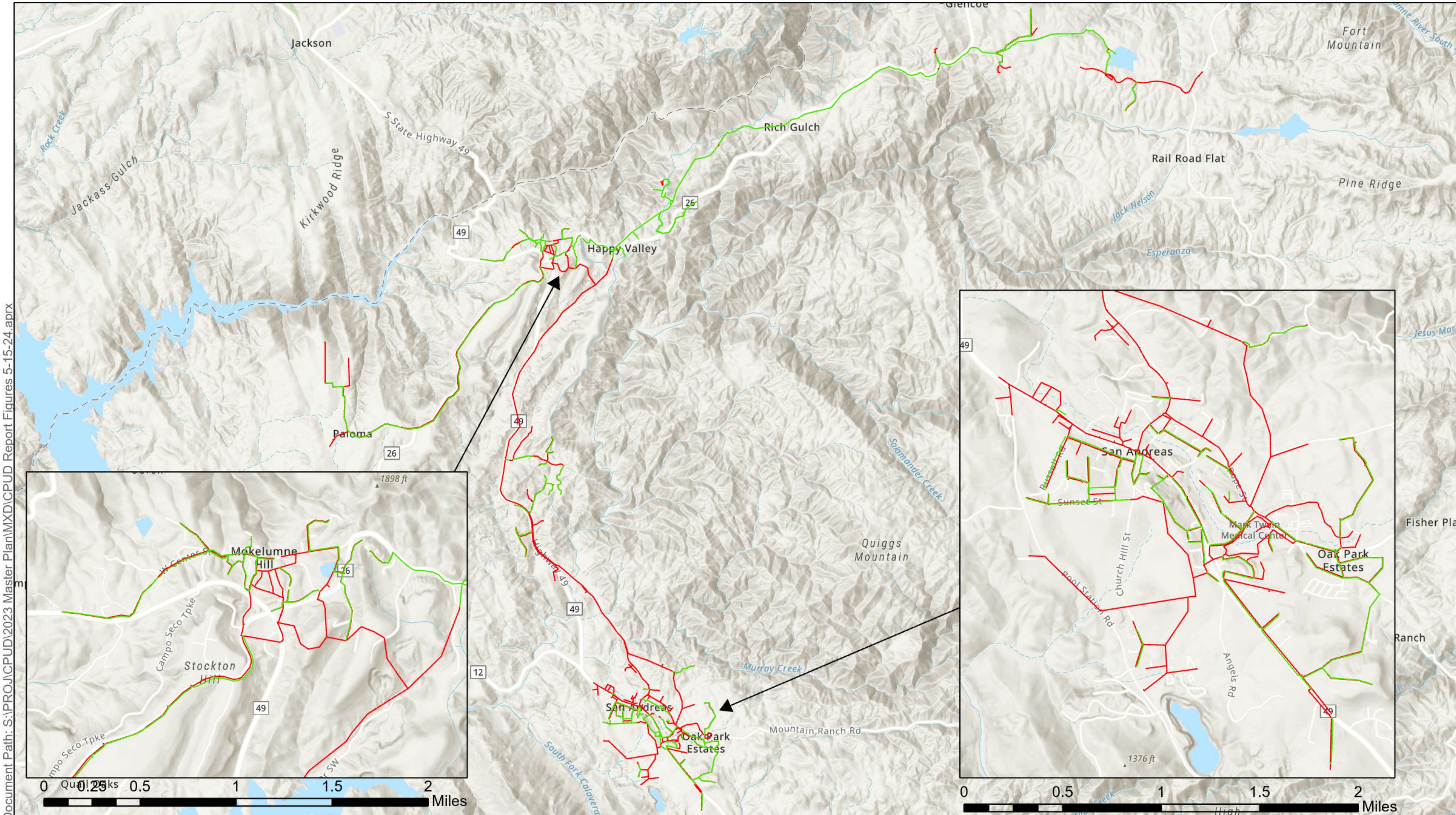


8.5.7 *Overall Distribution System*

Figure 8-17 and Figure 8-18 summarize the overall maximum water age from the extended period simulation for the District's distribution system piping.

As the District's system serves more people and water demands increase, water age will lessen throughout the distribution system. Longer water age can lead to water quality issues such as high disinfection byproducts (DBPs) including total trihalomethanes (TTHM) and five haloacetic acids (HAA5). Per the District's recent Consumer Confidence Reports, the maximum TTHM level was 56 ug/L (MCL = 80 ug/L) in 2020 and the maximum HAA5 level was 37 ug/L (MCL = 60 ug/L) in 2019. Since DBP water quality issues are not a current issue for the District, actions do not need to be currently taken to address the long water ages present in the system. It is recommended to continue monitoring water quality and DBP levels in the system to ensure the long water age does not negatively impact the District's customers.

If water quality and DBP formation becomes an issue for the District, it is recommended to provide a mixing system in all the storage tanks, except for the Jeff Davis Clearwells, to reduce water age, thermal stratification, and the overall temperature in the tanks. Higher water temperatures can increase formation of DBPs as the chemical reactions proceed faster at higher temperatures. Also, higher water temperatures often cause a higher chlorine demand, requiring an increased disinfectant dose and resulting in higher DBP formation potential.



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N

Legend
- Water Age > 3 Days
- Water Age < 3 Days

0 0.5 1 1.5 2 Miles

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Existing ADD Water Age Map

FIGURE 8-16

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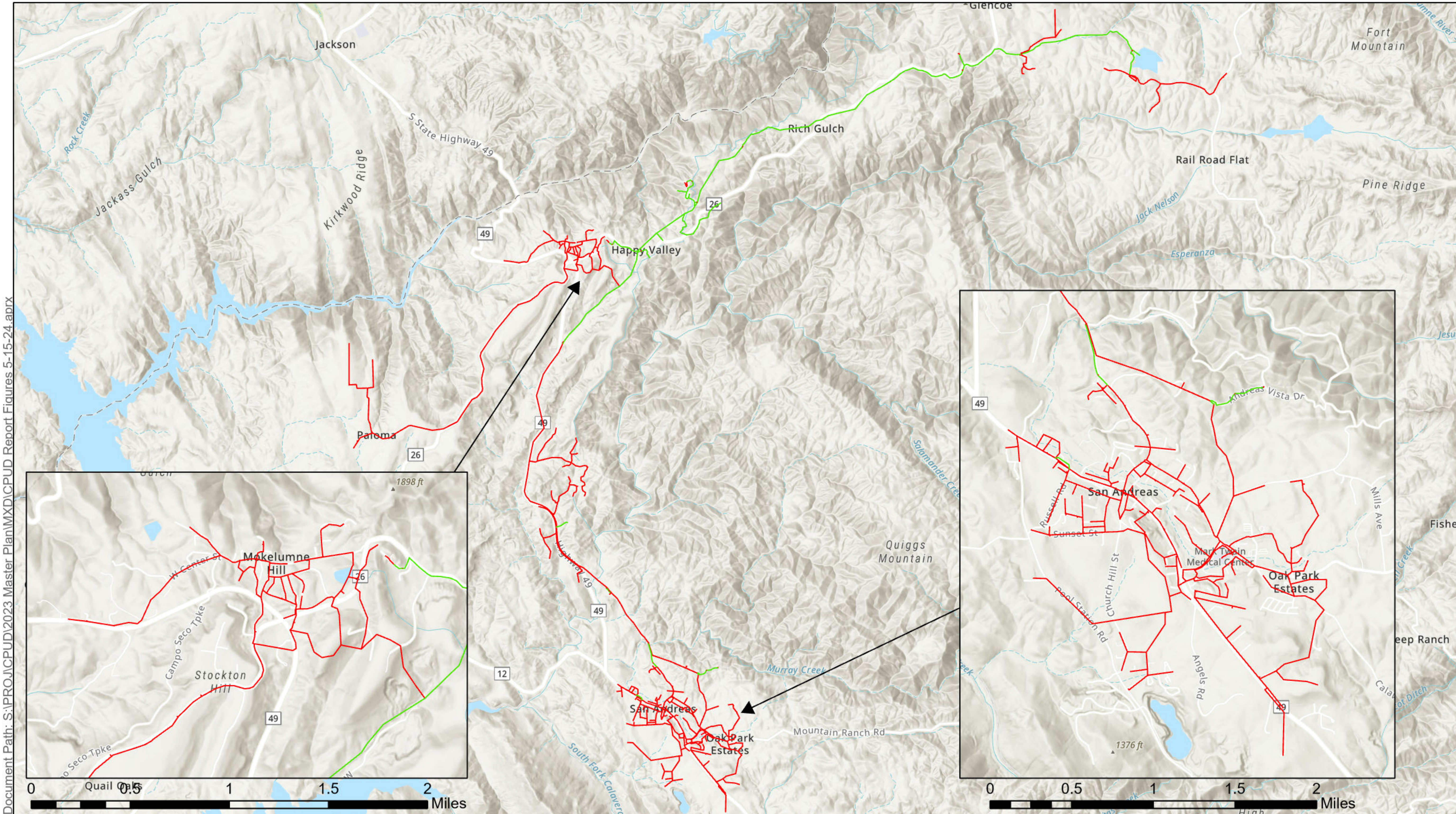

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Legend

- Water Age > 3 Days
- Water Age < 3 Days

0 0.5 1 1.5 2 Miles

CALAVERAS PUBLIC UTILITY DISTRICT

2043 ADD Water Age Map

FIGURE 8-17

CHAPTER 9 – FACILITY CONDITION ASSESSMENT

The following sections present a summary of information gathered during site visits to the main components of the District's water system. The sections are organized starting at the top of the system through the bottom.

9.1 South Fork Pump Station

The South Fork Pump Station is located just past the confluence of the Licking and South Forks of the Mokelumne River. This pump station is the intake point of the system and pumps raw water to the Jeff Davis Reservoir at the top of the system. Improvements to this facility are a top priority for the District. The facility has original infrastructure from 1974, and the pipe conveying water to the Jeff Davis Water Treatment Plant is the main concern. This 20" steel pipe climbs approximately 700 feet to reach the Jeff Davis Reservoir. Other concerns at the pump station intake include debris plugging the intake to the sump and a broken river gate that prevents maintenance from occurring. Undercutting of the existing dam is also a concern, however, a project for rehabilitation is currently being scoped to mitigate this issue.

The District has the capacity at the Jeff Davis Reservoir to store about 2 years' worth of water if the pump station is offline due to debris interfering with operation. The two pumps at the pump station are both 9 stage, 400 hp, and both pumps and motors were rebuilt in 2019 and 2020. Running one pump can yield approximately 1800 gpm while running two pumps can yield approximately 2700-2800 gpm depending on the pressure at the Jeff Davis Water Treatment Plant. Operators can run these pumps together but prefer to alternate use when possible. The pump station is set up with the ability to install two future pump cans approximately 20 feet deep. The pump station has a hydropneumatic tank for surge protection, but it is currently inoperable. This results in a surge in pressure during pump shut down. The valve at the pump station does not seal all the way, resulting in draining of the penstock over time and air buildup in the lines during pump start up. The valve cannot be fixed without draining the approximately 25' deep sump.

Electrical components at the pump station are nearing the end of their useful life and should be upgraded. Installation of VFDs would eliminate surging on the pipeline at startup and shutdown. The pump station has a transformer with PG&E to receive power and the District is charged based on the baseline of maximum usage of the pump station. The District's permit restricts the pump station to receiving up to 15 cfs of flow. Enough flow must be maintained in the South Fork Mokelumne River to provide the required fish flow. The typical season of operation for the pump station is approximately February to June, however the right conditions could allow the station to run all year.

9.2 Rail Road Flat Pump Station

The Rail Road Flat Pump Station is located at the WTP. The pump station pulls water from the inlet side of the clearwell to fill the Rail Road Flat tank. There are two pumps that are active and there is room for an additional pump; the plumbing stubbed out with a blank flange for future pump installation. Each pump has a capacity of approximately 250 gpm. The pumps are 5 stage, and they operate on a lead/lag system. Overall, this pump station is in good condition.

9.3 Rail Road Flat Tank

The Rail Road Flat tank is a welded steel tank built in 2001. Rail Road Flat tank is a baffled 47 ft diameter tank with a capacity of 500,000 gal. The tank is 40 ft tall and typically operates between 34 to 37 ft. The coatings are original and have not been redone since installation. There is a shared 8” inlet that comes from the Rail Road Flat Pump Station, a 12” outflow pipe that serves the Rail Road Flat service area, as well as two manholes for entry. On the interior, there is an overflow and floor drain that goes to the surrounding ditch. The Rail Road Flat tank is baffled and able to provide CT if needed.

The field work for this inspection was completed on August 10, 2023, with a tank water level of 34 ft. The interior inspection was done using special underwater diving equipment and techniques. The exterior inspection was done from the ground and from the roof. The exterior coating of the tank was determined to be in overall good condition, while the interior is described as fair condition. Appendix C presents a copy of this report.

9.3.1 *Tank Interior*

The coating on the underside of the roof plates was determined to be in overall poor condition and worse than the rest of the interior. At locations of dissimilar metal connections, exfoliation and dark rust is present. The lining of the shell was found to be in good condition with minor areas of dark rust mainly found below the high-water level. The floor is in fair condition with rusting located at crevices and some rust nodules. The nodules had corrosion pitting and were patched during the inspection by CSI. Figure 9-1and Figure 9-2 present examples of the tanks roof and floor condition.

Figure 9-1. Rail Road Flat Tank Dissimilar Metal Location Example

Figure 9-2. Rail Road Flat Tank Interior Floor Example

CSI recommends that within the next year, the interior lining should be removed and replaced. This work should include the following:

1) Cleaning all surfaces in accordance with SSPC's Surface Preparation Standard No. 10 "Near-White Metal Blas Cleaning" (SSPC-SP10) followed by three 4 to 6 mil coats of an NSF Certified epoxy lining.
2) Caulk all crevices in the tank such as roof lap seams.
3) Anticipate the need for structural repairs (welding, grinding, etc.)
4) Eliminate all dissimilar metal connections within the tank by electrically isolating these connections with phenolic washers, nylon inserts, neoprene or Teflon buffers.
5) Consider retrofitting the tank piping to include flexible couplings and the relocation of tank bottom connections to the lower shell.

9.3.2 *Tank Exterior*

The exterior shell is in excellent condition with minimal chalking, but the roof was found to be in poor condition. There is a minor amount of isolated light rust present in areas that have been vandalized or mechanically damaged. The total amount of rust was very minimal.

CSI recommends to continue to perform spot repairs on the paint system at the next maintenance interval.

9.4 Glencoe Pump Station

The Glencoe Pump Station provides water to the community of Glencoe. It was originally installed in the 1970s, and it still operates with the originally installed pumps. There are two 25 horsepower (hp) pumps that boost water into a 20,000-gal hydropneumatic tank located at the pump house. There is no meter onsite, so the exact capacity of the pump station is unknown. The site is equipped with a backup generator to keep the pumps running during power outages. There is very low pressure just upstream of the pump station (approximately 5-20 psi). The pump station has two pumps that operate on a lead/lag setting. There are issues meeting demands and keeping up with fire flow due to the 1 ½" bottleneck on both of the pumps. If there is a leak in the system or a fire, the pumps with the bottleneck cannot meet the demands. A 27" concrete steel mortar lined transmission main feeds the station. Near the station, two 20-foot sections have been replaced due to pipe failure. Along with transmission main failures, the hydropneumatic tank has also had several welded repairs for leaks. The electrical system at the pump station is outdated and will need to be upgraded during future renovations.

The Glencoe Pump Station requires a significant number of renovations to operate more effectively. The District is considering alternatives to mitigate the low pressure and flow issues at the site. One alternative is to is to add a new pump station turnout off the transmission main that is designed to handle likely fire flows. In addition to pump station improvements, the entire site should have meters and SCADA added to provide monitoring and control for the system.

9.5 Ponderosa Hydro #1

The Ponderosa Hydro Station #1 was installed in the mid 1980's and was originally a PRV station that was later retrofitted with a turbine. The hydro station's turbine runs at 1,500 gpm and only runs when the Main Control Valve Hydro #2 is filling the Mokelumne Hill tank. When the tank is not filling, the 2" PRV feeds the system. The station is equipped with a 6" PRV that operates when the turbine is inoperable. The hydro generates approximately 70 kW when running. The hydro station has a removable steel roof, and the ceiling support structures are failing. There are no isolation valves at the hydro station to maintain the system. The station needs electrical upgrades.

9.6 Main Control Valve Hydro #2

The Main Control Valve (MCV) Hydro #2 was installed in the mid 1980's and was originally a PRV station that was later retrofitted with a turbine. The hydro station's turbine runs at 1,500 gpm and only runs when the Mokelumne Hill tank is filling. The station is equipped with a 6" PRV that operates when the turbine is inoperable. The hydro generates approximately 68 kW when running. The hydro station has a removeable steel roof, and the ceiling support structures are failing. There are no isolation valves at the hydro station to maintain the system.

9.7 Mokelumne Hill Tank

The Mokelumne Hill tank is an 80 ft diameter tank with a capacity of 1.5 MG that was installed in the 1980's. The tank is 40 ft tall, and it typically operates from 30 ft to 40 ft. The tank has an inlet/outlet pipe that is located 18 ft above ground. If the level in the tank drops below 18 ft, customers between the MCV Hydro #2 station and the Mokelumne Hill Tank will lose water and pressure. There is also an additional 14" outflow pipe at the bottom of the tank that provides water to the Mokelumne Hill service area as well as the Paloma Tank. The tank's overflow daylights at the bottom of the hill access road.

Similar to the San Andreas tank, there are multiple updates needed to bring the tank to current requirements. The tank will need exterior and interior recoating to prevent further corrosion. The ladder system will need to be updated since it does not meet current OSHA standards. Additionally, solar backup power should be installed to keep the level transducer and future SCADA operating during power outages.

The field work for this inspection was completed on August 9, 2023, with a tank water level of 21 ft. The interior inspection was done using special underwater diving equipment and techniques. The exterior inspection was done from the ground and from the roof. The exterior coating of the tank was determined to be in overall fair condition, while the interior is described as poor condition. Appendix C presents a copy of this report.

9.7.1 *Tank Interior*

The coating on the underside of the roof plates and roof support structure are in poor condition with corrosion common to the edges of the support member flanges and roof plates. Throughout the tank there is spot peeling and cracking present. The interior shell has areas of dark rust, especially below the high-water line. The amount of corrosion on the shell was found to be excessive but covers approximately less than 1 percent of the total surface. The floor was also determined to be in poor condition with some pitting that was patched during the inspection. Figure 9-3 and Figure 9-4 present examples of the condition of the interior roof and floor.

Figure 9-3. Example of Interior Mokelumne Hill Tank Roof

Figure 9-4. Example of Interior Mokelumne Hill Tank Floor

CSI recommends that within the next 2 to 3 years, remove and replace the interior lining. This work should include the following:

1) Remove and replace the ling system at all interior surfaces. This work should include cleaning all surfaces in accordance with SSPC's Surface Preparation Standard No. 10 "Near-White Metal Blas Cleaning" (SSPC-SP10) followed by three 4 to 6 mil coats of an NSF Certified epoxy lining.
2) Caulk all crevices in the tank such as roof lap seams.
3) Anticipate the need for minor structural repairs (welding, grinding, etc.)
4) Consider retrofitting the tank piping to include flexible couplings and the relocation of tank bottom connections to the lower shell.

9.7.2 *Tank Exterior*

The exterior roof is highly weathered and was determined to be in overall poor condition. The exterior shell is in fair condition. There is moderate chalking present on the entire tank as well as dark rust in areas that have been mechanically damaged from operations or vandalism. Figure 9-5 and Figure 9-6 show examples of the condition of the tanks exterior roof and the thickness of the paint on the tank's shell.

Figure 9-5. Example of Mokelumne Hill Tank Roof

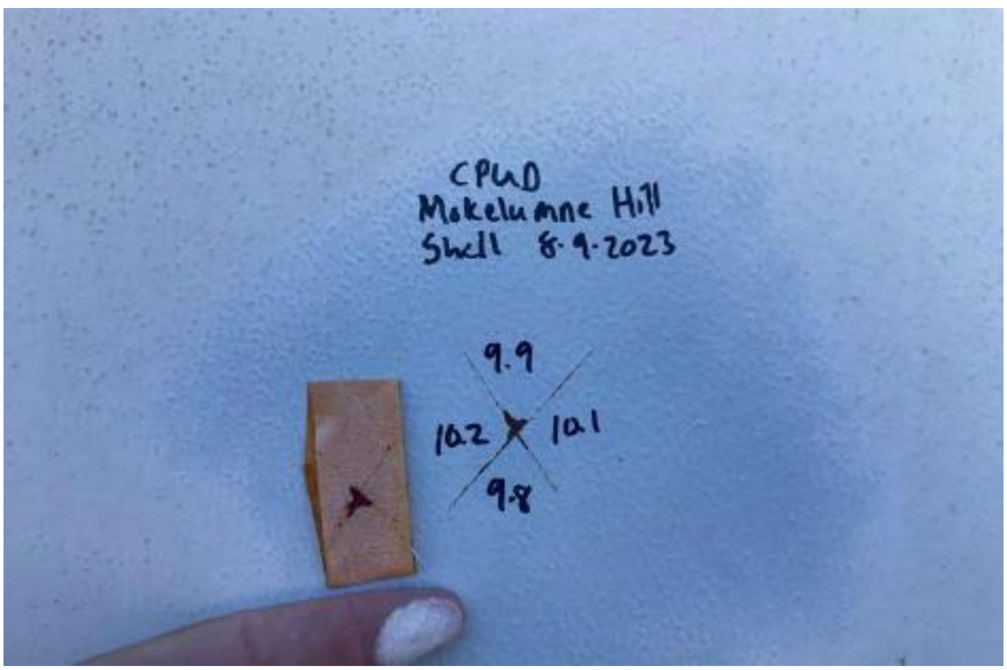

Figure 9-6. Example of Mokelumne Hill Tank Shell Paint

CSI recommends that within the 4 to 6 years, spot repair and overcoat the exterior coating. This work should include the following:

1) This work should include cleaning all surfaces in accordance with SSPC's Surface Preparation Standard No. 15, "Commercial Power Tool Cleaning" followed by 4-6 mils of an industrial epoxy primer and 3-5 mils of a polyurethane finish coat.

2) Test the paint system for heavy metals to determine if any special actions are required to protect workers and the environment during paint disturbance.

9.8 Paloma Tank

The Paloma tank is 30 ft diameter tank that has a capacity of 120,000 gal and was built in the 1980's. The tank is 24 ft tall with a 6" inlet and an 8" outlet. The tank is fed from Mokelumne Hill Tank and typically operates from 20 ft to 22 ft. There is a 2" bypass Cla-Val outside the tank. The main from Mokelumne Hill Tank often has problems that require consistent maintenance.

The Paloma tank will need to be upgraded or replaced in the near future. The tank will need to be evaluated to account for future growth. The District is considering connecting the tank to SCADA to allow for additional monitoring of the system and tank level.

The field work for this inspection was completed on August 9, 2023, with a tank water level of 21 ft. The interior inspection was done using special underwater diving equipment and techniques. The exterior inspection was done from the ground and from the roof. The exterior coating of the tank was determined to be in overall fair condition, while the interior is described as poor condition. Appendix C presents a copy of this report.

9.8.1 *Tank Interior*

Spot peeling, cracking, exfoliation, and structural loss were observed throughout the entirety of the tank's interior. Spot checking revealed the lining on the shell to be in overall poor condition with areas of dark rust, mainly below the high-water level. Spot checking on the tank floor revealed the floor to be in poor condition with small, medium-dense blisters. Figure 9-7 and Figure 9-8 show examples of the existing conditions of the tank's interior.

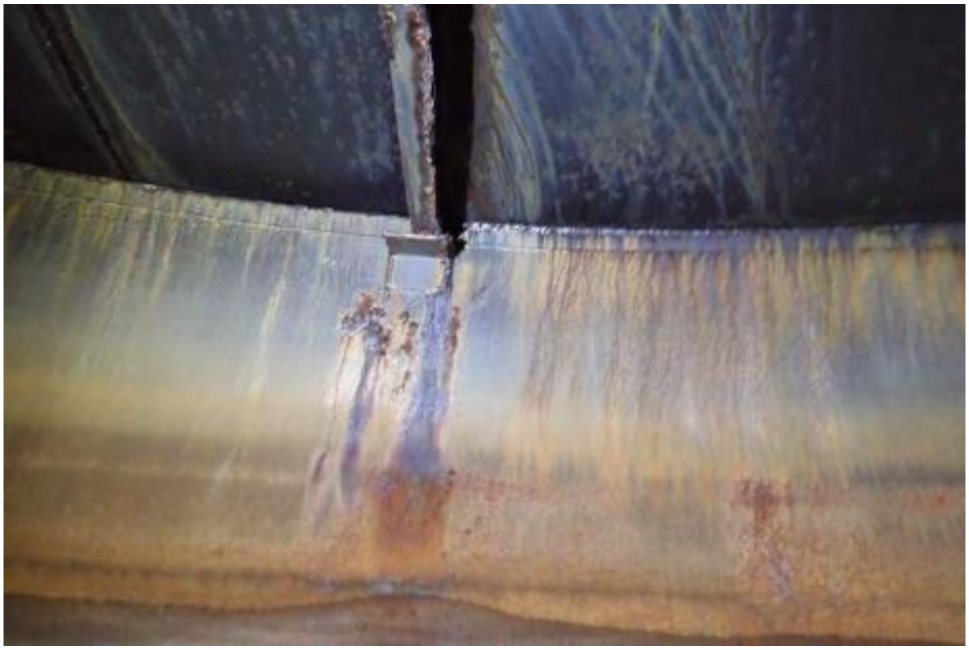

Figure 9-7. Example of Paloma Tank Interior Roof

Figure 9-8. Example of Paloma Tank Interior Floor and Shell

CSI recommends the interior lining of the tank to be removed and replaced withing the 1 to 2 years. This work should include the following:

1) Remove and replace the lining system at all interior surfaces. This work should include cleaning all surfaces in accordance with SSPC's Surface Preparation Standard No. 10 "Near-White Metal Blast Cleaning" (SSPC-SP10) followed by three 4 to 6 mil coats of an NSF Certifies epoxy lining.

2) Caulk all crevices in the tank such as roof lap seams.

3) Anticipate the need for minor structural repairs (welding, grinding, etc.)

4) Consider retrofitting the tank piping to include flexible couplings and the relocation of tank bottom connections to the lower shell.

9.8.2 *Tank Exterior*

The exterior roof is highly weathered and was determined to be in overall poor condition. The exterior shell is in fair condition. There is moderate chalking present on the entire tank as well as dark rust in areas that have been mechanically damaged from operations or vandalism. Figure 9-9 and Figure 9-10 show examples of the exterior tank's existing conditions.

Figure 9-9. Example of Exterior Paloma Tank Roof

Figure 9-10. Example of Exterior Paloma Tank Shell

CSI recommends that within the next 4 to 6 years, spot repair and overcoat the exterior coating. This work should include the following:

1) This work should include cleaning all active rust sites in accordance with SSPC's Surface Preparation Standard No. 15, "Commercial Power Tool Cleaning" followed by 4-6 mils of an industrial epoxy primer and 3-5 mils of a polyurethane finish coat.
2) Test the paint system for heavy metals to determine if any special actions are required to protect workers and the environment during paint disturbance.

9.9 Garamendi Hydro Station #3

The Garamendi hydro station #3 was installed in the mid 1980's and was originally a PRV station that was later retrofitted with a turbine. The hydro station's turbine runs at 1,500 gpm and only runs when the San Andreas tank is filling. When the tank is not filling, the PRV feeds the system. The hydro generates approximately 68 kW when running. The hydro station has a removeable steel roof, and the ceiling support structures are failing. There are no isolation valves at the hydro station to maintain the system. The station is in need of electrical upgrades.

9.10 Golden Hills Tank

The Golden Hills tank serves the nearby neighborhood that consists of two pressure zones. The tank has a storage capacity of approximately 40,000 gal, a diameter of 20 ft, and a height of 16 ft and was built in the 1970’s. The tank is fed off the low-pressure system by a 6” inflow/outflow pipe. The tank resides on a gravel bed foundation, and it typically operates between the levels of 10 ft and 14ft. There are issues filling the tank when Hydro #3 outlet pressure is less than 90 psi. The Garamendi PRV that is upstream needs over 90 psi to open the 2” valve that feeds the tank. During high demands, typically in the summer, the pressure drops below 90 psi. The valve can be opened manually but the pressure is not high enough to fill the tank.

The Golden Hills tank is currently planned to be abandoned as it is not required for optimal operations. It is possible to pressurize the system from the transmission main of the adjacent higher-pressure zone, which would allow the tank to be decommissioned. The 2-inch fill line would need to be upsized to meet fire flow demands.

The field work for this inspection was completed on August 10, 2023, with a tank water level of 8 ft. The interior inspection was done using special underwater diving equipment and techniques. The exterior inspection was done from the ground and from the roof. The exterior coating of the tank was determined to be in overall fair condition, while the interior is described as poor condition. Appendix C presents a copy of this report.

9.10.1 *Tank Interior*

Spot peeling and cracking was observed throughout the roof of the tank, leading to lamellar or exfoliation corrosion and structural loss. The roof corrosion was common to the edges of the support member flanges and roof plates. While spot checking the shell of the tank, areas were found with dark rust, primarily below the high-water line. The coal tar epoxy system on the floor of the tank was found to be in poor condition, with fields of small, medium-dense blisters, and pitting. Figure 9-11 and Figure 9-12 show examples of the existing conditions of the tank’s interior.


Figure 9-11. Example of Golden Hills Tank Interior Roof


Figure 9-12. Example of Golden Hills Tank Interior Floor

CSI recommends to remove and replace the interior lining as soon as possible. This work should include the following:

1) Remove and replace the lining system at all interior surfaces. This work should include cleaning all surfaces in accordance with SSPC's Surface Preparation Standard No. 10 "Near-

White Metal Blast Cleaning" (SSPC-SP10 followed by three 4 to 6 mil coats of an NSF Certified epoxy lining.

2) Caulk all crevices in the tank such as roof lap seams.

3) Anticipate the need for structural repairs (welding, grinding, etc.)

4) Consider retrofitting the tank piping to include flexible couplings and the relocation of tank bottom connections to the lower shell.

9.10.2 *Tank Exterior*

CSI recommends that within the next 4 to 6 years, the exterior coating should be spot repaired and receive a new overcoat. This work should include the following:

1) Cleaning all surfaces in accordance with SSPC's Surfaces in accordance with SSPC's Surface Preparation Standard No. 15, "Commercial Power Tool Cleaning" followed by 4-6 mils of an industrial epoxy primer and 3-5 mils of a polyurethane finish coat.

2) Test the paint system for heavy metals to determine if any special actions are required to protect workers and the environment during paint disturbance.

9.11 San Andreas Tank

The largest tank in the system is the San Andreas tank with a storage capacity of 2.8 MG and was built in 1972. The diameter of the tank is 110 ft, the height is 43 ft, and the typical operating range is from 30 ft to 40 ft. The overflow is interior and drains to the outside of the nearby hill; it will need to be redesigned to incorporate an airgap and screen to meet state requirements. There is an 18" inflow pipe that has an 8" Cla-Val valve that maintains the level in the tank. The valve opens at a predetermined time and/or level and closes at a predetermined level. The valve is permitted to only open partially to allow Mokelumne Hill tank to be filled as well. There is a manual bypass next to the control valve that stays closed; it is only opened during power outages or emergencies. The bypass has bleeding issues that cause problems when not running on hydropower. The tank has an 18" outflow pipe that feeds San Andreas area.

During the last inspections and tank cleaning, elastomeric type material was found within the tank, presumably lining of the transmission main. The tank still has the original coatings from installation and will need to be recoated in the near future. The ladder system will need to be updated as it does not meet OSHA standards. Additionally, there is no backup power. A new electrical service should be installed to incorporate solar backup power.

The field work for this inspection was completed on August 8, 2023, with a tank water level of 21 ft. The interior inspection was done using special underwater diving equipment and techniques. The exterior inspection was done from the ground and from the roof. The exterior coating of the tank was determined to be in overall poor condition with widespread and extensive corrosion, while the interior lining of the tank was determined to be an overall unsatisfactory condition with widespread rust. Appendix C presents a copy of this report.

9.11.1 *Tank Interior*

Spot peeling and cracking was observed throughout the roof of the tank and the coating on the underside of the roof plates and roof support structure were found to be in poor condition with advanced corrosion. While spot checking the shell of the tank, areas were found with dark rust, primarily below the high-water level. Minor pitting and fields of intact and broken, medium dense blisters were also observed throughout the shell of the tank. The lining system on the floor was found to be in poor condition, with fields of small, medium-dense blisters and some pitting of the floor plate. Figure 9-13 and Figure 9-14 show examples of the existing conditions of the tank's interior.

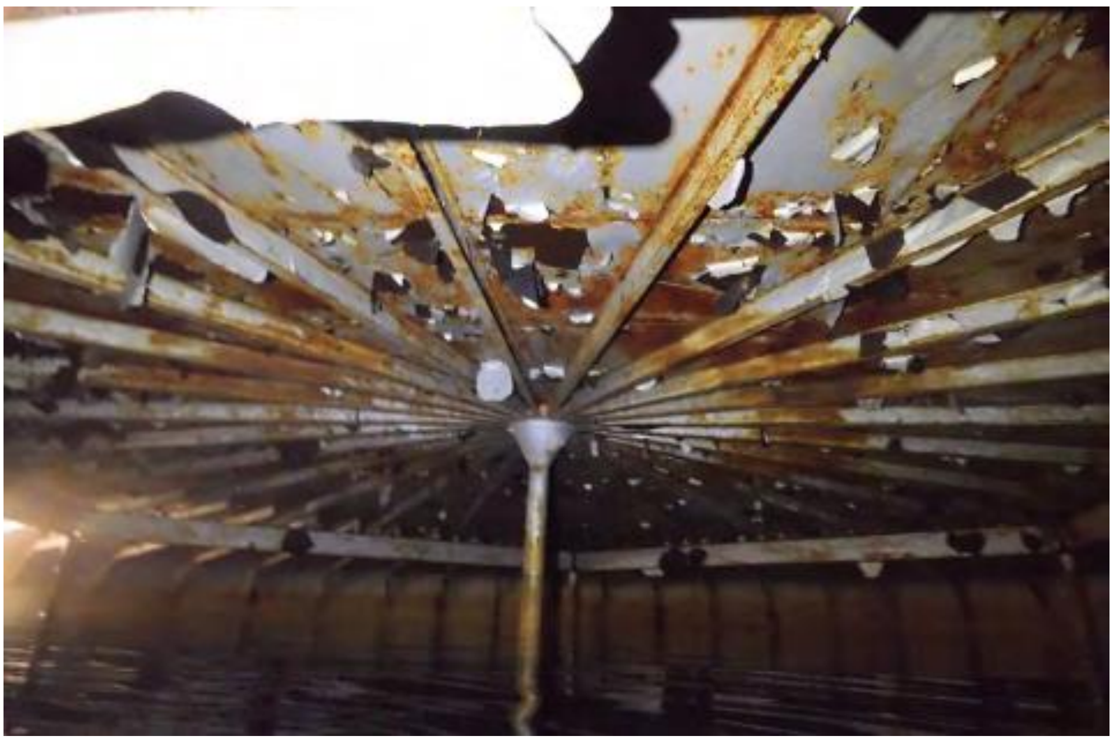

Figure 9-13. Example of San Andreas Tank Interior Roof

Figure 9-14. Example of San Andreas Tank Interior Floor

CSI recommends removing and replacing the interior lining as soon as possible. This work should include the following:

1) Remove and replace the lining system at all interior surfaces. This work should include cleaning all surfaces in accordance with SSPC's Surface Preparation Standard No. 10 "Near-White Metal Blast Cleaning" (SSPC-SP10 followed by three 4 to 6 mil coats of an NSF Certified epoxy lining.
2) Caulk all crevices in the tank such as roof lap seams.
3) Anticipate the need for structural repairs (welding, grinding, patch plating and steel member replacement)
4) Consider retrofitting the tank piping to include flexible couplings and the relocation of tank bottom connections to the lower shell.

9.11.2 *Tank Exterior*

The exterior of the tank was visually examined primarily on the low areas, the upper shell areas adjacent to the ladder, and the roof. The roof was found to be heavily weathered and the exterior paint is in poor condition. Dark rust was found in the areas that had been damaged from operations or vandalism and areas where the paint is peeling. Figure 9-15 and Figure 9-16 show examples of the existing conditions of the exterior of the tank.

Figure 9-15. Example of San Andreas Tank Exterior Roof

Figure 9-16. Example of San Andreas Tank Exterior Shell

CSI recommends that within the next 3 to 5 years, the exterior coating be spot repaired and receive a new overcoat. This work should include the following:

1) Spot power tool clean all active rust sites in accordance with SSPC's Surface Preparation Standard No. 15, "Commercial Power Tool Cleaning" followed by 4-6 mils of an industrial epoxy primer and 3-5 mils of a polyurethane finish coat.
2) Test the paint system for heavy metals to determine if any special actions are required to protect workers and the environment during paint disturbance.

9.12 Jeff Davis Clearwell

The Clearwell is a welded steel on grade structure built in 1972. The Clearwell is approximately 70 feet in diameter by 16 feet high providing a nominal capacity of 500,000 gallons and is located at the Jeff Davis WTP. It is believed that both the interior and exterior linings are the original coatings applied. The interior steel exposed surfaces, including the roof and roof support members are coated with a coal tar epoxy system while the tank shell, floor, and appurtenances are coated with an epoxy lining. The exterior roof, shell, and appurtenances are painted with what appears to be an alkyd system.

The field work for this inspection was completed on May 11, 2023 with a Clearwell water level of 14 ft. The interior inspection was done using special underwater diving equipment and techniques. The exterior inspection was done from the ground and from the roof. The 51-year old coating systems on the tank are in overall poor condition with widespread and pervasive corrosion. Appendix B presents a copy of this report.

9.12.1 *Tank Interior*

The lining in the tank is in an overall unsatisfactory condition with widespread rust and blistering. The majority of the corrosion is in the upper part of the tank and includes structural loss. The most advanced corrosion spots below the current water level were patched during this inspection using NSF certified underwater curing epoxy. Figure 9-17, Figure 9-18, and Figure 9-19 present examples of the Clearwell's interior corrosion on the floor, roof and roof supports.

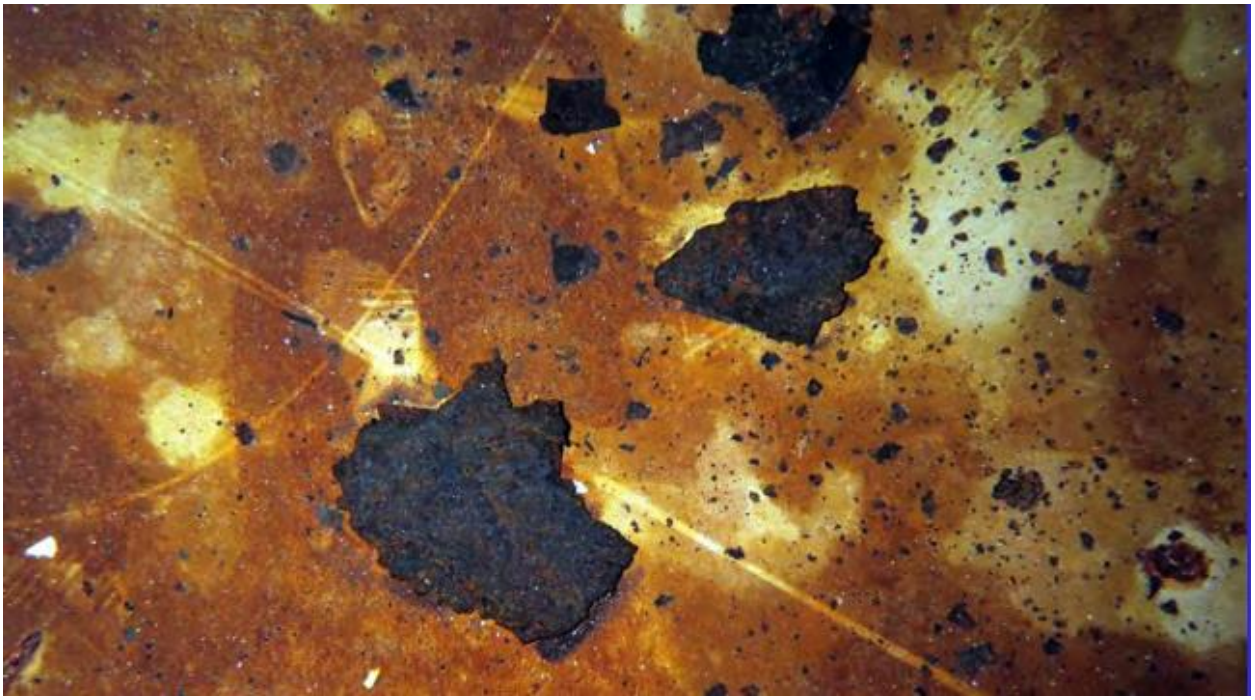

Figure 9-17. Clearwell Interior Corrosion Example (Floor)

Figure 9-18. Clearwell Interior Corrosion Example (Roof)

Figure 9-19. Clearwell Interior Corrosion Example (Roof Support)

The existing lining conditions dictate that the existing interior lining system should be removed and replaced within the next year to prevent further metal loss. This work should include the following:

1) Remove and replace the lining system at all interior surfaces. This work should include cleaning all surfaces in accordance with SSPC's Surface Preparation Standard No. 10 "Near-White Metal Blast Cleaning" (SSPC-SP10) followed by three 4 to 6 mil coats of an NSF Certified epoxy lining.
2) Caulk all crevices in the tank such as roof lap seams.
3) Anticipate the need for structural repairs (welding, grinding, etc.).
4) Consider retrofitting the tank piping to include flexible couplings and the relocation of tank bottom connections to the lower shell.

9.12.2 *Tank Exterior*

The exterior paint system is severely weathered and has poor adhesion. The exterior paint is believed to be the original system applied and very likely has high concentrations of heavy metals (e.g. lead, chromium, etc.) that will require special precautions to protect the workers and environment when it is disturbed. Figure 9-20 and Figure 9-21 show examples of the existing conditions of the exterior of the tank.

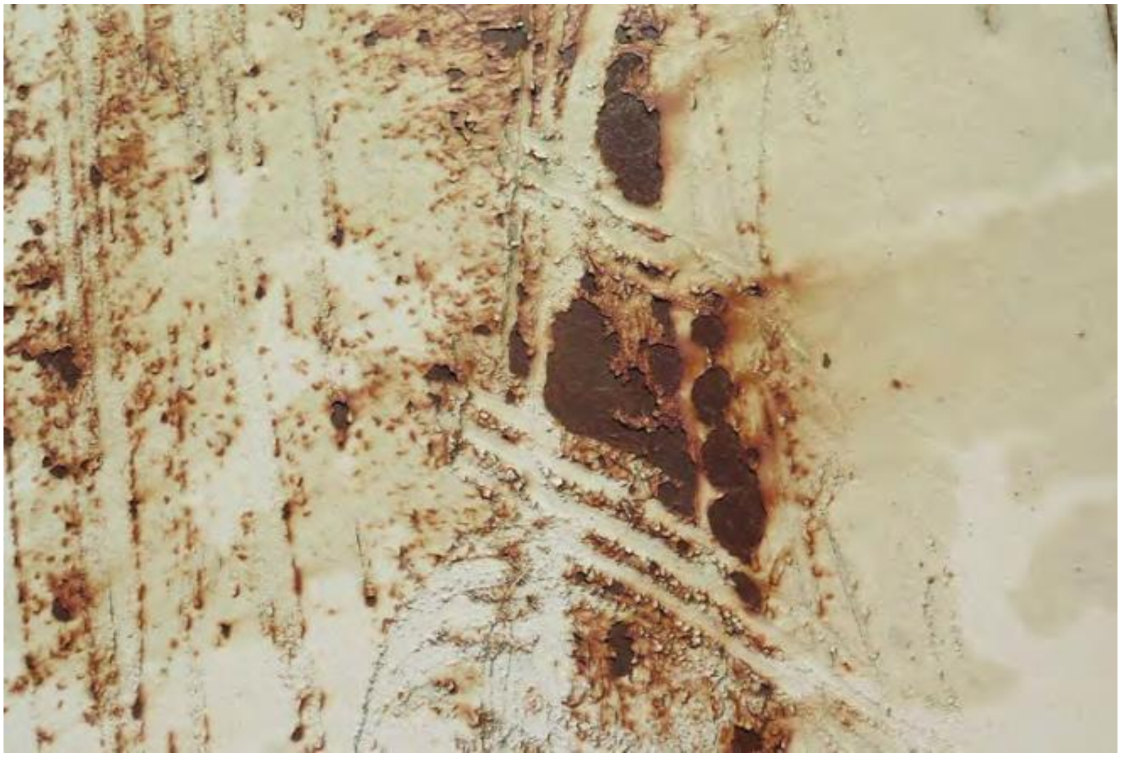

Figure 9-20. Clearwell Exterior Corrosion Example (Roof)

Figure 9-21. Clearwell Exterior Corrosion Example (Sidewall)

The existing lining conditions dictate that the existing exterior paint system should be removed and replaced within the next year to prevent further metal loss. This work should include the following:

1) Remove and replace the exterior paint system. This work should include cleaning all surfaces in accordance with SSPC's Surface Preparation Standard No. 6, "Commercial Blast Cleaning" (SSPC SP-6) followed by 4-6 mils of an industrial epoxy primer and 3-5 mils of a polyurethane finish coat.
2) Test the paint system for heavy metals to determine if any special actions are required to protect workers and the environment during paint disturbance.
3) To accommodate construction activities, the existing Clearwell tank will need to be taken offline. The Jeff Davis WTP will need to operate using only the recently installed twin Clearwell Tank during this time.

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CHAPTER 10 – RECOMMENDED CAPITAL IMPROVEMENT PROJECTS

The recommended projects are divided into the following two categories:

- High priority Projects
- Annual Infrastructure Programs

The proposed implementation schedule, based on the project priority, and estimated costs of the projects are presented in Chapter 11.

10.1 High Priority

The high priority improvements are improvements correlated to system reliability and safety of the water system. These projects include:

- South Fork Pump Station –
    - Repair undercutting of the dam
    - Replace 20” pipeline to Jeff Davis Reservoir
    - Repair broken river gate and add a catwalk
    - Address intake plugging and a safe mechanism to raise and lower the intake pump station gates
    - Replace soft starters with VFDs and remove hydropneumatic tank
    - Repair valve in sump
    - Add flow new meter
    - Upgrade electrical and add SCADA controls for remote operation
- Glencoe Pump Station – renovate pump station to improve operability, address fire flows, and provide meters and SCADA for monitoring
- Ponderosa Hydro #1 – Provide isolation valves for station, structural upgrades, and upgrade electrical equipment and add SCADA
- Main Control Valve Hydro #2 – Provide isolation valves for station and structural upgrades, and add SCADA
- Mokelumne Hill Tank – Recoat tank interior and exterior, upgrade ladder for OSHA, add meters, and provide backup power
- Paloma Tank – Replace or upgrade tank and provide SCADA and add meter

- Garamendi Hydro #3 – Provide isolation valves for station, structural upgrades and upgrade electrical equipment, and add SCADA
- Golden Hills Tank – Upsize the piping in the road in order to allow the Golden Hills tank to be abandoned.
- San Andreas Tank – Recoat tank interior and exterior, upgrade ladder for OSHA, modify overflow to provide airgap, provide meters and SCADA for monitoring and provide backup power
- Jeff Davis WTP – Replace piping in building and add backwash reclaim system
- Jeff Davis Clearwell #1 – Recoat tank interior and exterior including structural repairs, and add baffling to match the new tank

10.2 Annual Infrastructure Programs

An annual repair and replacement of distribution pipelines in the system is included, intending to cover costs associated with newly leaking pipes that require regular replacement. Much of the District's system was installed in the 1970's; however, only approximately 5% of the District's piping has a known vintage. It is assumed that approximately 50% of the existing piping is past its useful life. Therefore, all pipes will be at the end of their useful life within the next 50 years and will need replacement. It is recommended to replace 2% of the distribution system piping per year. High priority distribution projects per the 2022 Distribution Feasibility Study include (in order of priority):

- Priority 1:
  - Replace undersized distribution mains in San Andrea Pressure Zone
  - Replace undersized distribution mains in Mokelumne Hill Pressure Zone
- Priority 2:
  - Glencoe Pressure Zone Fire Flow Improvements
  - Golden Hills Pressure Zone Fire Flow Improvements
- Priority 3:
  - Redundant transmission main between Mokelumne Hill and Golden Hills
  - Redundant transmission main between Golden Hills and San Andreas
  - Transmission Main Replacement between Mokelumne Hill and Paloma

To determine the construction budget for replacing the existing system piping over the next 50 years, the current value of all the pipe in the system was estimated. Table 10-1 presents the total value of the transmission and distribution system piping in $2024 along with the annual 2% construction cost.

Table 10-1. Annual Construction Cost for 2% Replacement of Existing System Piping

New Pipe Diameter (in)	Planning Level Construction Cost ($2024/LF)	Existing System Pipe Length (LF)	Total Cost to Replace Existing System ($2024)	2% Annual Cost of Construction ($2024/yr)
6	$195.00	65,252	$ 12,700,000	$ 254,000
8	$216.00	98,415	$ 21,300,000	$ 425,000
10 and 12	$245.00	120,875	$ 29,600,000	$ 592,000
18 to 27	$360.00	112,422	$ 40,500,000	$ 809,000
		Total	**$ 104,100,000**	**$ 2,080,000**

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CHAPTER 11 – RECOMMENDED CAPITAL IMPROVEMENT PROGRAM

Recommendations for a capital improvement program (CIP) were developed based on the assessment of the District's water system that was described in Chapter 9 and summarized in Chapter 10. The following section presents the estimated costs and a prioritized implementation schedule for the recommended improvements.

11.1 Approach

Planning level cost estimates were made for each of the recommended capital improvements.

The following contingencies and allowances were added to the base construction cost:

- 20% Estimating Contingency
- 7.5% Allowance for Engineering/Design Cost
- 7.5% Allowance for Construction Management
- 5% Allowance for Bonds/Insurance/Mobilization

The recommended projects, estimated costs, and proposed schedule were developed through a planning-level of analysis that was appropriate for the 2024 Master Plan and should be re-evaluated in further detail prior to implementation.

11.2 Implementation Schedule

The fire flow improvement projects are considered high priority projects that should be completed as soon as possible to improve fire flow delivery capabilities.

For the 2% Annual Pipeline Replacement, the priorities for construction are presented in Section 10.2.

Once these high priority projects are complete, the District can incrementally resolve the low domestic service pressure issues and replace aging infrastructure.

11.3 Recommended Capital Improvement Program (CIP)

Table 11-1 presents the recommended CIP for the District's water system. There first five years (2025 through 2029) are provided in detail. For years 2030 through 2044 the CIP is provided in general 5 year increments.

Table 11-1. Capital Improvement Plan for 2025 - 2044 ($000, 2024)

Improvement		TOTAL Estimated Construction Cost ($000, 2024)	TOTAL Estimated Project Cost ($000, 2024)	2025	2026	2027	2028	2029	2030-2034	2035-2039	2040-2044
South Fork Pump Station	Replace 20" pipeline to Jeff Davis Reservoir	$5,760	$8,064				$2,661	$2,661	$2,742		
	Repair undercutting of the dam	$200	$280	$280							
	Repair broken river gate	$25	$35	$35							
	Address intake plugging	$25	$35	$35							
	Repair hydropneumatic tank	$10	$14	$14							
	Repair valve in sump	$25	$35	$35							
	Electrical Upgrades	$200	$280						$280		
Jeff Davis WTP	Recoat Clearwell #1 interior and exterior including structural repairs	$375	$525					$525			
	Replace Piping in building	$75	$105			$105					
	Add backwash reclaim system	$1,000	$1,400			$1,400					
Pump Stations	Renovate Glencoe Pump Station to improve operability, address fire flows, and provide meters and SCADA for monitoring	$380	$532	$532							
Hydro Stations	Provide isolation valves for station, upgrade electrical equipment at Ponderosa Hydro #1, and building repairs	$200	$280			$280					
	Provide isolation valves for station at Main Control Valve Hydro #2 and building repairs	$150	$210	$210							
	Provide isolation valves for station and upgrade electrical equipment at Garamendi Hydro #3 and building repairs	$200	$280	$280							
Storage Tanks	Mokelumne Hill Tank – Recoat tank interior and exterior, upgrade ladder for OSHA, add tank mixing system, and provide backup power	$375	$525				$525				
	Railroad Flat Tank - Structural repairs, recoat tank interior, spot repair tank exterior, and add tank mixing system	$375	$525		$525						
	Paloma Tank – Replace or upgrade tank and provide SCADA, recoat tank interior and exterior, and add tank mixing system	$180	$252			$252					
	Golden Hills Tank – System improvements to abandon tank/ tank demo	$200	$280	$280							
	San Andreas Tank – Recoat tank interior and exterior, structural repairs, upgrade ladder for OSHA, modify overflow to provide airgap, provide meters and SCADA for monitoring, add tank mixing system, and provide backup power	$1,400	$1,960		$1,960						
Distribution System	2% Annual Pipeline Replacement	$2,080	$2,912	$2,912	$2,912	$2,912	$2,912	$2,912	$14,560	$14,560	$14,560
			TOTAL CIP ($000, 2024)	$4,613	$5,397	$4,949	$6,098	$6,098	$17,582	$14,560	$14,560
			TOTAL CIP ($000, escalated 5% per year)	$4,844	$5,950	$5,729	$7,412	$7,783	$26,038	$27,520	$34,756

Appendix A

Field Fire Flow Tests and Calibration Results

Appendix A - Prior Field Fire Flow Tests

Test No.	Description	Pressure Zone	Hydrant ID	Ave. Flow (gpm)	Guage 5 Hydrant ID	Static (psi)	Residual (psi)	Satisfy 25% Pressure Drop?	Extrapolated Flow	Model Static (psi)	% diff	Model Flow	% diff
2	KASL Test	Railroad Flat	18H-150	732	18H-140	65	49	YES	1279.44331	61.28	6%	998.66	22%
2	Calibrated	Railroad Flat	18H-150	732	18H-140	65	49	YES	1279.44331	61.28	6%	1248.52	2%
7	KASL Test	Main Control Valve	16H-20	698	16H-10	102	85	NO	1632.572533	103.77	2%	1567.95	4%
9	KASL Test	Moke Hill FS	13H-80	148	13H-70	73	32	YES	170.0072343	72.49	1%	584.83	244%
9A	District Test	Moke Hill FS	14H-40	531	14H-30	121	65	YES	730.1406504	115.95	4%	527	28%
9A	Calibrated	Moke Hill FS	14H-40	531	14H-30	121	65	YES	730.1406504	115.96	4%	659.71	10%
12	KASL Test	Mokelumne Hill	12H-30.2	345	12H-120	78	55	YES	568.5087851	79.29	2%	614.45	8%
13	KASL Test	Poloma	15H-170	493	15H-160	61	32	YES	594.3678132	65.63	8%	611.64	3%
14	KASL Test	Poloma	15H-70	795	15H-50	113	82	YES	1438.840343	115.51	2%	1461.93	2%
15	KASL Test	Golden Hills	17H-50	493	17H-60	83	71	NO	1207.071353	84.28	2%	930.65	23%
15A	District Test	Golden Hills	17H-50	628	17H-60	84	63	YES	1146.300312	84.28	0%	931	19%
15A	Calibrated	Golden Hills	17H-50	628	17H-60	84	63	YES	1146.300312	84.33	0%	1137.87	1%
18	KASL Test	Mobile Home	10H-120	493	10H-130	50	32	YES	649.598845	52.07	4%	3918.2	503%
18-1	District Test	Mobile Home	10H-120	692	10H-130	52.07	46.5	NO	1780.892592	52.07	0%	3917.41	120%
19	KASL Test	Garamendi	7H-80	624	7H-70	60	48	YES	1195.471184	58.74	2%	1067.46	11%
19-1	Calibrated	Garamendi	7H-80	624	7H-70	60	48	YES	1195.471184	58.74	2%	1095.98	8%
21	KASL Test	San Andreas	10H-20	1178	10H-10	158	147	NO	4616.660591	157.24	0%	4445.96	4%
24	District Test	San Andreas West	9H-50	643	9H-20	78	73	NO	2415.562546	74.46	5%	4403.04	82%
24A	Calibrated	San Andreas West	9H-50	1112	9H-40	94	73	YES	2195.287966	92.8	1%	2260.41	3%
29	KASL Test	San Andreas	6H-80	1035	6H-50	122	120	NO	8650.241749	121.62	0%	8520.91	1%
30	KASL Test	San Andreas	6H-170	394	6H-160	57	42	YES	641.5579233	58.24	2%	608.14	5%
32	KASL Test	Tscornia Field	4H-70	643	4H-60	67	46	YES	993.4485885	71.13	6%	2162.17	118%
32A	District Test	Tscornia Field	4H-70	1838	4H-60	64	44	YES	2813.544281	71.13	11%	2162	23%
32A	Calibrated	Tscornia Field	4H-70	1838	4H-60	64	44	YES	2813.544281	71.13	11%	2701.35	4%

Appendix B

List of Proposed Distribution Pipe Improvements by Zone

DESCRIPTION	EXISTING DIAMETER	RECOMMENDED DIAMETER, INCHES	LENGTH, LINEAR FEET
SAN ANDREAS PRESSURE ZONE (PZM1) - Total Length: 27,714			
W. Oak Park Dr	4	6	700
Oak Park Dr	4	12	450
Highway 49 South of Buckskin Way	6	8	450
Cemetery Ln	4	6	550
Across Pope St.	2	6	60
Pope St.	2	6	300
Pope St.	2	6	750
Golden San Andreas Health Center	4	6	550
Angels Rd	1	6	400
Off Toyanza Dr.	6	8	250
Highway 49	6	8	3500
Perpendicular to Highway 49	4	8	700
Calaveritas Rd	4	6	1350
Oak Park Dr	4	6	400
Off Edgewood Dr.	6	12	1200
Saddleback Dr.	6	8	1550
Magers Rd	6	8	1300
Gold Hunter Rd	6	8	3300
Pope St	4	8	70
Mountain Ranch Road	6	12	2010
Diagonal Btwn Wimbledon and Mountain Ranch Rd	6	12	200
Gold Hunter Rd off Forest Hill Dr.	6	12	520
Toyon Dr.	6	12	1350
Toyanza Dr.	6	12	860
Highway 49	6	8	70
Perpendicular off Saddleback Dr.	6	12	30
Btwn Mountain Ranch Rd and W Oak Park Dr	6	12	330
Btwn Calaveritas Rd and W Oak Park Dr	6	12	430
Calaveritas Rd	6	12	1200
Edgewood Dr.	6	12	1700
Off Hindebrant St	2	6	350
Hindebrant St	2	6	184
Buckskin Way	6	12	650

DESCRIPTION	EXISTING DIAMETER	RECOMMENDED DIAMETER, INCHES	LENGTH, LINEAR FEET
SAN ANDREAS WEST PRESSURE ZONE (PZM3) - Total Length: 15,460			
N. California St.	2	6	200
Pope St. Btwn N. California and Roberts Ave	4	8	1250
Roberts Ave south of Pope St	2	6	175
Roberts Ave Btwn Berry St and Treat Ave	2	8	200
Berry St	2	6	200
Parallel to E. Saint Charles St	4	6	1100
Mountain View Ave	4	8	250
Btwn Mountain View Ave and Family Cir	2	12	400
Catholic Cemetery Rd	10	12	500
Dead End Parallel to E. Saint Charles St	2	6	220
W Saint Charles St	6	8	600
E Saint Charles St	6	8	2820
Perpendicular off Gatewood Ave	4	6	330
Broadway St South of Market	4	8	300
Sunset Street	4	10	700
Across E Saint Charles St	8	12	620
Cemetary PRV	10	12	90
Market St	4	8	2100
Russell Rd	4	8	530
Russell Rd	4	6	1170
Gatewood Ave	12	8	360
Gatewood Ave	4	8	630
Off Gatewood Ave, parallel to E Saint Charles	4	6	190
Gatewood Ave	2	6	525

DESCRIPTION	EXISTING DIAMETER	RECOMMENDED DIAMETER, INCHES	LENGTH, LINEAR FEET
MOKELUMNE HILL PRESSURE ZONE (PZM12) - Total Length: 31,850			
Prindle Rd.	4	8	650
Highway 26 near Italian Vista Ct	4	6	1150
Easy Bird Rd	4	6	1450
Prospect St off Maretta	2	6	300
Off Maretta St	6	8	600
Highway 26 btwn Howard Ln and Corral Flat	6	10	2250
Highway 26	6	10	18700
Prindle Rd	4	8	1000
Highway 26 off Prindle Rd	4	8	400
Maretta St	6	8	1050
Highway 26 (Perpencicular)	4	6	300
Main Street	6	8	1600
Lafayette	6	8	800
E Center St	6	8	1600

DESCRIPTION	EXISTING DIAMETER	RECOMMENDED DIAMETER, INCHES	LENGTH, LINEAR FEET
MOKELUMNE FIRE STATION PRESSURE ZONE (PZM5) - Total Length:11,050			
Prospect St off Lafayette	6	8	700
Main St Between Persall Ave and Church St.	4	6	250
Main St. Between Lafayette and E. Center St	4	8	400
E. Center	4	6	500
E. Center East of Main	3	8	350
Persall Ave	4	12	200
W. Center St East of Peek Cir	6	8	200
Clark St	6	8	150
Hoerchner Pl	6	8	250
W. Center off Garden Lane	4	8	500
Dead end near Clark St.	6	8	300
Milano Rd.	6	8	400
Miwok Trl off W. Center	6	8	1200
W. Center btwn Old Toll Rd and Miwok Trl	6	8	1700
Clark St	4	8	400
W. Center St (Perpendicular)	6	8	400
W. Center St	6	8	600
Btwn W Center and Hoerchner	6	8	350
W. Center St Btwn Lona Lane to Old Toll Rd	6	8	2100
Hoerchner Pl dead end	6	10	100

DESCRIPTION	EXISTING DIAMETER	RECOMMENDED DIAMETER, INCHES	LENGTH, LINEAR FEET
GOLDEN HILLS SOUTH PRESSURE ZONE (PZM14) - Total Length: 8,870			
Btwn Highway 49 and Magnolia Ln	2	6	1450
Lombardi Dr.	6	10	1950
Glory Hole Ct	6	8	800
Lombardi Dr. Btwn Glory Hole Ct and McKeany Ct	6	10	600
McKeany Ct	6	10	1050
Golden Gate Dr.	6	8	1900
Lombardi Dr.	6	10	1100
Btwn Glory Hole Ct Lombardi Dr.	6	10	20

DESCRIPTION	EXISTING DIAMETER	RECOMMENDED DIAMETER, INCHES	LENGTH, LINEAR FEET
CHURCH HILL PRESSURE ZONE (PZM2) - Total Length: 7,364			
Broadway St. N of Oak St	2	6	550
Sunset St Btwn Mariposa St and Broadway St	6	10	650
Sunset St Btwn Mariposa St and Oak Ln	6	12	80
Sunset St Btwn Mariposa St and Oak Ln	6	10	1050
Oak Ln	2	6	280
Sunset St	6	8	650
Oak Pl	4	6	510
Mariposa St North of Oak St	4	8	760
Oak St	6	10	650
Mariposa St	4	10	150
Mariposa St	6	10	211
Broadway St	2	8	174
Sunset St	6	10	500
Broadway St	2	8	200
Mariposa St	4	10	200
Oak St	1	8	750

DESCRIPTION	EXISTING DIAMETER	RECOMMENDED DIAMETER, INCHES	LENGTH, LINEAR FEET
GARAMENDI PRESSURE ZONE (PZM4) - Total Length: 11,600			
Lyle Ct to Golden Hills Tank	6	8	1600
Donya Dr.	6	8	1500
Lombardi Dr.	6	8	6100
Lombardi Dr	2	8	300
Andreas Vista Dr.	6	8	2100

DESCRIPTION	EXISTING DIAMETER	RECOMMENDED DIAMETER, INCHES	LENGTH, LINEAR FEET
MAIN CONTROL VALVE HYDRO PRESSURE ZONE (PZM6) - Total Length: 10,850			
Jessica Ct	2	6	400
Montgomery Dr.	6	8	800
Candy Cir. Adjacent to Ian Ct.	6	8	1250
Candy Cir.	6	8	450
Adjacent to Calaveras Public Utility Ditch	6	8	2600
Along Highway 26	4	8	4350
Jennifer Ct.	6	8	300
Montgomery Dr.	6	8	700

DESCRIPTION	EXISTING DIAMETER	RECOMMENDED DIAMETER, INCHES	LENGTH, LINEAR FEET
GLENCOE PRESSURE ZONE (PZM7) - Total Length: 7,500			
Independence Rd Btwn Improbability and Ridge	6	8	3500
Off Independence Rd	2.5	8	2400
Btwn Ridge Rd and Blue Ridge Rd	6	8	1600

DESCRIPTION	EXISTING DIAMETER	RECOMMENDED DIAMETER, INCHES	LENGTH, LINEAR FEET
ANGELS ROAD PRESSURE ZONE (PZM9) - Total Length: 4,770			
Angels Rd	2	6	1000
Alfreda St	2	6	400
Mountain Rach Rd	4	12	1050
Marshall Ave off Mountain Ranch	6	8	1570
Mountain Ranch rd btwn Pope St and Marshall Ave	4	12	600
Marshall Ave	6	8	150

DESCRIPTION	EXISTING DIAMETER	RECOMMENDED DIAMETER, INCHES	LENGTH, LINEAR FEET
RAIL ROAD FLAT PRESSURE ZONE (PZM8) - Total Length: 1,300			
Simpson Rd	6	8	1300

DESCRIPTION	EXISTING DIAMETER	RECOMMENDED DIAMETER, INCHES	LENGTH, LINEAR FEET
TSCORNIA FIELD PRESSURE ZONE (PZM10) - Total Length: 1,200			
Church Hill St	6	8	1200

DESCRIPTION	EXISTING DIAMETER	RECOMMENDED DIAMETER, INCHES	LENGTH, LINEAR FEET
JEFF DAVIS PRESSURE ZONE (PZM13) - Total Length:1,100			
Stormy Lane	6	12	1100

DESCRIPTION	EXISTING DIAMETER	RECOMMENDED DIAMETER, INCHES	LENGTH, LINEAR FEET
PALOMA PRESSURE ZONE (PZM16) - Total Length: 9,300			
Paloma Rd btwn Nine Oaks Rd and Paloma Tank	8	10	4300
Gwin St	8	10	4350
Paloma Rd	8	10	650

Appendix C
Storage Tank Inspections
(CSI Services, 2023)

P. O. Box 801357
Santa Clarita, CA 91380-2316
Phone: 877.274.2422
Fax: 661.775.7628
www.CSIServices.biz

Providing Quality Technical Services to the Coating Industry

July 21, 2023

Via Email: asmith@pbieng.com

Ashley Smith, PE
Peterson Brustad Inc.
80 Blue Ravine Road, Suite 280
Folsom, CA 95630

Office: 916.608.2212
Cell: 530.200.6309

Subject: Final Report - Maintenance Inspection

Re: CPUD - Clear Well Tank

Dear Ashley:

Please find attached the final report for the evaluation that was completed on the above referenced tank. Also attached is our invoice.

Thank you for your business and please let me know if you have any questions or comments about our findings. I can always be reached by cell at 951.609.6991 or by e-mail at rgordon@csiservices.biz.

Sincerely,
CSI Services, Inc.

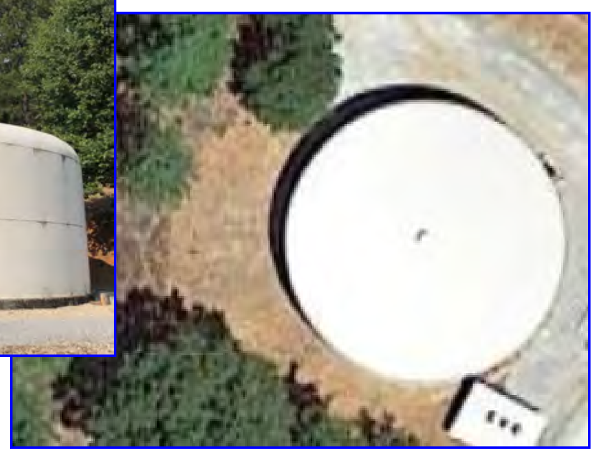
N. Randy Gordon

N. Randy Gordon, PCS
Technical Services Manager

CSI SERVICES

P. O. Box 801357, Santa Clarita, CA 91380 877.274.2422

Final Report
Maintenance Inspection
Clear Well Tank
Calaveras Public Utility District



Prepared for:
Ashley Smith, PE
Peterson Brustad Inc.
80 Blue Ravine Road, Suite 280
Folsom, CA 95630

PROTECTIVE COATING SPECIALIST
N. RANDY GORDON
No. 2018-621-011
Exp. 12-31-26
PCS
STATE OF CALIFORNIA

Prepared by:
CSI Services, Inc.

N. Randy Gordon, PCS
Technical Services Manager

July 21, 2023

Table of Contents

Attachments

- Field Notes
- Exterior Photos
- Interior Photos
- CSI Chart 1 – General Description of Conditions
- CSI Chart 2 – Rust Grade Criteria
- CSI Chart 3 – Corrosion Grade Criteria
- CSI Chart 4 – Coating Chalking Criteria
- CSI Chart 5 – Coating Adhesion Criteria
- CSI Chart 6 – Coating Blistering Criteria

Introduction

Peterson Brustad Inc. authorized CSI Services, Inc. (CSI) to conduct a maintenance inspection on the Calaveras Public Utility District, Clear Well Tank located at 1500 W Forty Rd, Mokelumne Hill, CA. This report documents the findings of the inspection and services performed.

Any recommendations have been made in accordance with the applicable requirements of American Water Works Association's Standard (AWWA) D102 "Coating Steel Water Storage Tanks," AWWA Standard M42 "Steel Water Storage Tanks," and CSI's experience with evaluating over a thousand water storage facilities. A photo summary and narrated video are also included to document the condition of the tank.

The field-work was completed on May 11, 2023 by a team primarily comprised of Anthony Jackson, Steven Metcalf and Steven Metcalf Jr. The exterior shell observations were made mostly from grade level, while the exterior of the roof was examined close-up. The interior inspection was carried out with the tank's water level at approximately 14 feet using special underwater diving equipment and techniques. Steve Metcalf was the site supervisor and Anthony Jackson was the lead diver. Mr. Randy Gordon, Technical Services Manager, reviewed the results of the field data and prepared recommendations for maintenance work. Mr. Gordon has over 30 years of experience through the evaluation of over a thousand storage tanks and other structures. He is certified as an SSPC Protective Coating Specialist (PCS) and NACE/SSPC Level 3 Coating Inspector.

Summary

The 51-year old coating systems on the tank are in overall poor condition with widespread and pervasive corrosion. The exterior paint system is severely weathered and has poor adhesion. The exterior paint is believed to be the original system applied and very likely has high concentrations of heavy metals (e.g. lead, chromium, etc.) that will require special precautions to protect the workers and environment when it is disturbed.

The lining in the tank is in an overall unsatisfactory condition with widespread rust and blistering. The majority of the corrosion is in the upper part of the tank and includes structural loss. The most advanced corrosion spots below the CWL were patched during this inspection using NSF certified underwater curing epoxy. The existing lining conditions dictate that the existing exterior paint and interior lining system should be removed and replaced within the next year to prevent further metal loss.

Background

The Clear Well Tank is a Welded Steel on grade structure built in 1972. The tank is approximately 70 feet in diameter by 16 feet high providing a nominal capacity of 500,000 gallons and is located at W Forty Rd, Mokelumne Hill, CA 95245.

The tank shell has two courses that are connected to a roof with rafters, girders and one center column. The tank has one roof vent, one roof hatch, and one shell manway. There is one interior ladder and one exterior ladder. The exterior ladder has fall protection. The tank is anchored to a concrete ring wall. There is no internal or external cathodic protection (CP) system associated with this tank. The tank has no water level indicator.

It is believed that the interior linings are the original coatings applied. The interior steel surfaces, including the roof and roof support members are coated with a coal tar epoxy system while the tank shell, floor, and appurtenances are coated with an Epoxy lining. The exterior roof, shell, and appurtenances are painted with what appears to be an Alkyd system. The internal roof lap seams are not caulked.

Field Evaluation

The purpose of this survey was to assess the condition of the existing coatings and recommend maintenance coating work, where needed. The evaluation mainly involved visual observations, but also involved various testing procedures. Photographs and video were taken to document the field inspections, and a photo summary and narrated video is included within this report.

For survey purposes, the tank has been segmented into defined areas: exterior roof, exterior shell, interior roof, interior shell, and interior floor. The various appurtenances within each of these areas have also been evaluated. A rating system has been developed to quantify the condition of these various tank areas. Each of the rating criteria is found in the Attachments (Charts 1 through 6).

The condition of the coating systems was rated as being poor, fair, good, or excellent (Chart 1). The extent of any rust defects identified within each of the areas was generally determined using the guidelines set forth in ASTM D610 “Standard Test Method for Evaluating the Degree of Rusting of Painted Steel Surfaces” (Chart 2). Where applicable, the characteristic or stage of corrosion was determined in accordance with CSI Corrosion Grade criteria (Chart 3). The degree of paint chalking was determined in accordance with ASTM D4214 “Standard Test Method for Evaluating the Degree of Chalking of Exterior Paint Films," Test Method D659, Method C (Chart 4). Coating adhesion was assessed in accordance with ASTM D3359 "Standard Test Method for Evaluating Adhesion by Tape Test, modified Method A and/or a modified version of ASTM D6677 "Standard Test Method for Evaluating Adhesion by Knife" (Chart 5). The modified version of ASTM D6677 was used in areas where destructive testing was not found to be practical. Any blistering that may have been present was rated in accordance with ASTM D714 "Standard Test Method for Evaluating the Degree of Blistering in Paints" (Chart 6), and the paint dry film thickness was measured with a Positector 6000FN3 Type II gage in accordance with the applicable guidelines set forth SSPC PA2. The visual observations and data collected from the various areas of the tank are found in the charts below:

Exterior

Close-up visual examination of the coating was limited to the first (lowest) shell course, upper shell areas adjacent to the ladder, and the roof. The exterior paint on the roof and shell is in poor condition with moderate chalking (ASTM D4214, No. 6). Light rust (CSI Corrosion Grade 2) was present in areas that had been mechanically damaged from operations or vandalism and areas where paint was peeling. The amount of rust on the tank was deemed excessive but less than one percent of the overall surface area when and rated a 6 by ASTM D610. Areas where paint was found to be cracking were rated a 2 in accordance with ASTM D661. The paint thickness was found to range from 3.0 to 6.0 mils, and the paint was estimated to exhibit poor adhesion (ASTM D6677, 2A-3A). Some of the specific data collected follows:

Exterior Paint					**Overall Condition**		Poor					
Paint Defects	**Roof Quadrant**				**Shell Quadrant**				**Tank Support**			
	Exterior		Poor		Exterior		Poor		Exterior		Poor	
	S	**W**	**N**	**E**	**S**	**W**	**N**	**E**	**S**	**W**	**N**	**E**
Rust spots (ASTM D610)	6	6	6	6	6	6	6	6			6	6
Corrosion Grade	2	2	2	2	2	2	2	2			2	2
Rusting at crevices												
Spot peeling	Yes	Yes	Yes	Yes							Yes	Yes
Delamination												
Cracking (ASTM D661)	2	2	2	2	2	2	2	2			2	2
Checking (ASTM D660)												
Chemical staining												
Chalking	6	6	6	6	6	6	6	6			6	6

Interior

The roof area is defined as those surfaces above the highest water level (HWL). Close-up visual examinations were made to all areas below the waterline and all other areas were assessed from the water level. The coating on the underside of the roof plates and roof support structure is in poor condition with corrosion common to the edges of the support member flanges and roof plates. Spot peeling and cracking was observed throughout, leading to lamellar or exfoliation corrosion and structural loss (CSI Corrosion Grade 2, 4, 5). The total amount of corrosion on the roof was rated to be approximately 100% percent of the total surface (ASTM D610, 0), and there was a moderate amount of rust staining present at the upper shell course from the roof.

The shell surfaces are covered with a dark sediment, but spot checking revealed the lining on the shell was found to be in poor condition with areas of dark rust (CSI Corrosion Grade 2), especially below the high-water level segment of the shell. The total amount of corrosion on the shell was rated to be one-third of the total surface (ASTM D610, 2) with rust nodules and pitting observed. Fields of intact, medium dense blisters were observed (ASTM 714, 2)..

The floor had sediment upon it, but spot checking revealed a thin film epoxy system that was estimated to be in poor condition, (ASTM D610, 2) with fields of small, medium-dense blisters (ASTM 714, 2), and pitting that measured up to 0.220”. The pitting uncovered at the floor was patched during the inspection. The data collected follows:

Interior Paint			Above Water Condition			Poor		Below Water Condition			Poor	
Paint Defects/Overall Grade	Roof Quadrant				Shell Quadrant				Floor Quadrant			
	Interior		Poor		Interior		Poor		Interior		Poor	
	S	W	N	E	S	W	N	E	S	W	N	E
Rust spots (ASTM D610)	0	0	0	0	2	2	2	2	2	2	2	2
Rust areas (ASTM D610)												
Corrosion Grade	2, 4, 5	2, 4, 5	2, 4, 5	2, 4, 5	2,3	2,3	2,3	2,3	2,3	2,3	2,3	2,3
Rust staining	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
Rusting at crevices	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Spot peeling												
Delamination	Moderate	Moderate	Moderate	Moderate								
Cracking (ASTM D661)	2	2	2	2	2	2	2	2	2	2	2	2
Blistering (ASTM 714) Size/Densit					2/Medium	2/Medium	2/Medium	2/Medium	2/Medium	2/Medium	2/Medium	2/Medium
Pitting (Estimated Amount)									5	5	5	5
Pitting (Estimated Deepest Mils)									0.22	0.2	0.22	0.2

Dive Inspection Video

Click on link or cut and paste the external link: https://youtu.be/UKw440XLnms

Discussion

The paint system on the exterior was found to be relatively thin and in poor condition on both the roof and shell. All surfaces have isolated spot rust and areas of peeling and the paint system was found to have significantly weathered from chalking. It was also noted that the underside of the center vent has heavy corrosion up to and including some metal loss.

Chalking is the term for the powdery characteristic of an aged coating that may also have a faded finish. Chalking is a result of the natural breakdown of a paint system's binder when it is exposed to sunlight. The binder (or resin) degrades in ultraviolet light, which leaves behind the unbound pigment or chalk. Aside from a faded appearance, chalking can result in corrosion as the film weathers (thins) away through cycles of wind and rain. As the paint endures years of direct sunlight, it begins to weather away, which results in the paint no longer providing enough barrier protection from corrosion. On this basis, it is recommended that a plan for recoating the tank with an industrial paint should be completed.

Generally speaking, there are four possible approaches to maintenance coating work. The coatings can be either completely removed and replaced (repainted), spot repaired, spot repaired and overcoated, or simply overcoated. In evaluating the condition of a coating to determine the best approach there are a number of different factors to consider. The first set of factors includes the determination of the coating's ability to withstand the added stress of an additional coat(s). Attributes impacting this decision

include film thickness and adhesion. If a film is too thick or has poor adhesion, the tension from the curing stresses and/or the weight of the additional paint can cause the existing system to disbond. The second set of factors to consider when determining what maintenance coating approach to take is the amount of surface area requiring repair, the overall difficulty in providing access to the structure, and whether the coating system contains heavy metals. The final factor is the condition of the substrate.

When considering whether a spot repair approach is a viable option, a good rule of thumb is that up to 10 percent of the surface area requiring repair is the point at which making spot repairs with overcoat becomes a diminishing return. With 10 percent rusting, overcoating may be an option if the adhesion is better than fair. If there is more than 10 percent rusting and the substrate is free of mill scale, overcoating may be considered an option if the adhesion is satisfactory. Once the amount of surface area exceeds this range, the cost of cleaning and coating the individual rust spots approaches (or exceeds) the total cost of removal and replacement.

On this basis, it is recommended that the tank exterior paint system be removed and replaced within the next 1 to 2 years before any additional significant metal loss develops.

At interior surfaces, the tank lining system was found to have widespread dark corrosion above the highest water level (HWL) with lamellar and/or exfoliation corrosion common to knuckle bracing edges and structural loss at the rafters connected to the dollar plate. A significant amount of corrosion was found below HWL with pitting and medium dense patches of broken and unbroken blisters.

Exfoliation corrosion is a form of intergranular corrosion which involves selective attack of a metal at or adjacent to grain boundaries. In this process, corrosion products force metal to move away from the body of the material, giving rise to a layered, laminar appearance. Exfoliation corrosion is also known as layer corrosion or lamellar corrosion.

Since all of the blisters were underwater and below the common water level, it is presumed that the blisters are a result of osmotic forces. Osmotic blistering is typically caused when coatings that are to be placed into immersion service are applied too thick, overcoated too soon, under colder weather conditions, and/or over contaminated surfaces. One form of osmotic blistering is solvent entrapment. Solvents are added to coatings to act as a vehicle during application. When coatings are applied too thick the coating solvents that were designed to be released during application are locked in-place when the catalyzed coating reaches a full chemical cure. Additionally, if coatings are applied under cold or cooler conditions, the solvents have a difficult time escaping from the film before it gets hard. Blisters that result from solvent entrapment tend to be localized to the coolest and lowest areas of a tank. Solvent vapors are typically heavier than air, and the lowest portion of a tank tends to become saturated with these gases without proper ventilation at the time of application. Coated over contamination creates a source for osmotic forces. This contamination attracts fluid that creates pressures that exceed the film's ability to bond, creating blisters.

Isolated corrosion pits can develop within a coating system that may have only a few small breaks that were not corrected through periodic maintenance repairs. If the remaining, adjacent coating has excellent adhesion, it will inhibit undercutting corrosion. As a result, the corrosion forces will have a tendency to concentrate on the exposed bare metal, which results in pitting. Pitting can be critical in some instances. The maximum corrosion rate for steel in fresh water is typically no more than 30 mils per year (MPY). As a result, the pitting can develop into a perforation if not repaired. If a thru-hole develops within a tank bottom, the isolated issue can develop into a much larger corrosion problem. Corrosion requires oxygen to advance, and the underside of the tank bottoms are considered a dead-air space. As a result, the bottom of tank floors are typically not coated. A perforation or thru-hole with even a small trickle of water will reintroduce oxygen into the environment creating active corrosion that is difficult to identify until the steel floor plate requires replacement.

Industrial paint systems such as those applied to industrial facilities (i.e. piping, structural steel, storage tanks) typically have a life expectancy of 25 to 35 years before any spot maintenance coating repairs are required. The exterior paint system and the interior lining is 51 years old and cannot be spot repaired. The characteristics of the coating defects indicates that the lining failed many years ago.

A common tank design in the past was to run tank piping up through the tank bottom. This design can help prevent piping from obstructing outside areas of the tank but can be problematic during a seismic event. During an earthquake, there is the potential for the tank bottom to move at a different rate than the below grade piping. Past seismic events have resulted in piping connections being sheared or cracked, which resulted in a loss of water capacity during times when it was most needed during the emergency. Moving tank piping to the shell to include flexible connections for inlet/outlets is a better design when considering this issue.

Recommendations

The following activities are recommended for remedial work:

Exterior

Within the next one to two years, remove and replace the exterior coating. This work should include the following:

1) Remove and replace the exterior paint system. This work should include cleaning all surfaces in accordance with SSPC's Surface Preparation Standard No. 6, "Commercial Blast Cleaning" (SSPC SP-6) followed by 4-6 mils of an industrial epoxy primer and 3-5 mils of a polyurethane finish coat.

2) Test the paint system for heavy metals to determine if any special actions are required to protect workers and the environment during paint disturbance.

Interior

As soon as possible, remove and replace the interior lining. This work should include the following:

3) Remove and replace the lining system at all interior surfaces. This work should include cleaning all surfaces in accordance with SSPC's Surface Preparation Standard No. 10 "Near-White Metal Blast Cleaning" (SSPC-SP10) followed by three 4 to 6 mil coats of an NSF Certified epoxy lining.

4) Caulk all crevices in the tank such as roof lap seams.

5) Anticipate the need for structural repairs (welding, grinding, etc.)

6) Consider retrofitting the tank piping to include flexible couplings and the relocation of tank bottom connections to the lower shell.

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Phone: 877.274.2422 (toll free)
Fax: 661.755.7628
www.CSIServices.biz

Page	1	of	1
Date	5-11-2023	Thursday	
CSI Job No.	223068		
Completed By	Steven Metcalf		

Field Water Tank Dive Inspection Report

Tank Name:	Clear Well Tank	Dive Supervisor:	Steven Metcalf
Tank Owner/Client:	Calaveras Public Utility District	Dive Leader:	Anthony Jackson
Client Contact:	Karl Brustad	Dive Tender	Steven Metcalf Jr

Scope Maintenance Inspection

Site Information

Item	Description
Cross Street	Ridge Rd
Tank Location	1500 W Forty Rd, Mokelumne Hill, CA
GPS Coordinates	38.3437, -120.5433
Nearest Structures	2nd New Tank
Surrounding Site	Gravel

Item		Notes
Perimeter Fencing	Yes	around facility
Site secured on arrival	Yes	No Comments
Overhead Power Lines	No	None
Antenna on Tank	No	None
Roof Accessible	Yes	No Comments

Interior Structural Characteristics

Item	Data	
Roof Structure	rafters, girders and one center column	
Column Design	Pipe	
Upper Center Column	cone	
Column Base Design	Free plate with clips	
Connections	Bolted	
Overflow Design	Funnel and pipe, floor exit	
Inlet Interior Design	floor stub	
Lining Type/Original	CTX (Coal-Tar Epoxy)	Yes

Item	Data			
Outlet Design	floor stub			
No. Interior Ladder	Yes	one		
CP System/Type	No	None		
Water Depth	14 ft			
Water Agitator	No	None		
Barrier Walls	Four barrier walls			
No. of Columns	one column			
Caulking	Roof	No	Columns	No

Exterior Structural Characteristics

Item	Data	
Capacity (gallons)	500,000	
Diameter (feet)	70	
Height (feet)	16 ft	
Erection Year	1972	
Contract No.	32328	
Tank Type	Welded Steel	
Tank Profile	on grade	
Tank Geometry	cylinder	
Number of Courses	two	
Height of Each Course	8 ft	
Roof Design	pitched roof	
No. Shell Manways	one shell manway	
Type of Manways	round	
Manway Cover Design	unibolt	
Diameter of Manways	20 in	
No. Roof Hatches/Location	one	near edge
Hatch Design	square	
Size of Roof Hatch	20 in	
No. Roof Vents/Location	one	center
Roof Vent Design	round hood	
Construction Co.	Pitt Des Moins	

Item	Data	
Center Roof Vent Size	16 in	
Roof Vent Sealed	Yes	Satisfactory
Roof Rail System	Yes	top of ladder only
Roof Rail Satisfactory	Yes	No Comments
Rail Location	top of ladder only	
No. & Type Roof Access	one	ladder
Exterior Vandal Deterrent	yes	
Ext Ladder Satisfactory	one	yes
Ext Ladder Fall Prevent	yes	
Roof Tie-Off Present	yes	
Tank Piping	floor piping	
Inlet Diameter	12 in	
Outlet Diameter	12 in	
Flexible Pipe Coupling	no	
Overflow Pipe Diameter	12 in	
Overflow Exterior Design	none	
Drain Location	floor	
Tank Foundation	concrete ring wall	
Water Level Indicator	no	
Tank Type	potable	
Lining Type/Original	Alkyd	Yes

Miscellaneous Notes

EXTERIOR - Calaveras Public Utility District - Clear Well Tank - Maintenance Inspection

EXTERIOR - Calaveras Public Utility District - Clear Well Tank - Maintenance Inspection -001

EXTERIOR - Calaveras Public Utility District - Clear Well Tank - Maintenance Inspection -002

EXTERIOR - Calaveras Public Utility District - Clear Well Tank - Maintenance Inspection -003

EXTERIOR - Calaveras Public Utility District - Clear Well Tank - Maintenance Inspection -004

EXTERIOR - Calaveras Public Utility District - Clear Well Tank - Maintenance Inspection -005

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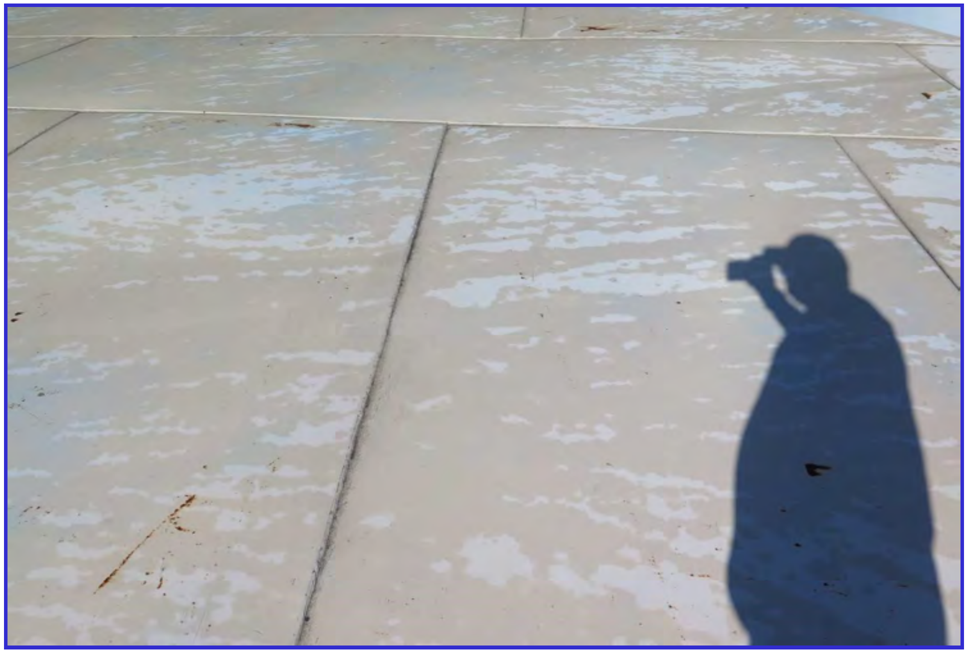
EXTERIOR - Calaveras Public Utility District - Clear Well Tank - Maintenance Inspection -007



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EXTERIOR - Calaveras Public Utility District - Clear Well Tank - Maintenance Inspection -009

EXTERIOR - Calaveras Public Utility District - Clear Well Tank - Maintenance Inspection -010

EXTERIOR - Calaveras Public Utility District - Clear Well Tank - Maintenance Inspection -011

EXTERIOR - Calaveras Public Utility District - Clear Well Tank - Maintenance Inspection -012

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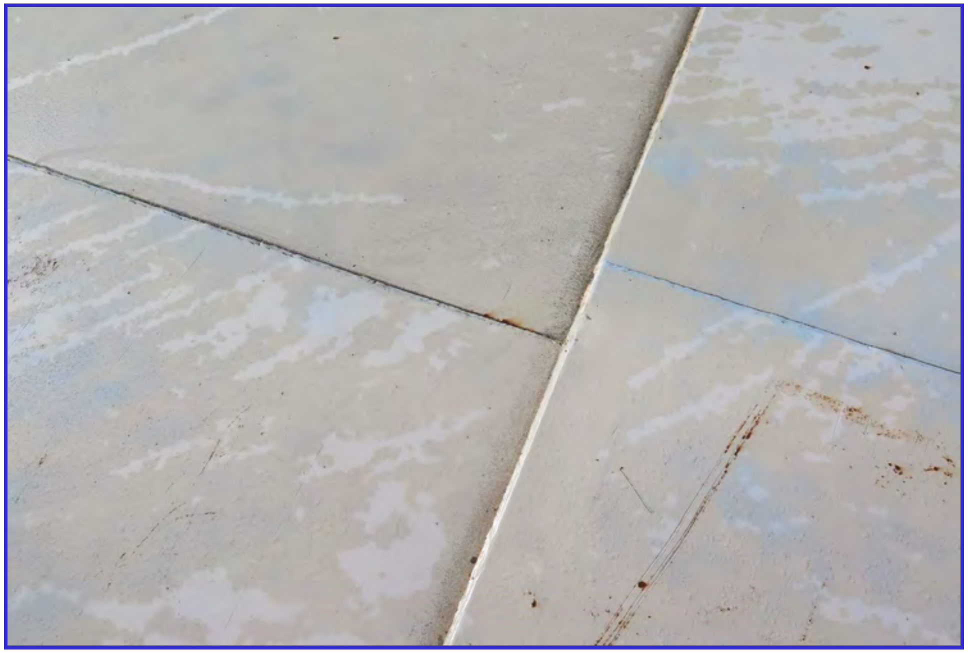
EXTERIOR - Calaveras Public Utility District - Clear Well Tank - Maintenance Inspection -021



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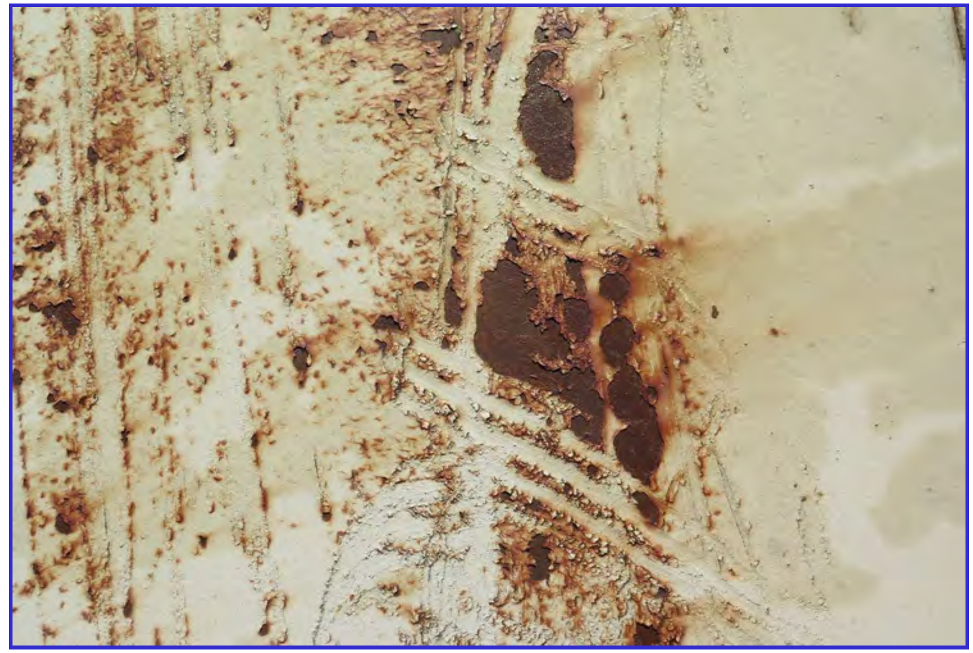

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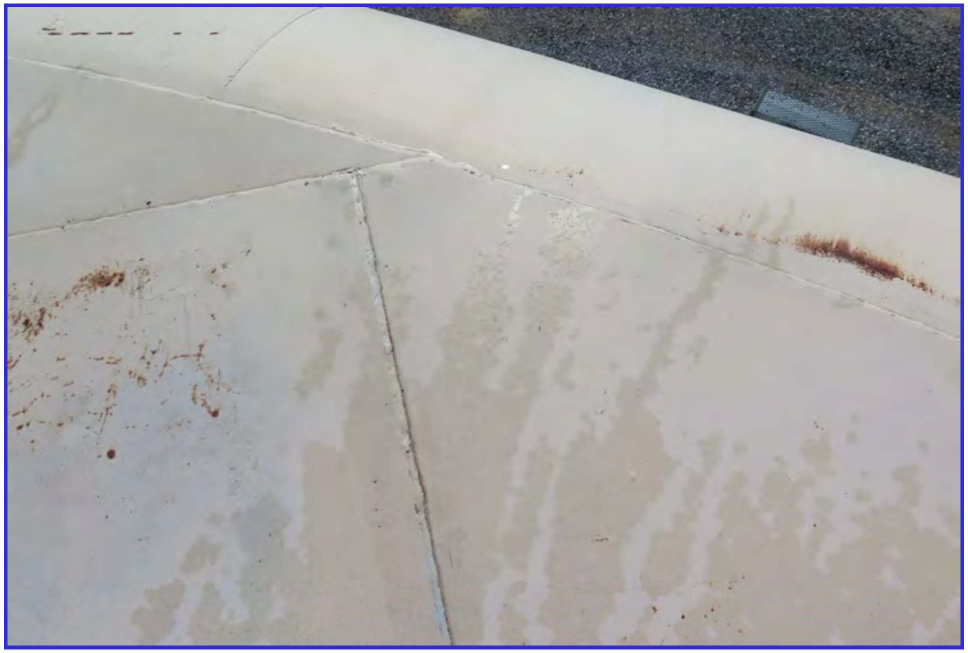

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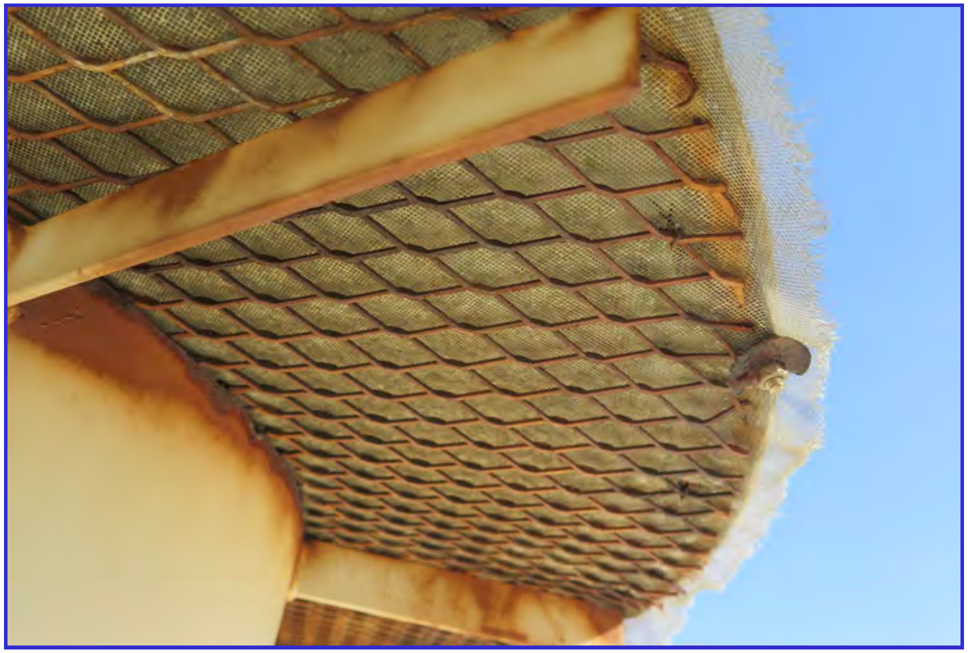

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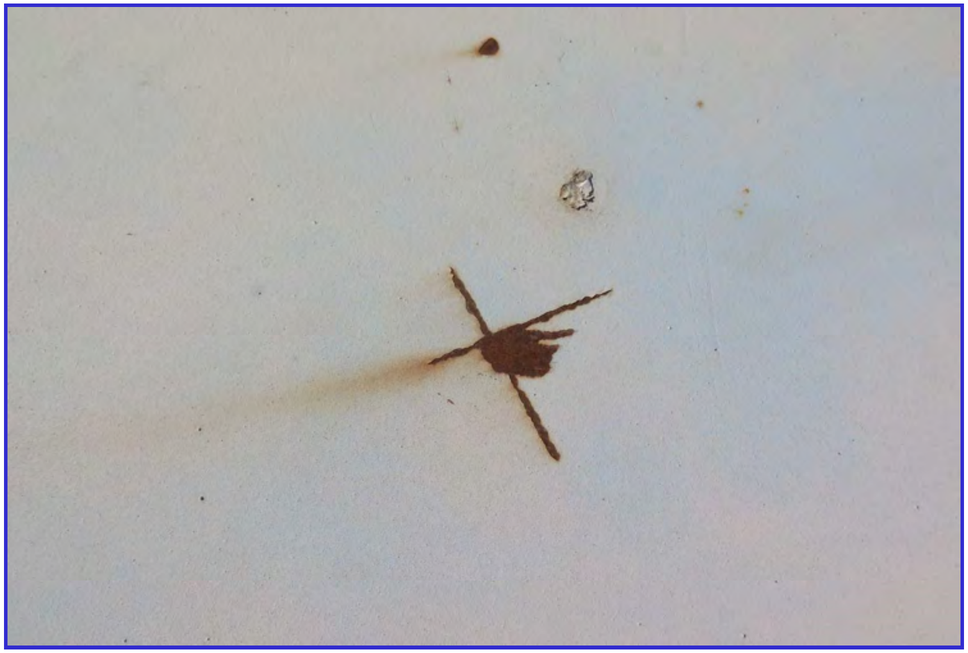

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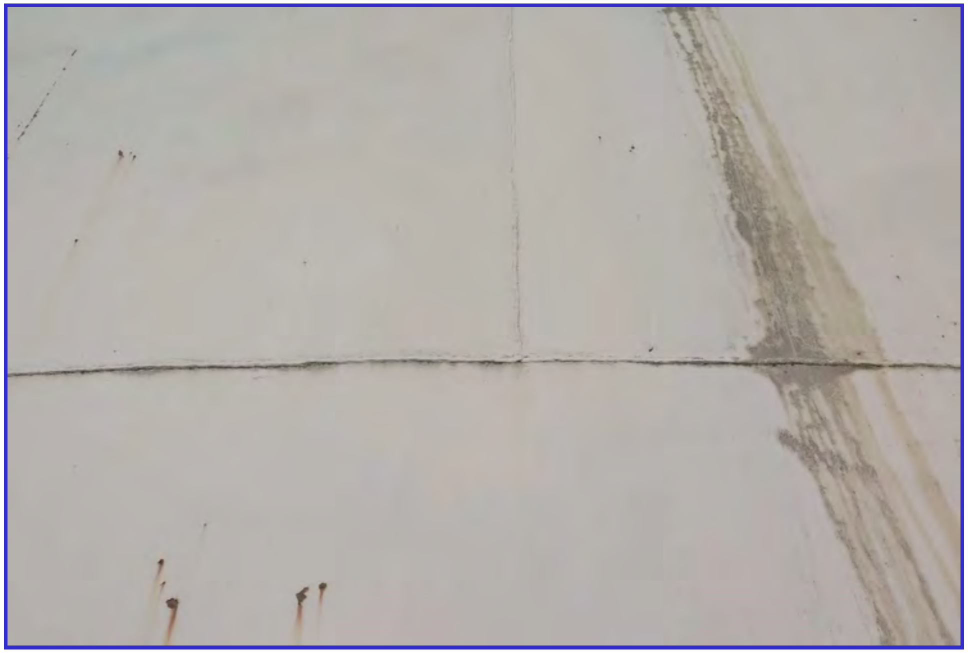

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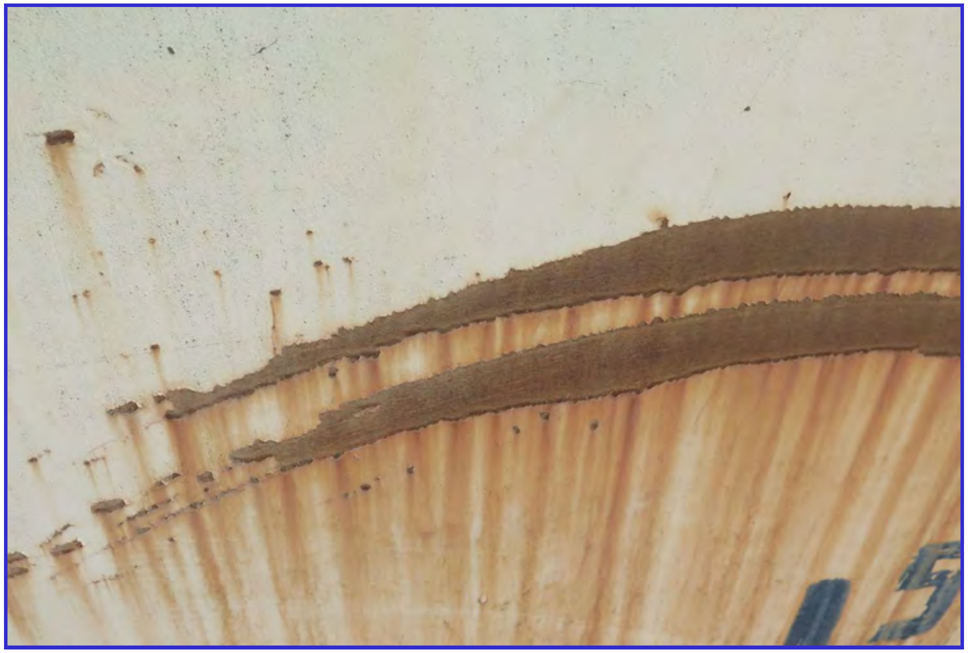

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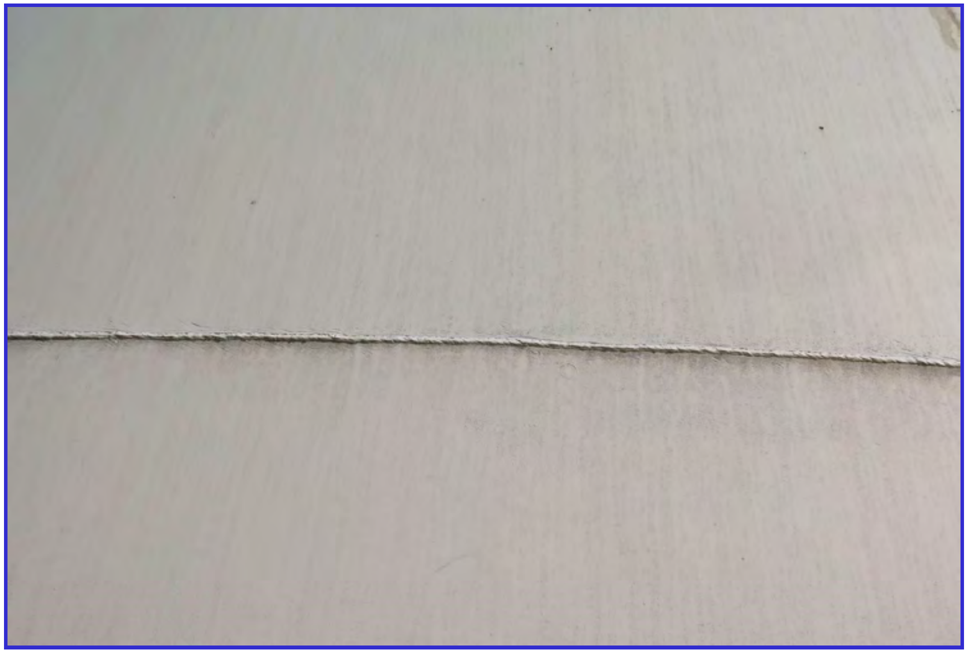

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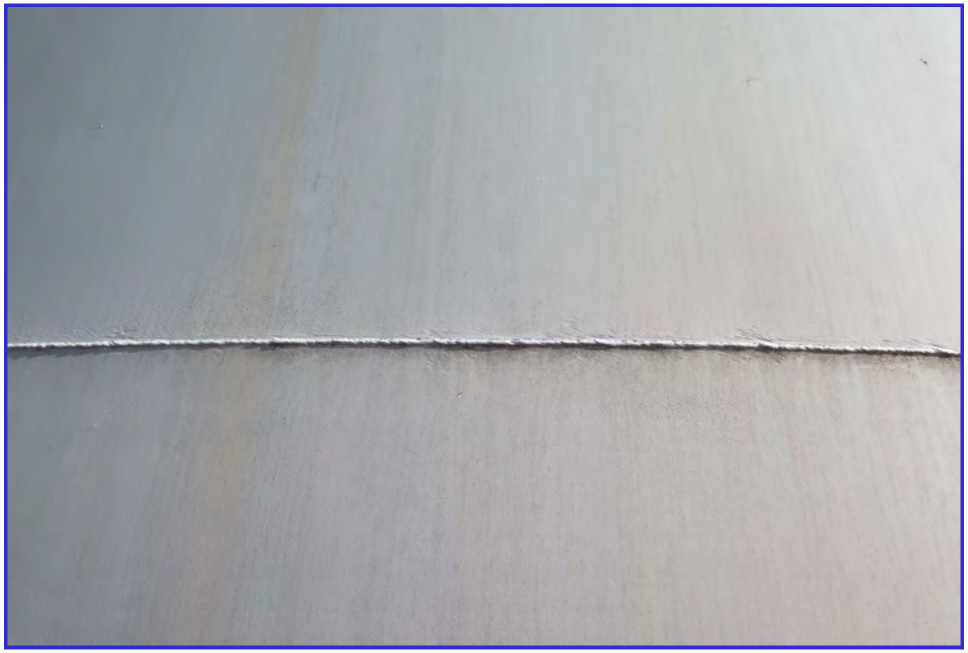

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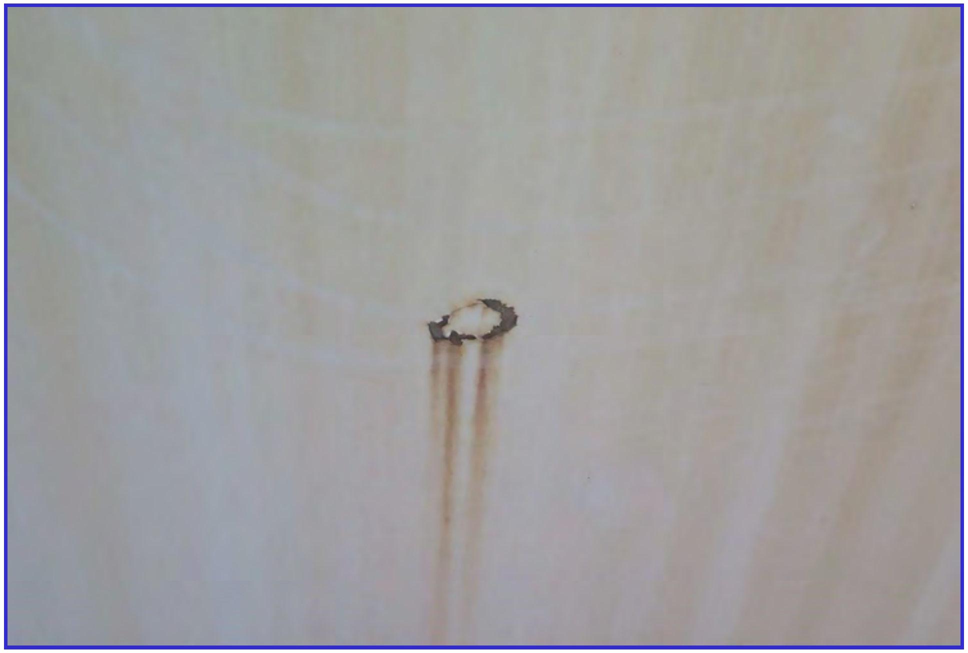

EXTERIOR - Calaveras Public Utility District - Clear Well Tank - Maintenance Inspection -100

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INTERIOR - Calaveras Public Utility District - Clear Well Tank - Maintenance Inspection

INTERIOR - Calaveras Public Utility District - Clear Well Tank - Maintenance Inspection -001

INTERIOR - Calaveras Public Utility District - Clear Well Tank - Maintenance Inspection -002

INTERIOR - Calaveras Public Utility District - Clear Well Tank - Maintenance Inspection -003

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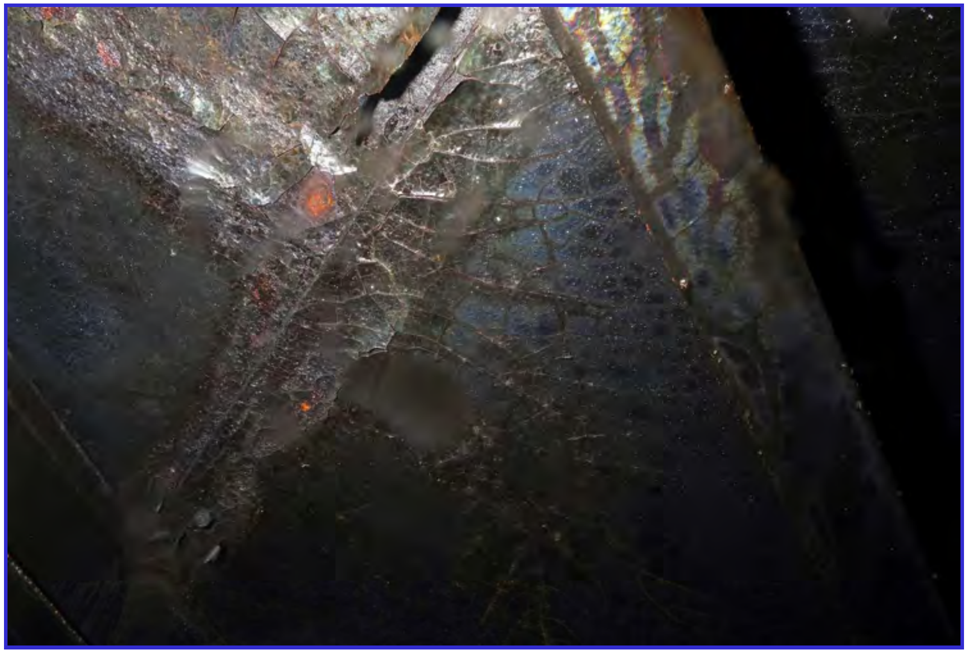

INTERIOR - Calaveras Public Utility District - Clear Well Tank - Maintenance Inspection -008

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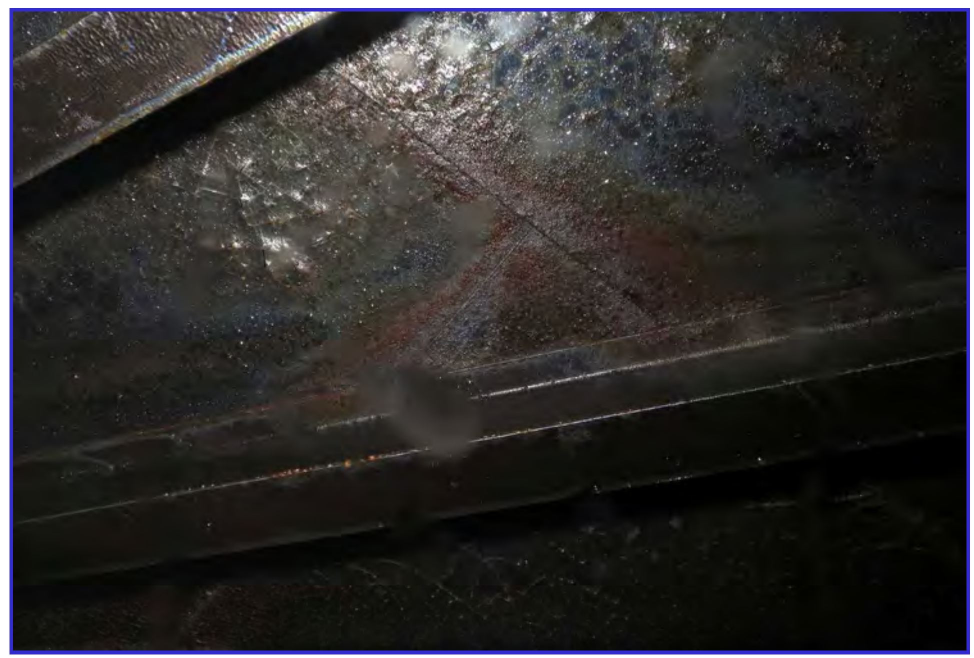
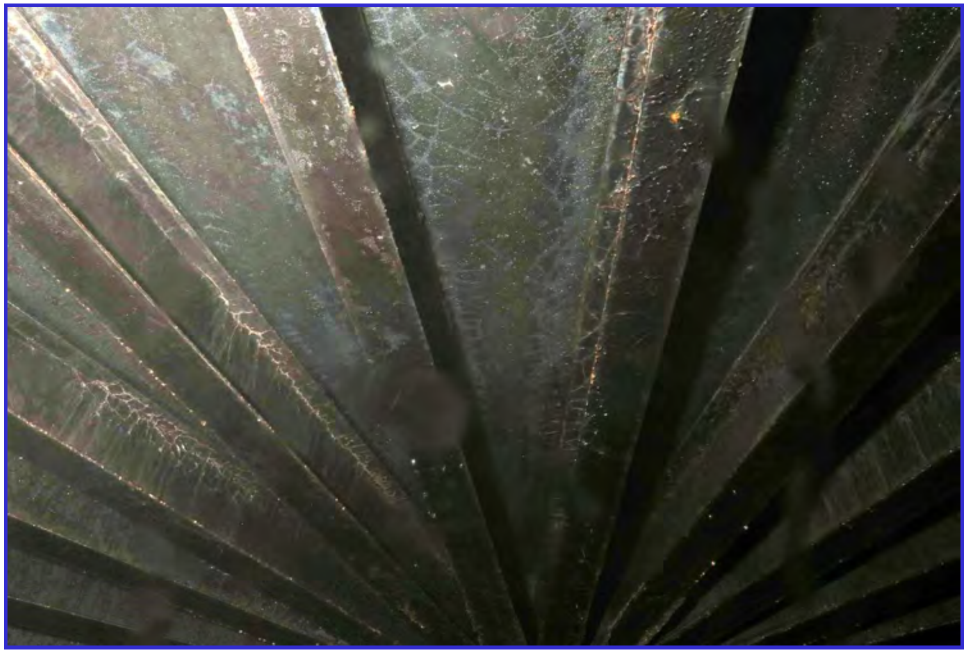
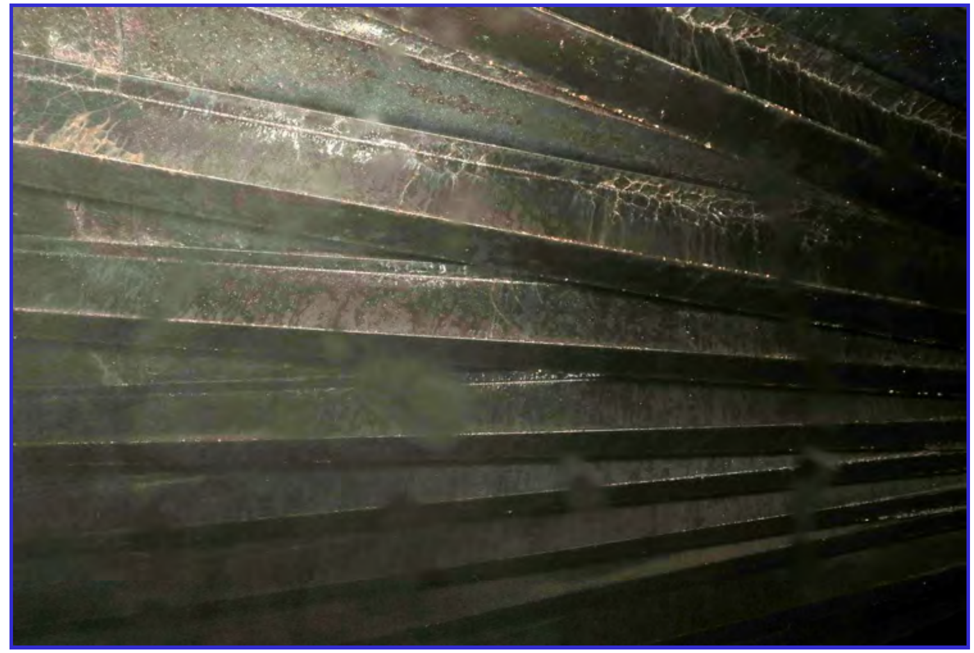


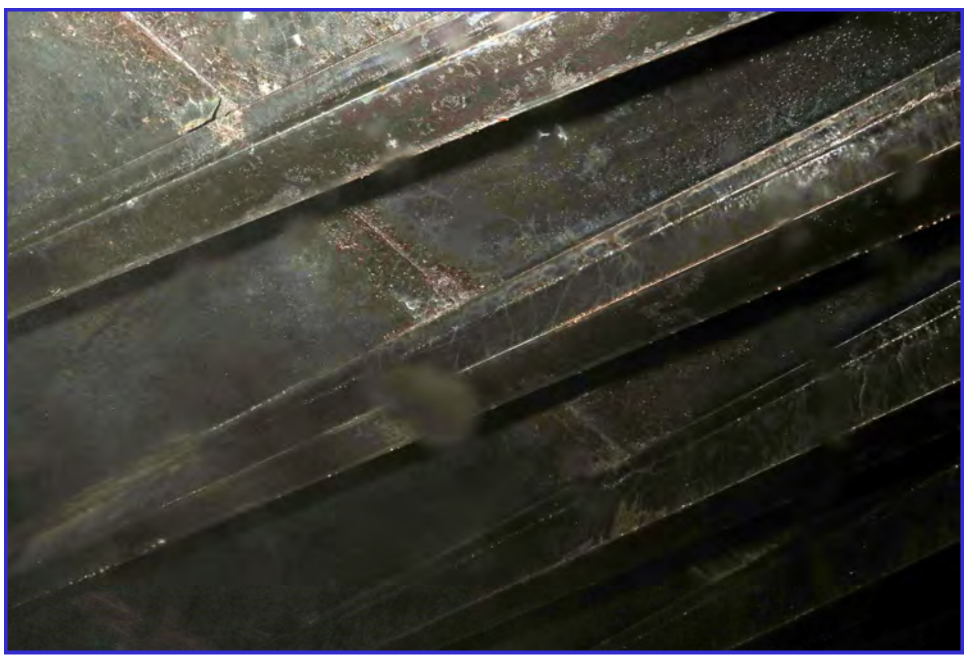
INTERIOR - Calaveras Public Utility District - Clear Well Tank - Maintenance Inspection -011



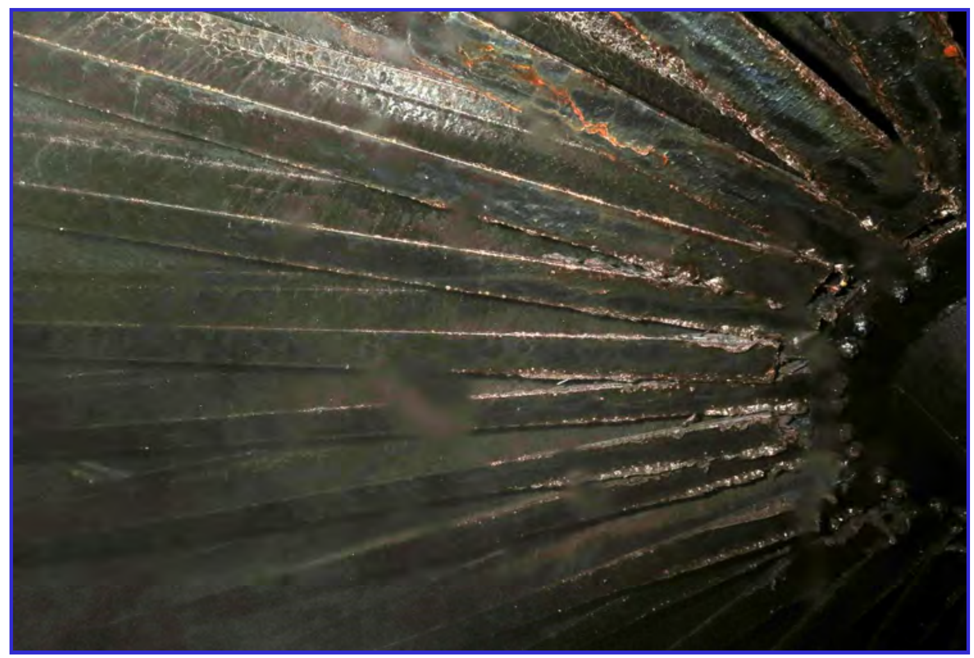
INTERIOR - Calaveras Public Utility District - Clear Well Tank - Maintenance Inspection -012



INTERIOR - Calaveras Public Utility District - Clear Well Tank - Maintenance Inspection -013



INTERIOR - Calaveras Public Utility District - Clear Well Tank - Maintenance Inspection -014



INTERIOR - Calaveras Public Utility District - Clear Well Tank - Maintenance Inspection -015

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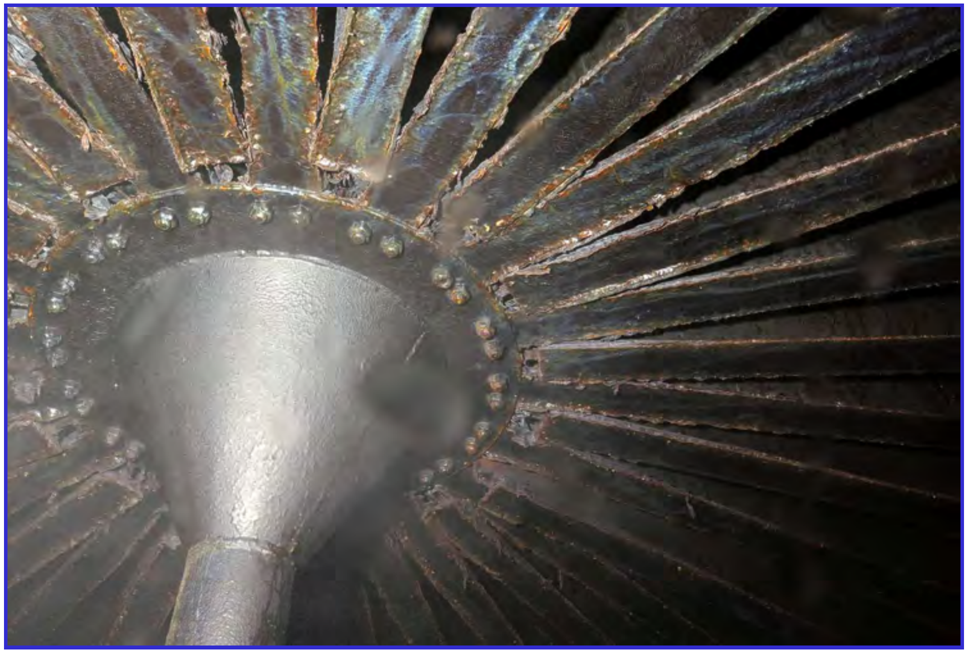
INTERIOR - Calaveras Public Utility District - Clear Well Tank - Maintenance Inspection -018



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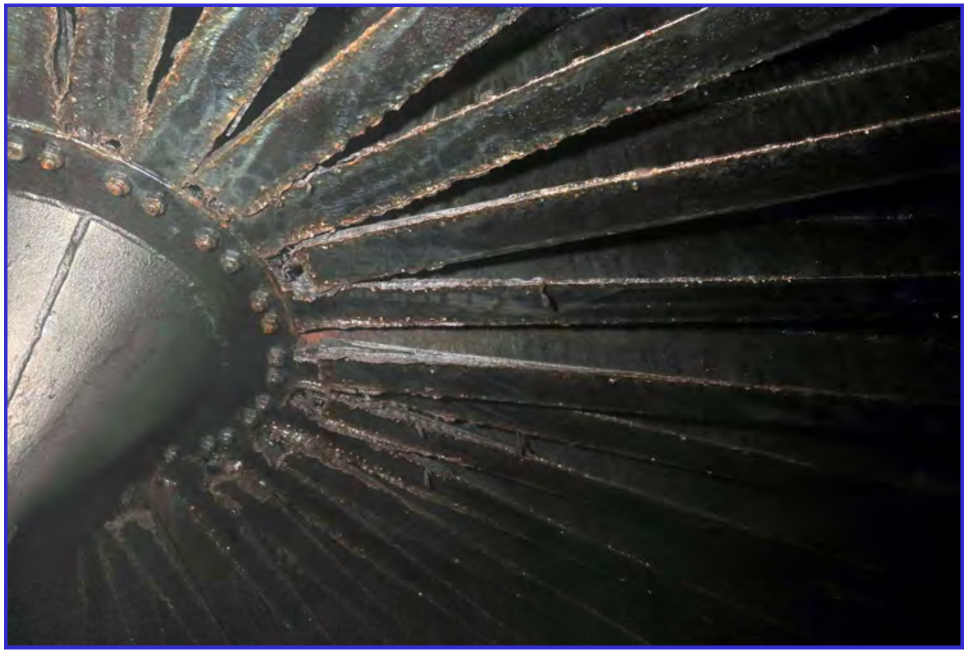

INTERIOR - Calaveras Public Utility District - Clear Well Tank - Maintenance Inspection -020

INTERIOR - Calaveras Public Utility District - Clear Well Tank - Maintenance Inspection -021

INTERIOR - Calaveras Public Utility District - Clear Well Tank - Maintenance Inspection -022

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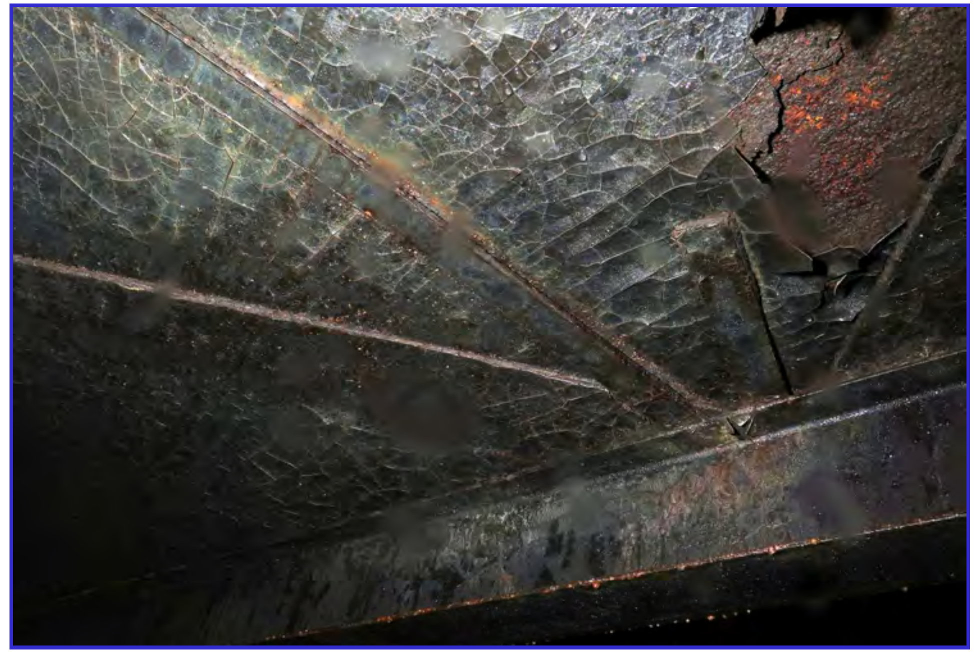

INTERIOR - Calaveras Public Utility District - Clear Well Tank - Maintenance Inspection -029

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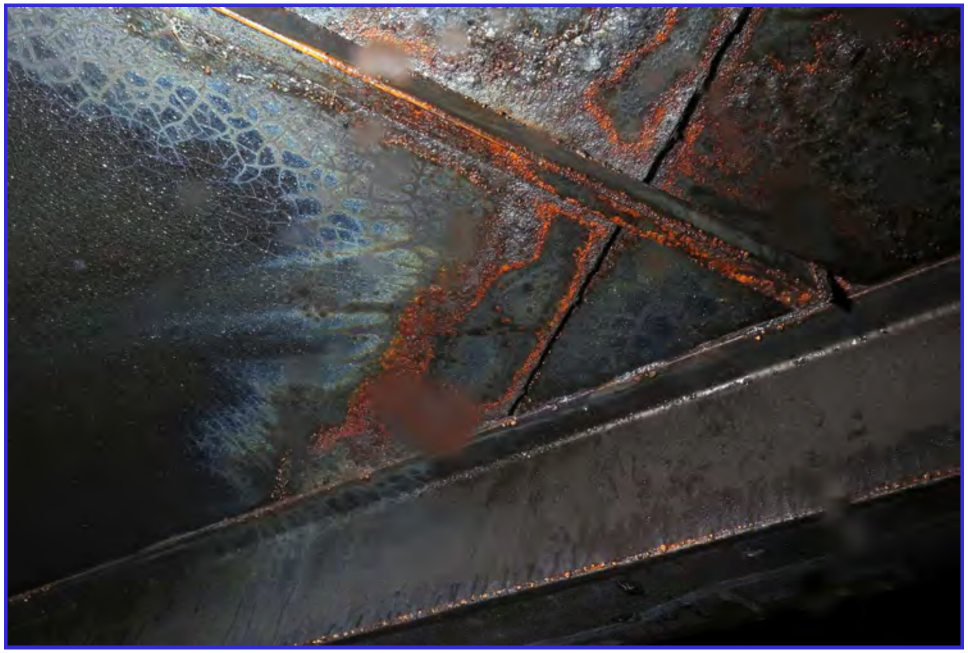
INTERIOR - Calaveras Public Utility District - Clear Well Tank - Maintenance Inspection -031



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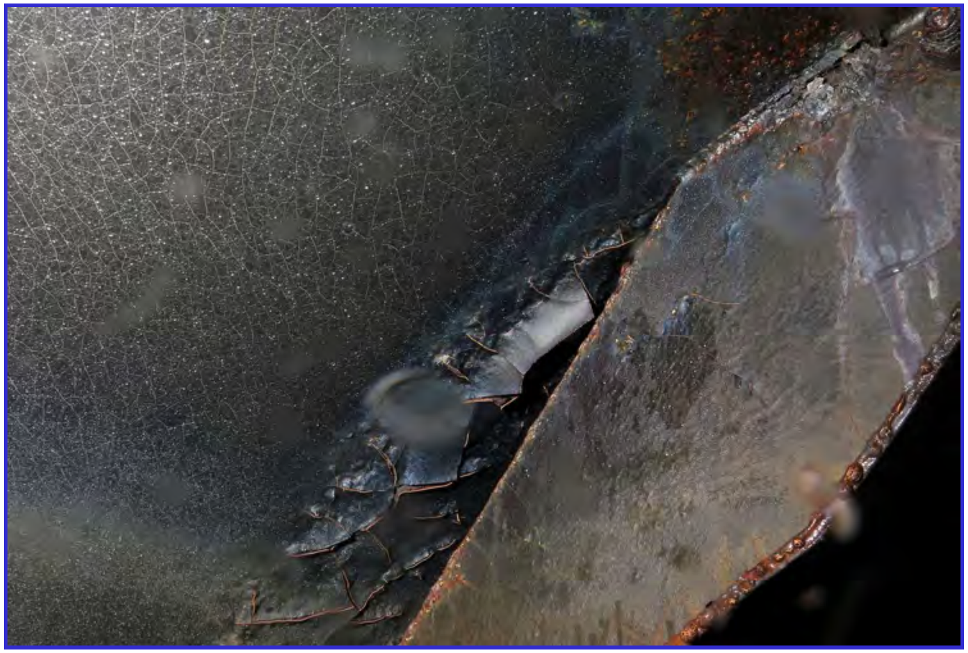

INTERIOR - Calaveras Public Utility District - Clear Well Tank - Maintenance Inspection -035

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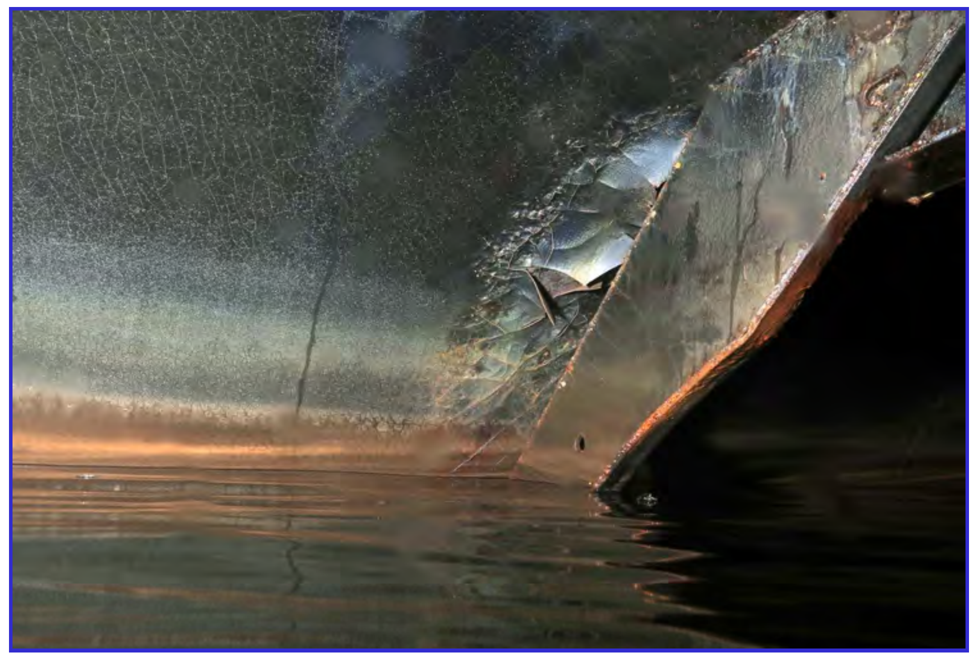
INTERIOR - Calaveras Public Utility District - Clear Well Tank - Maintenance Inspection -038



INTERIOR - Calaveras Public Utility District - Clear Well Tank - Maintenance Inspection -039

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INTERIOR - Calaveras Public Utility District - Clear Well Tank - Maintenance Inspection -042

INTERIOR - Calaveras Public Utility District - Clear Well Tank - Maintenance Inspection -043

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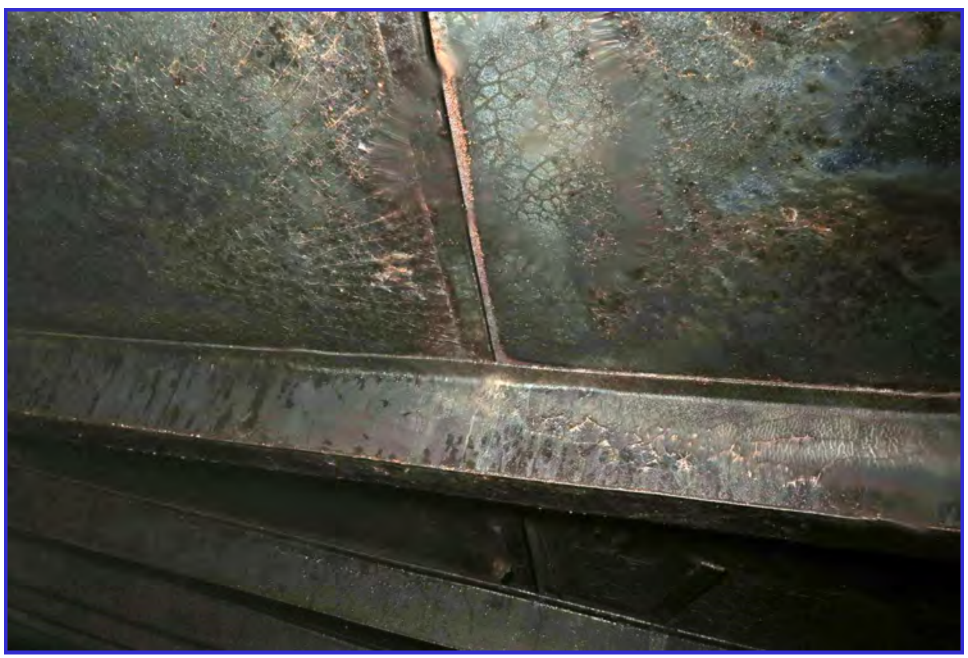
INTERIOR - Calaveras Public Utility District - Clear Well Tank - Maintenance Inspection -045



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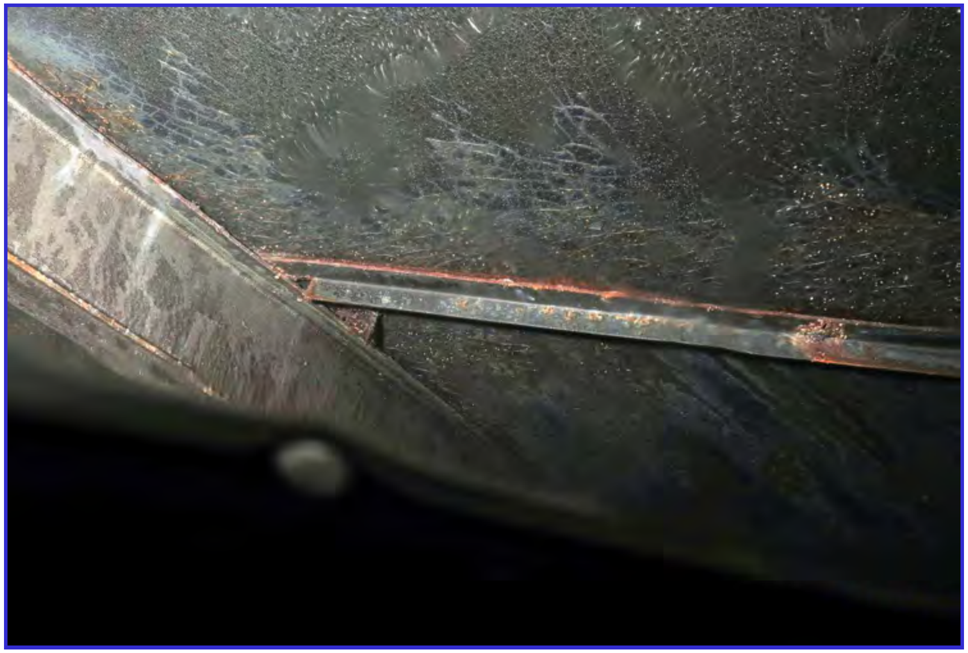

INTERIOR - Calaveras Public Utility District - Clear Well Tank - Maintenance Inspection -048

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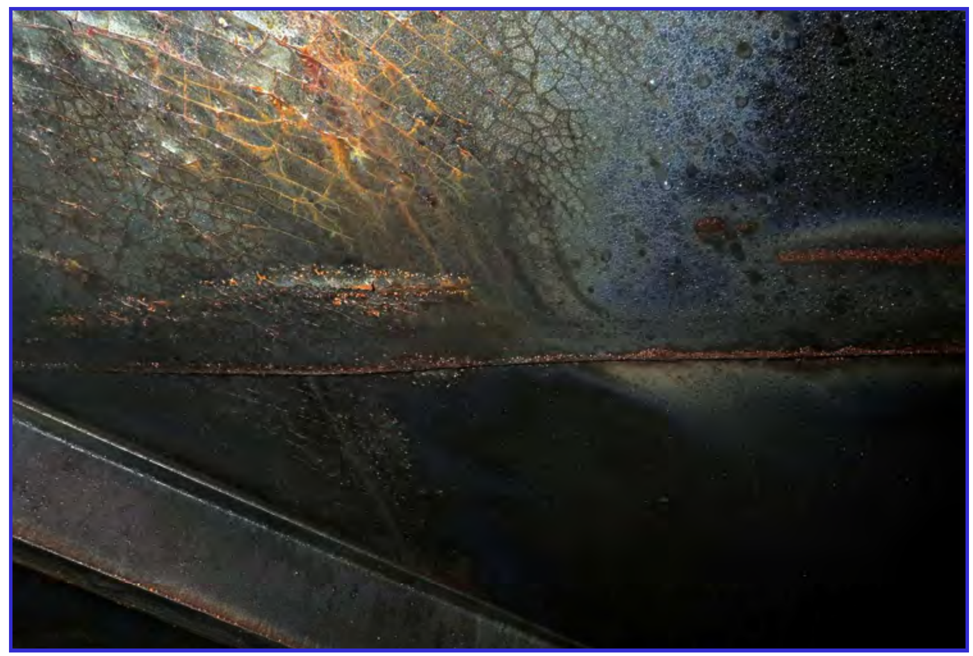
INTERIOR - Calaveras Public Utility District - Clear Well Tank - Maintenance Inspection -050



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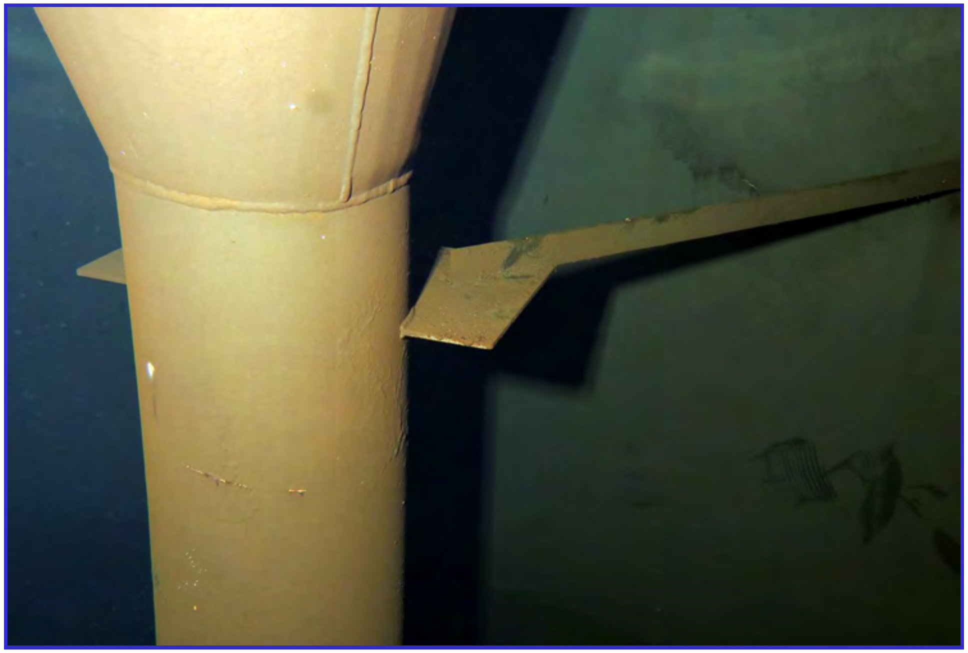
INTERIOR - Calaveras Public Utility District - Clear Well Tank - Maintenance Inspection -056



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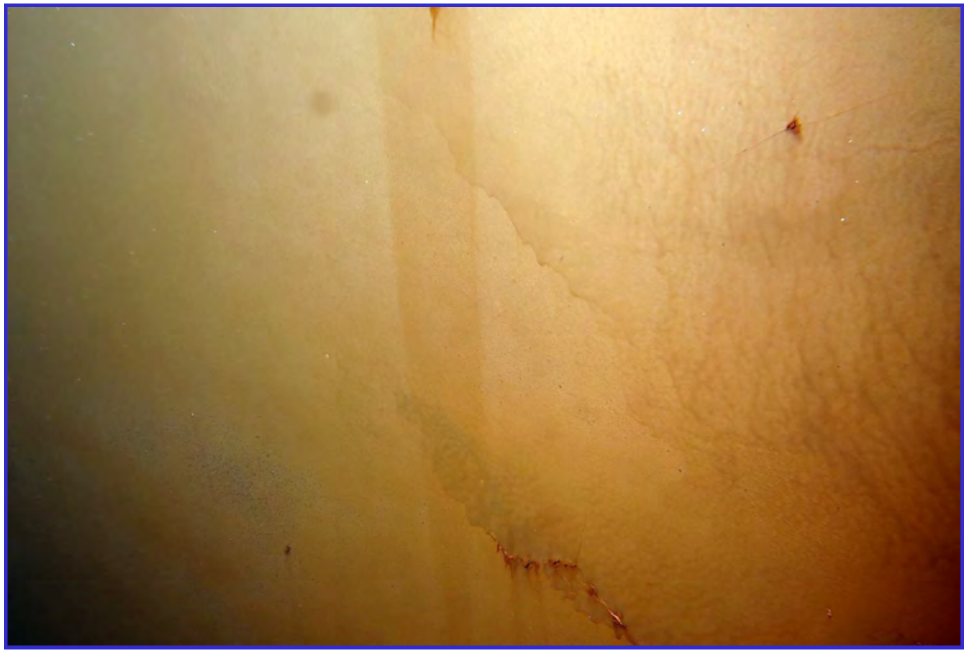

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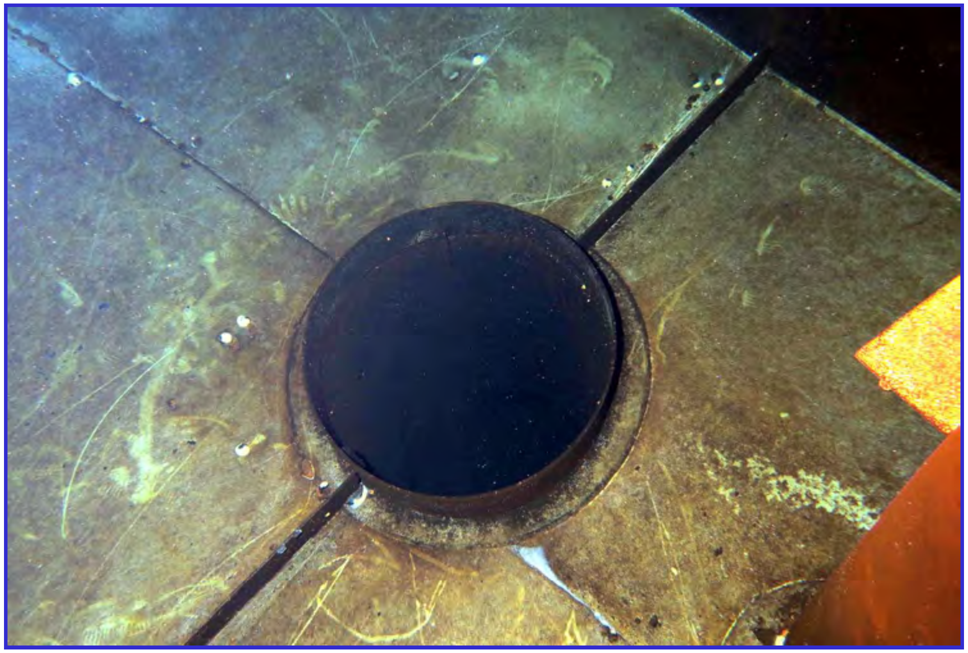

INTERIOR - Calaveras Public Utility District - Clear Well Tank - Maintenance Inspection -061

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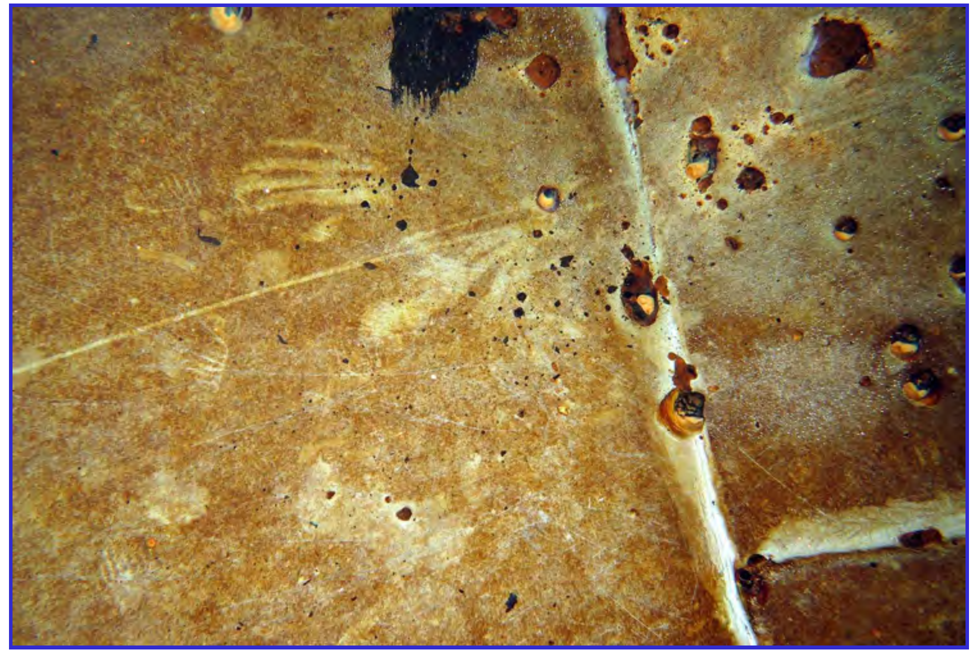
INTERIOR - Calaveras Public Utility District - Clear Well Tank - Maintenance Inspection -063

INTERIOR - Calaveras Public Utility District - Clear Well Tank - Maintenance Inspection -064



INTERIOR - Calaveras Public Utility District - Clear Well Tank - Maintenance Inspection -065

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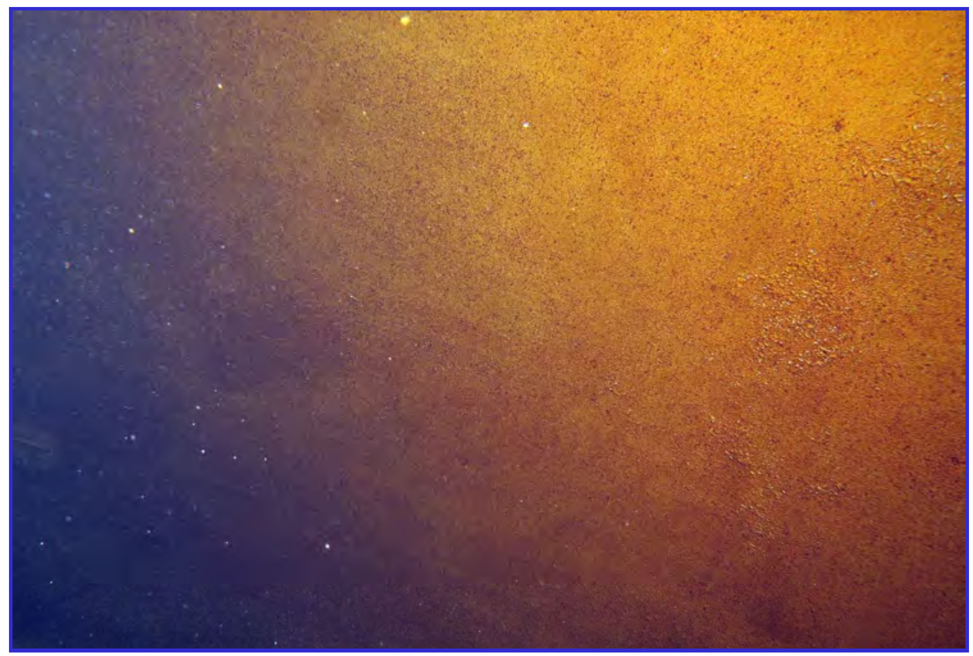
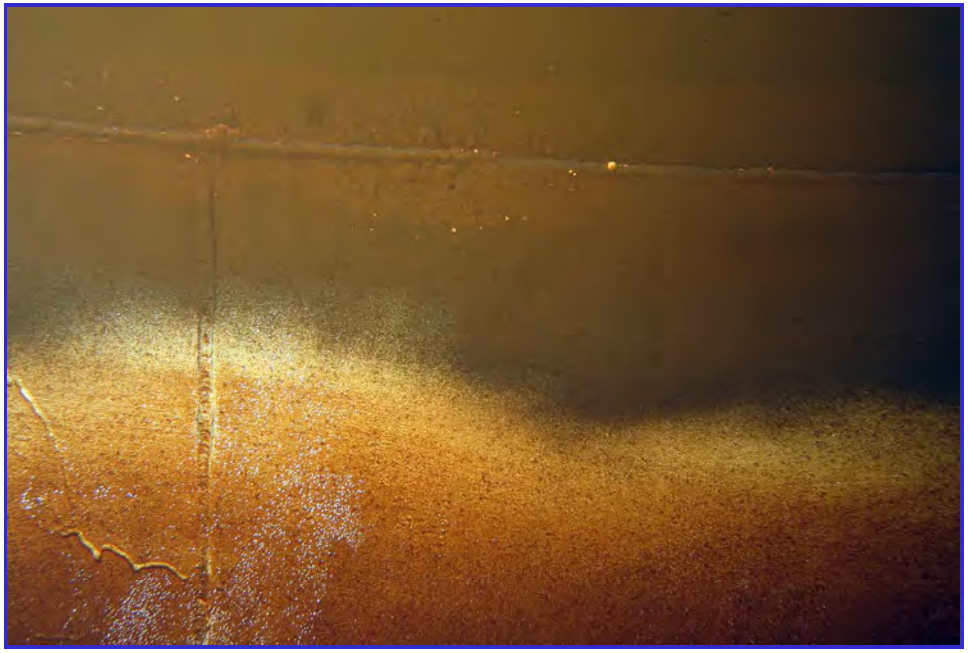


INTERIOR - Calaveras Public Utility District - Clear Well Tank - Maintenance Inspection -067



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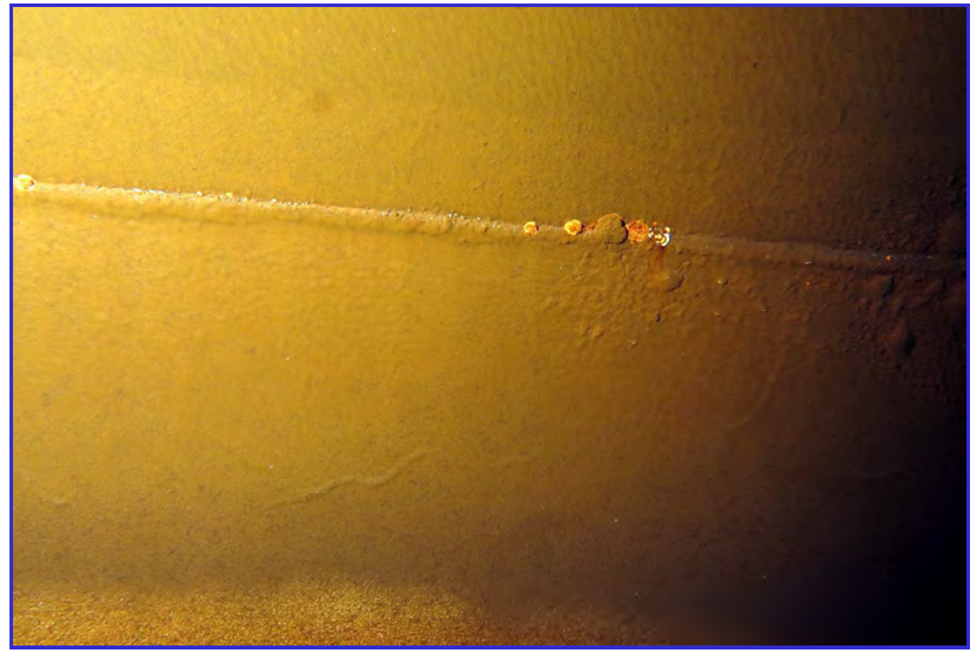
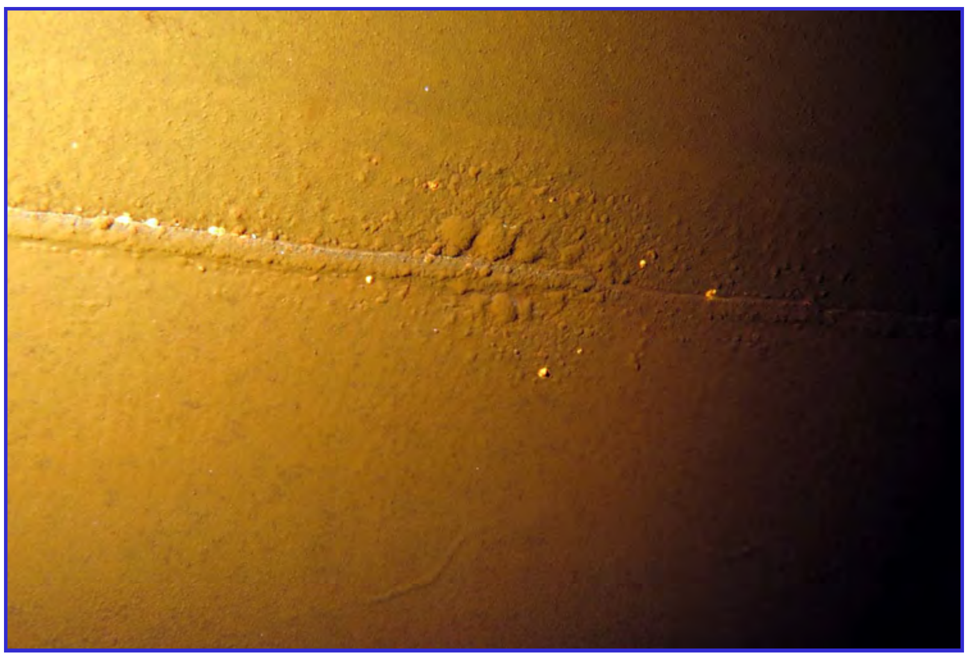


INTERIOR - Calaveras Public Utility District - Clear Well Tank - Maintenance Inspection -069



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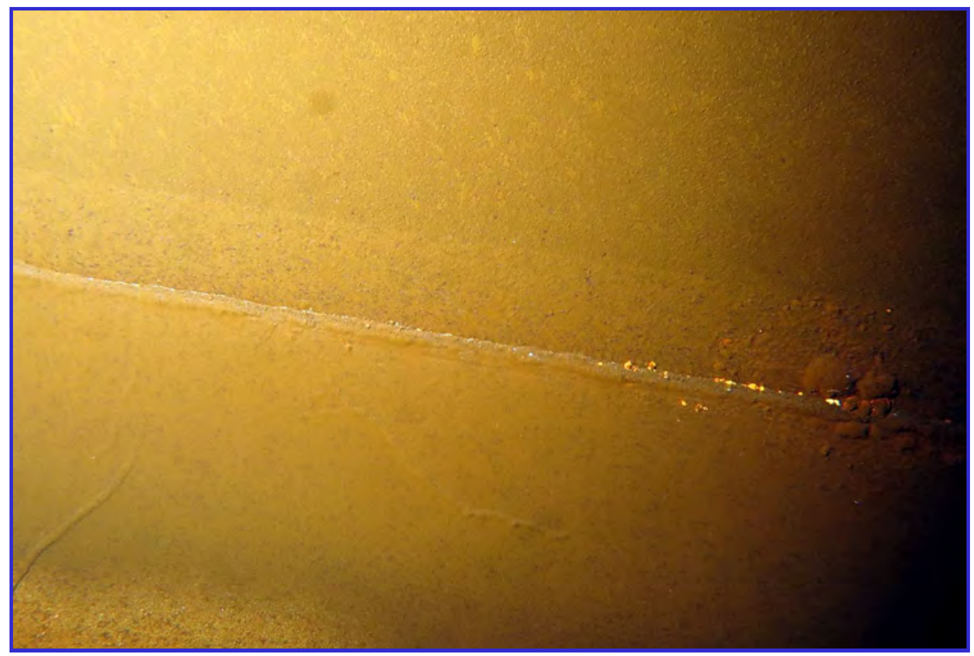

INTERIOR - Calaveras Public Utility District - Clear Well Tank - Maintenance Inspection -071

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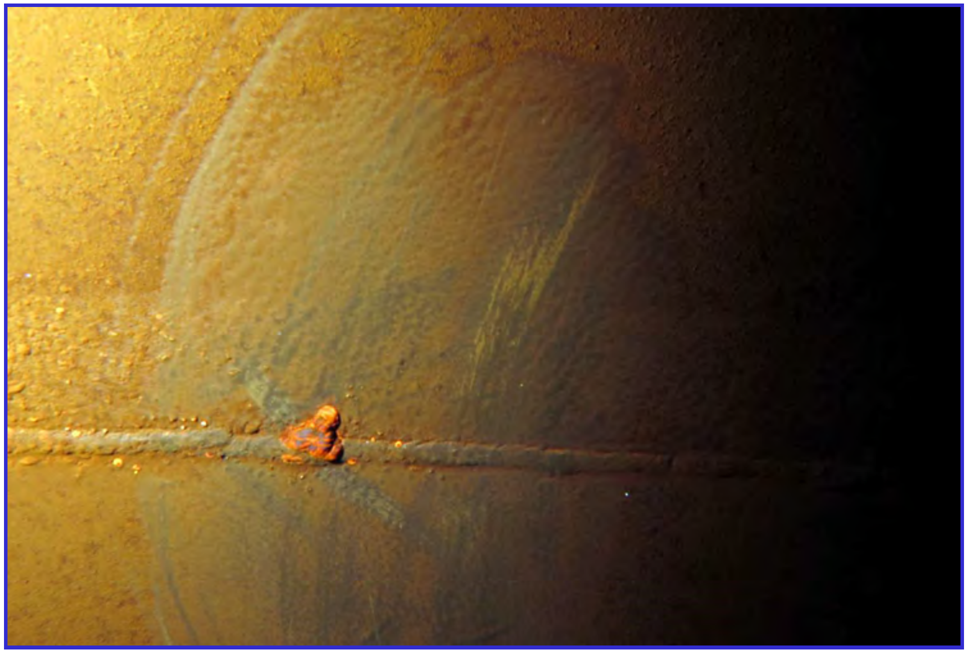

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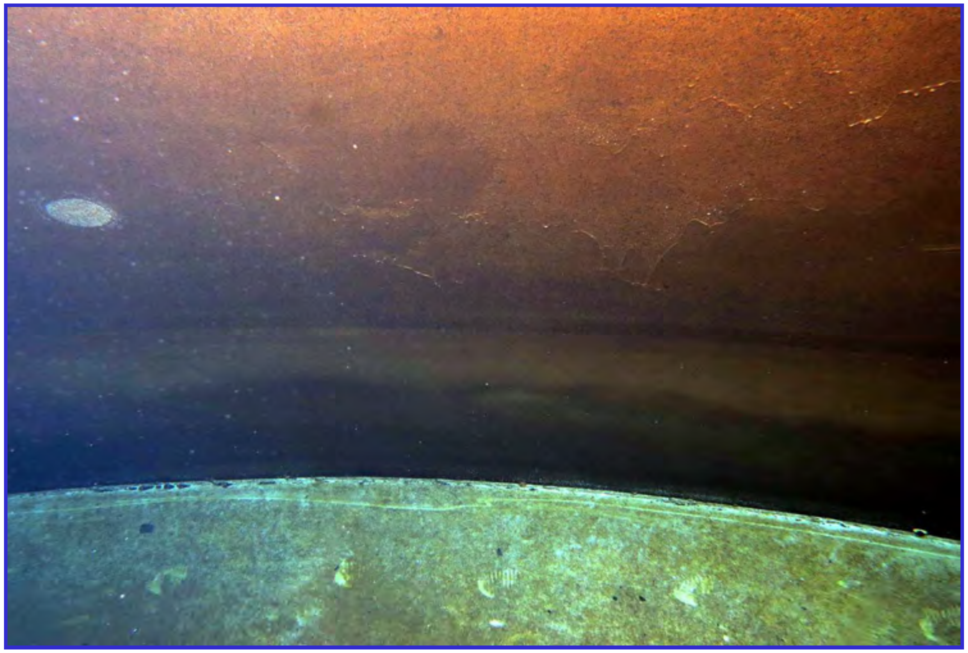

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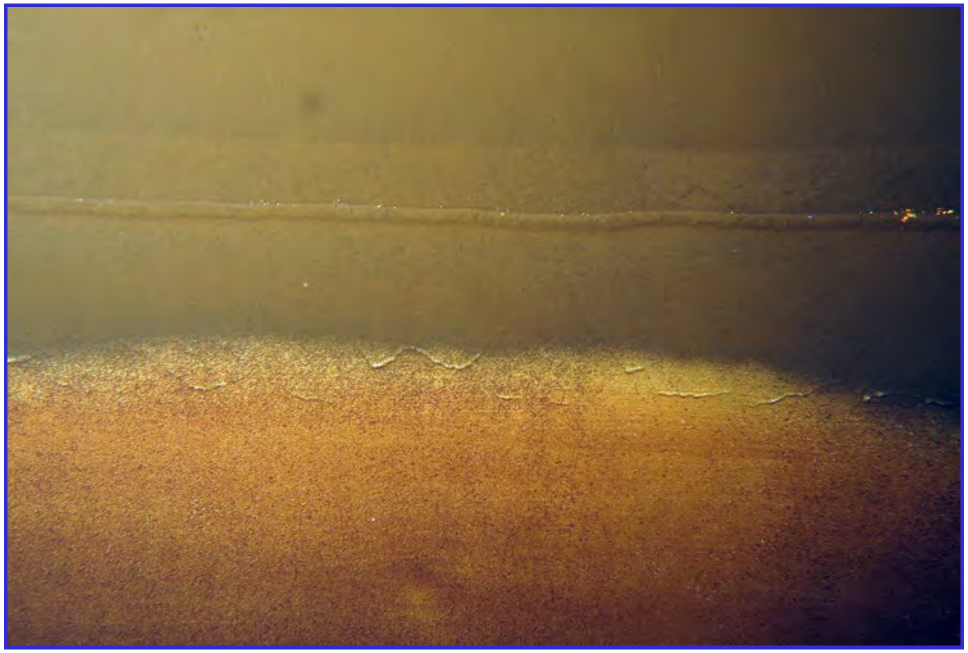

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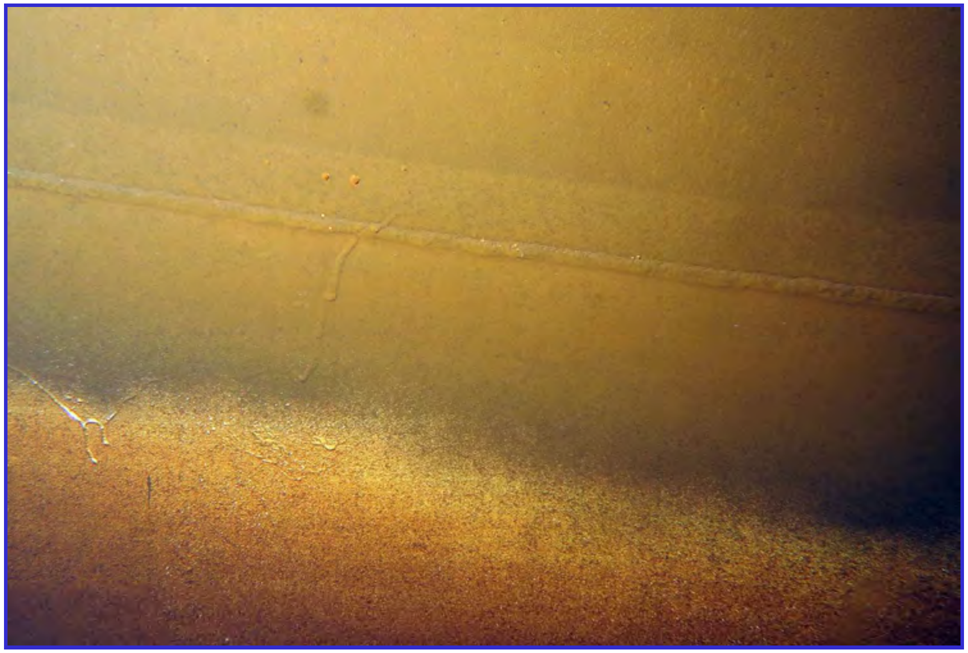

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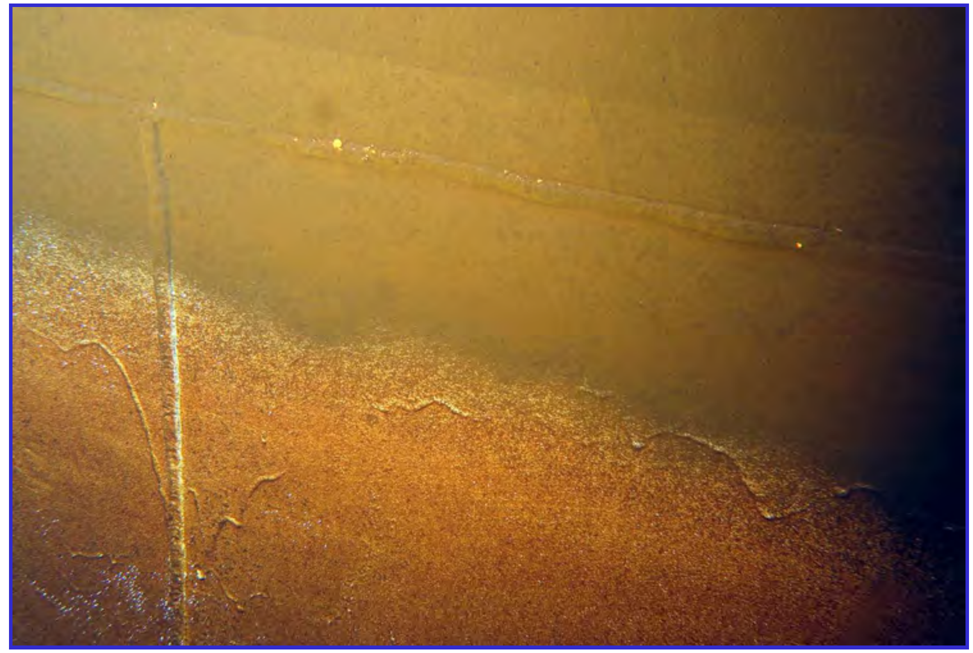

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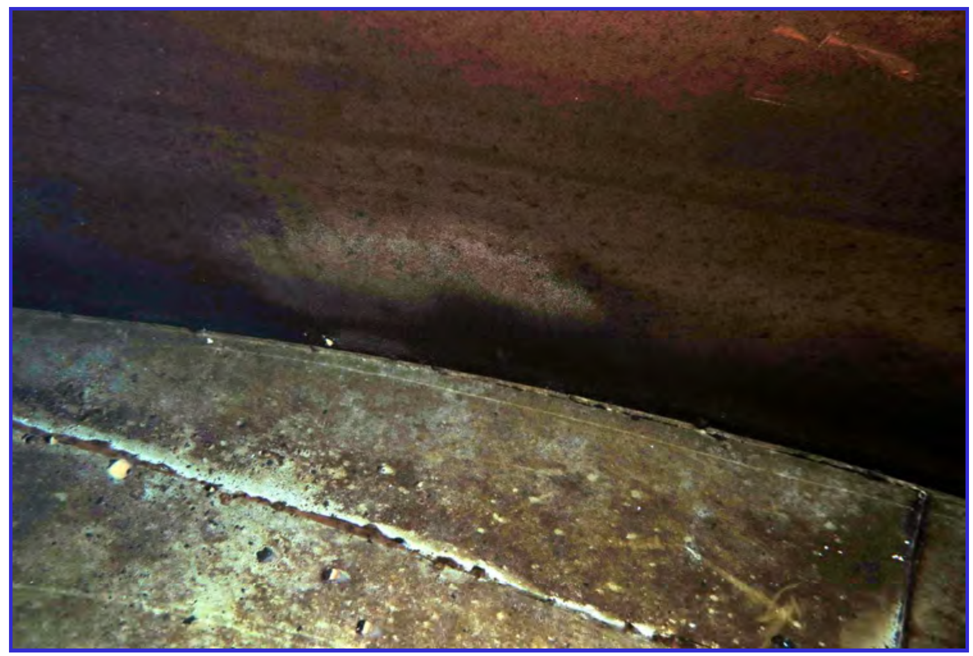

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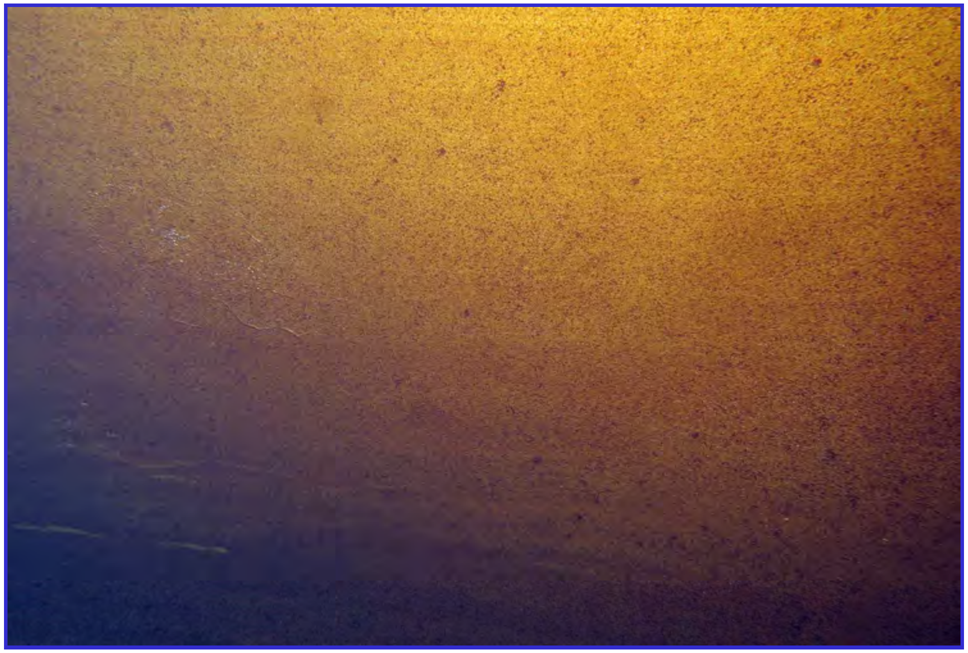

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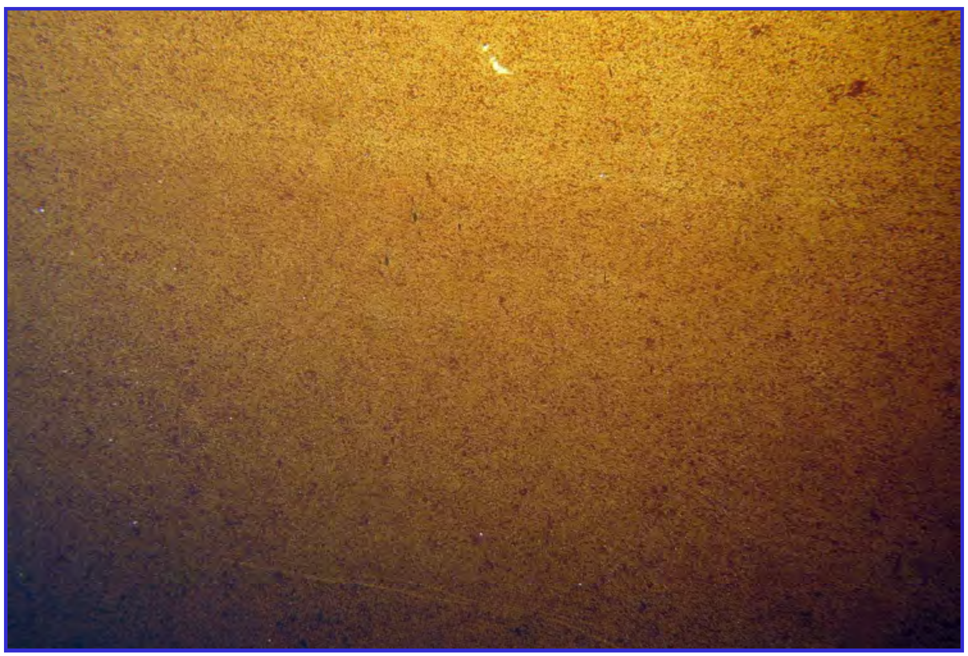

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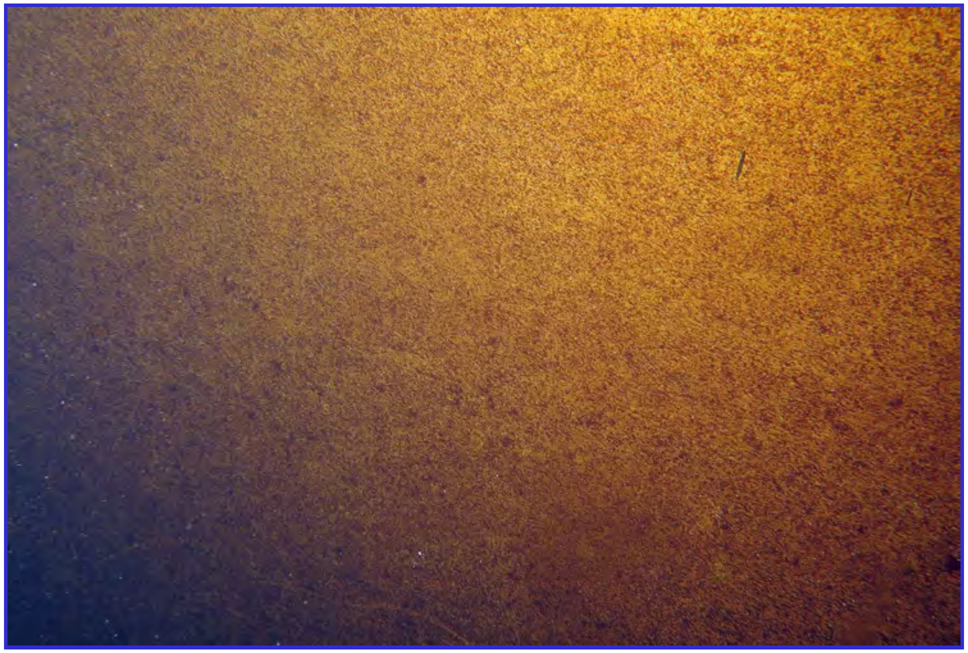

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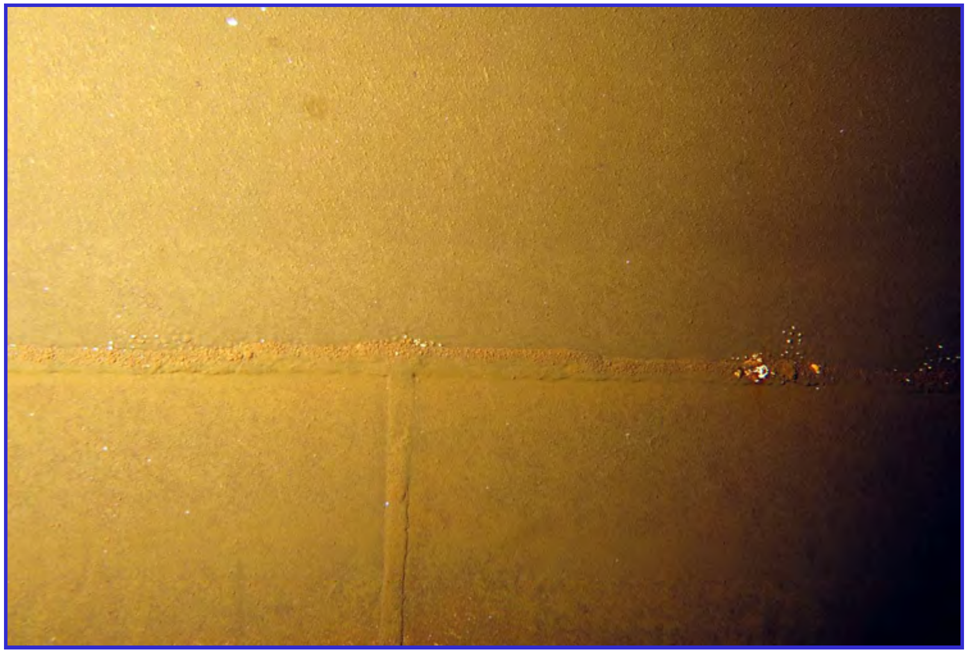

INTERIOR - Calaveras Public Utility District - Clear Well Tank - Maintenance Inspection -087

INTERIOR - Calaveras Public Utility District - Clear Well Tank - Maintenance Inspection -088

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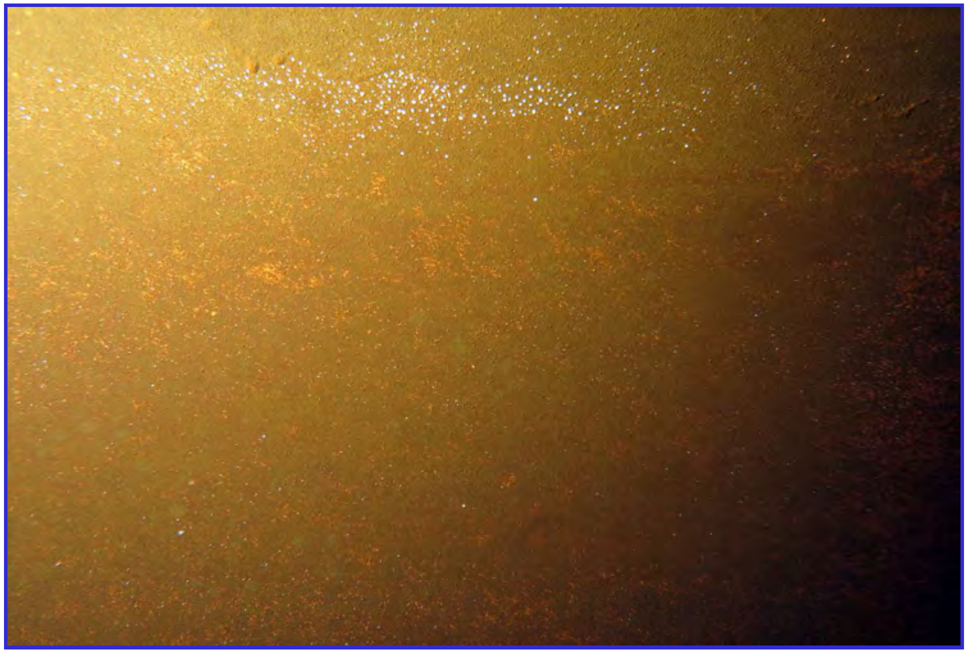
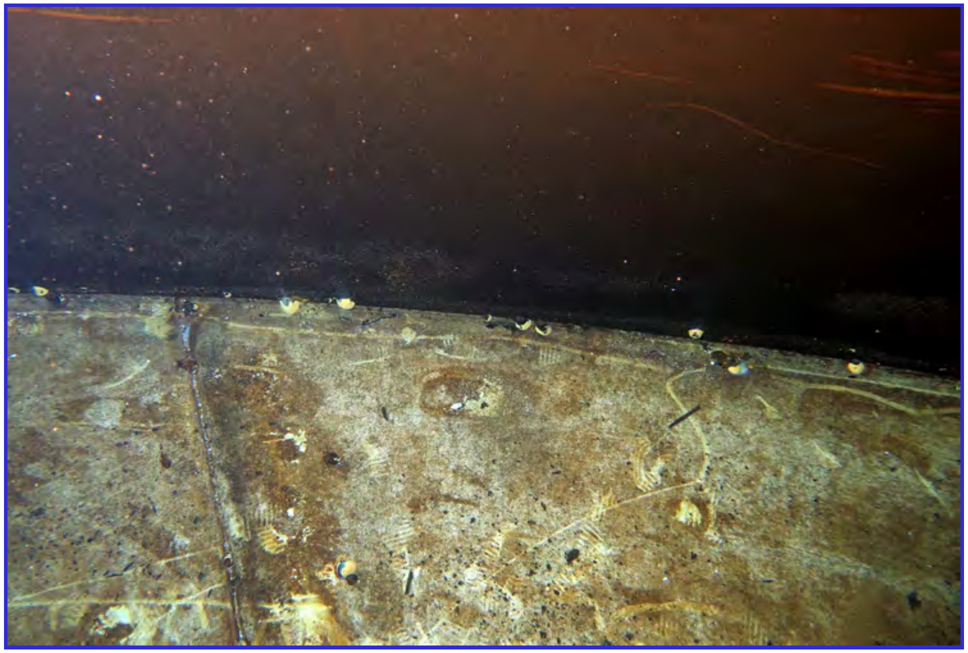
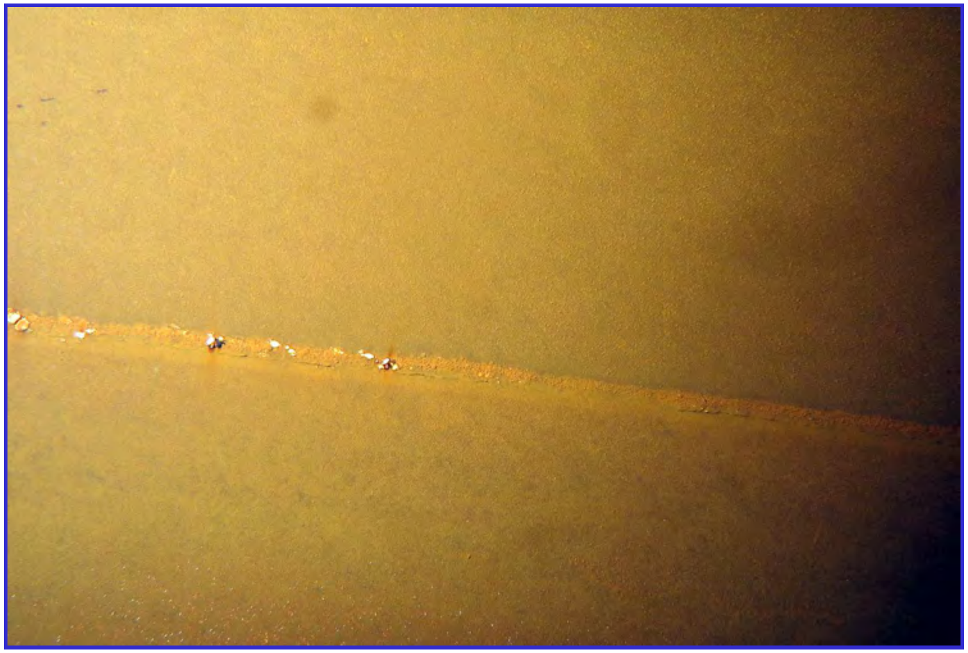


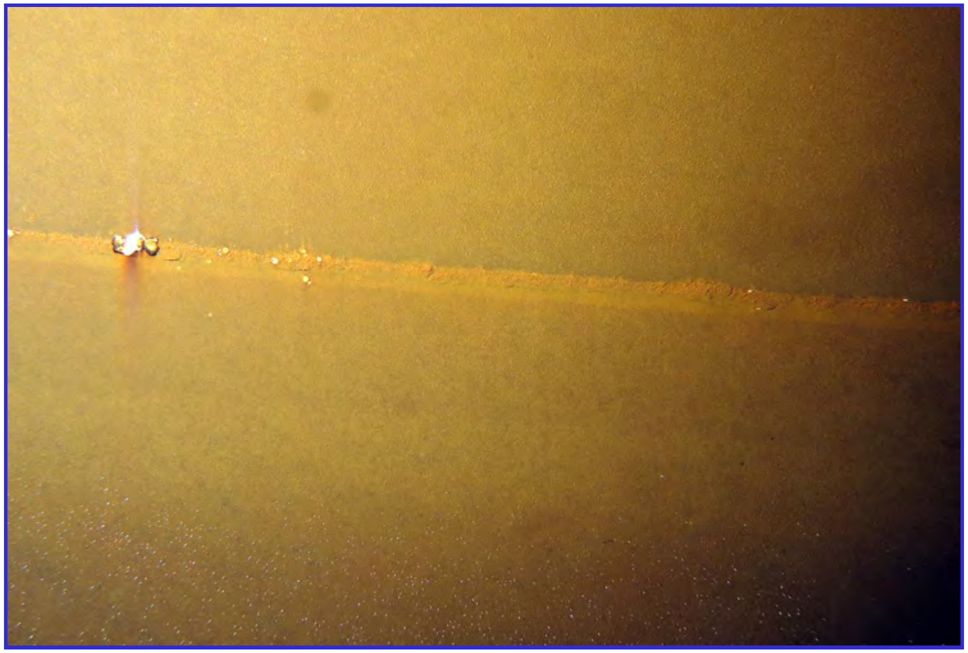
INTERIOR - Calaveras Public Utility District - Clear Well Tank - Maintenance Inspection -091



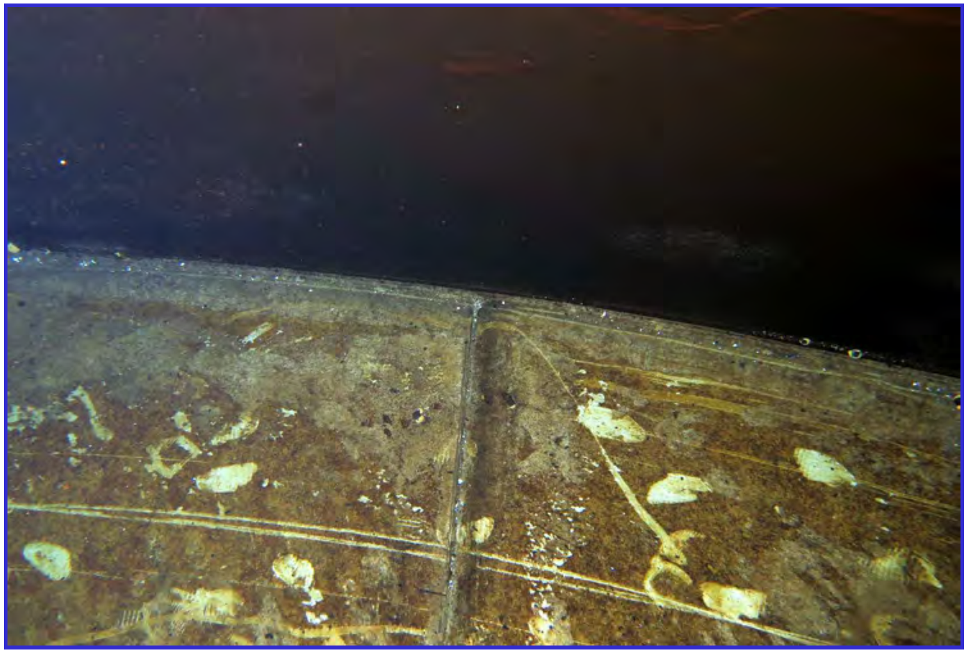
INTERIOR - Calaveras Public Utility District - Clear Well Tank - Maintenance Inspection -092



INTERIOR - Calaveras Public Utility District - Clear Well Tank - Maintenance Inspection -093



INTERIOR - Calaveras Public Utility District - Clear Well Tank - Maintenance Inspection -094



INTERIOR - Calaveras Public Utility District - Clear Well Tank - Maintenance Inspection -095

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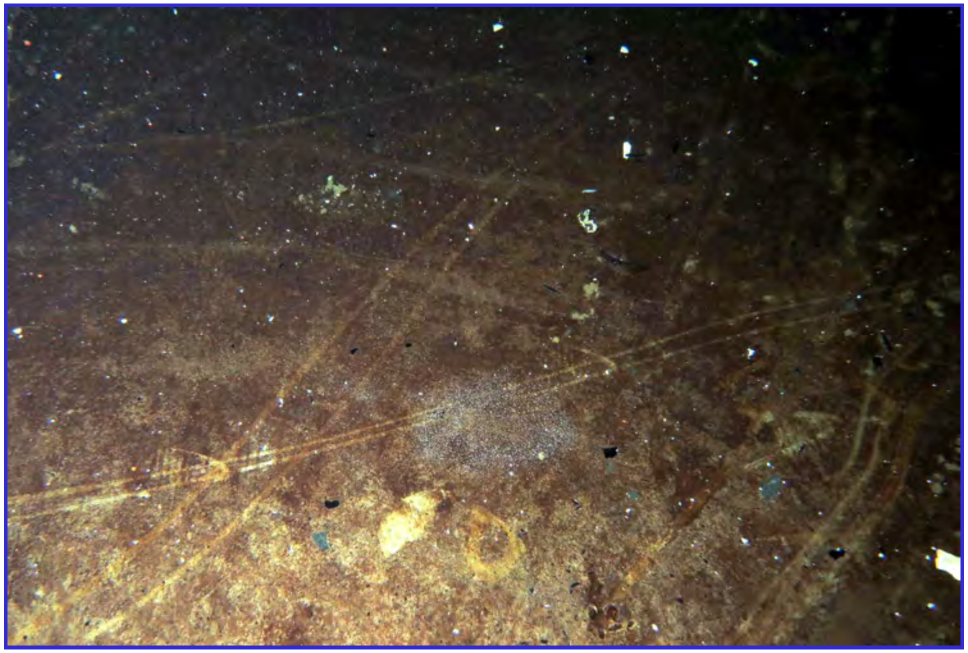
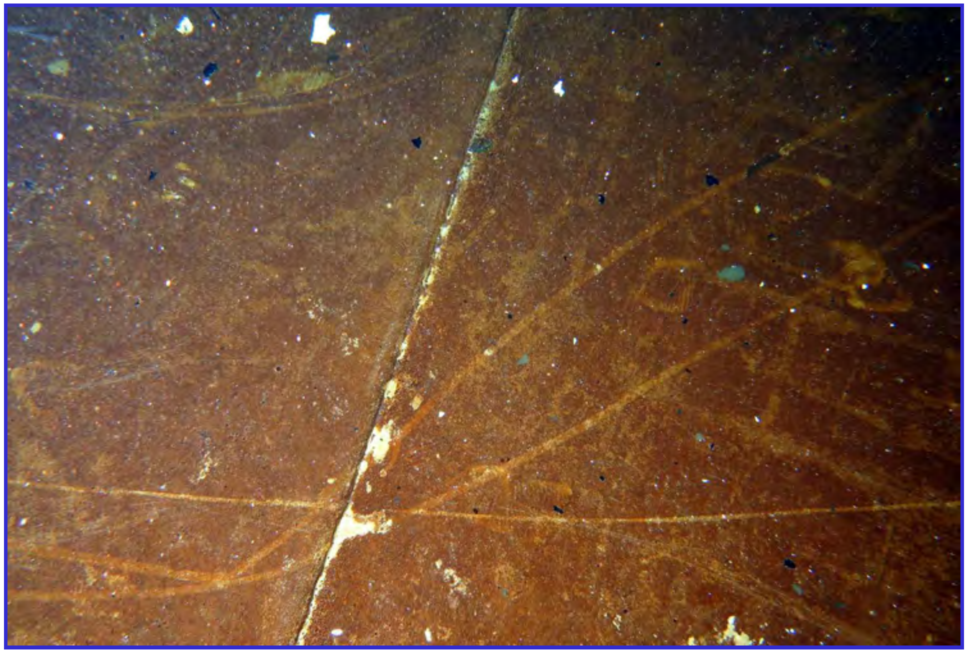
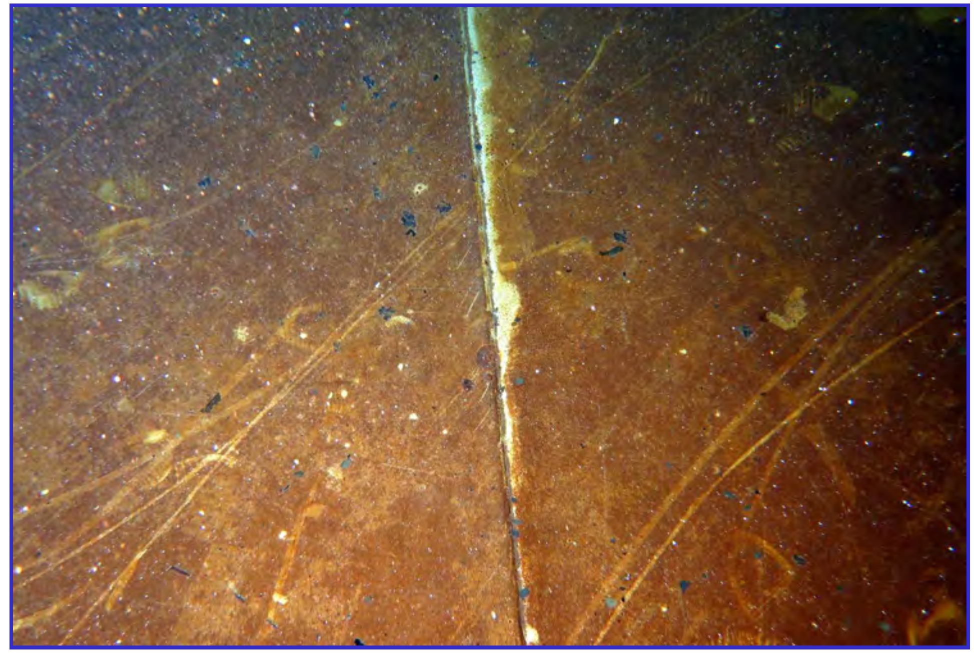


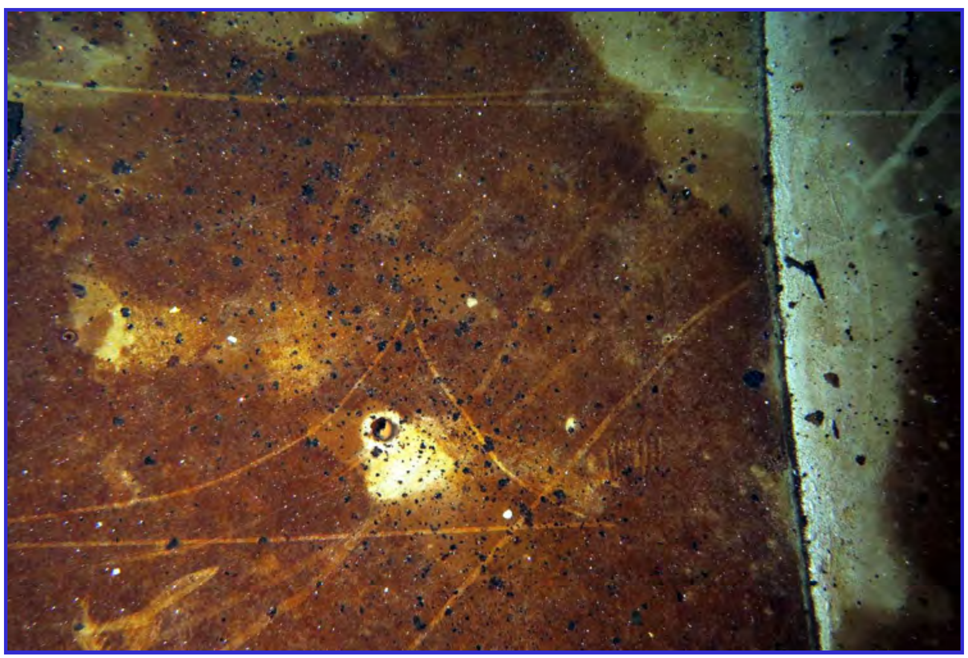
INTERIOR - Calaveras Public Utility District - Clear Well Tank - Maintenance Inspection -099



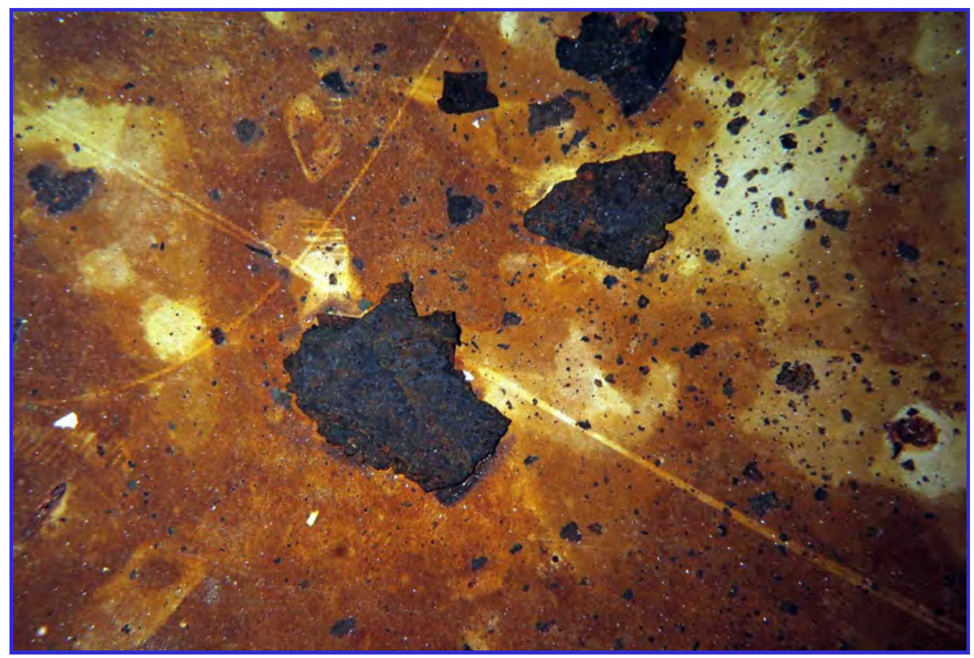
INTERIOR - Calaveras Public Utility District - Clear Well Tank - Maintenance Inspection -100



INTERIOR - Calaveras Public Utility District - Clear Well Tank - Maintenance Inspection -101



INTERIOR - Calaveras Public Utility District - Clear Well Tank - Maintenance Inspection -102



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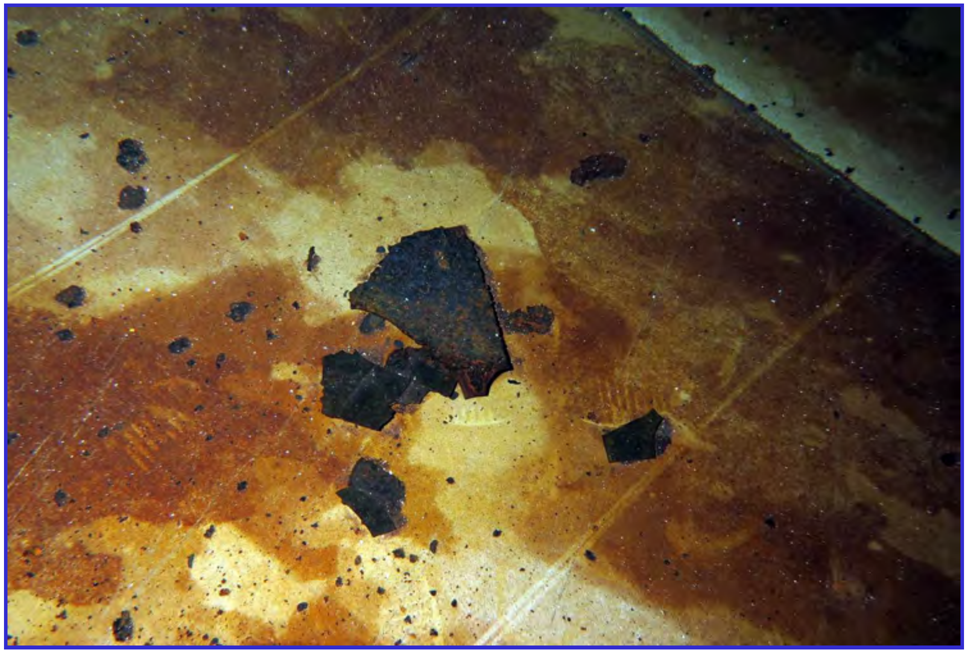
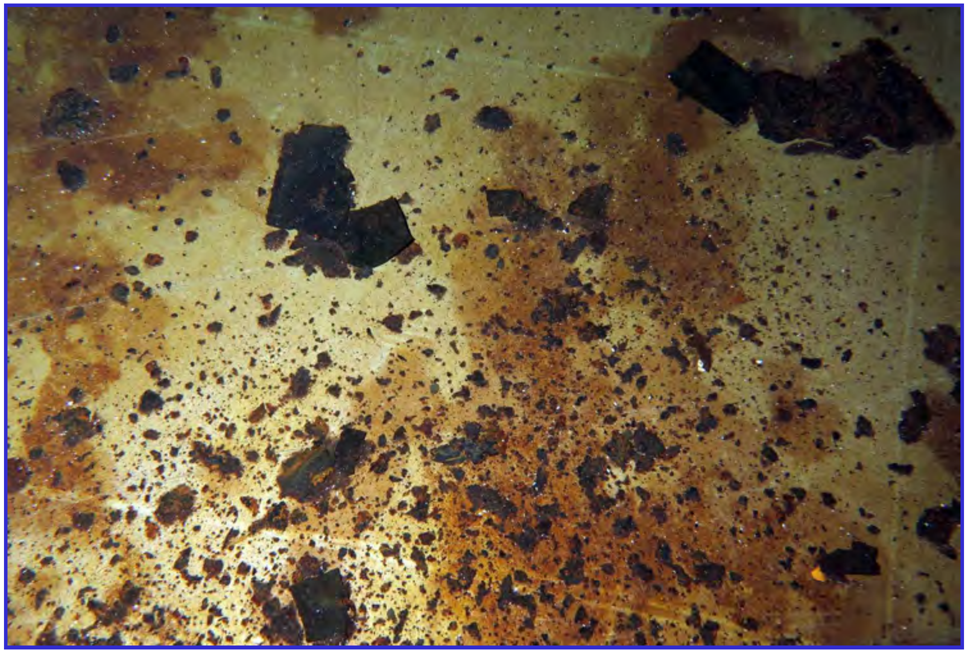

INTERIOR - Calaveras Public Utility District - Clear Well Tank - Maintenance Inspection -104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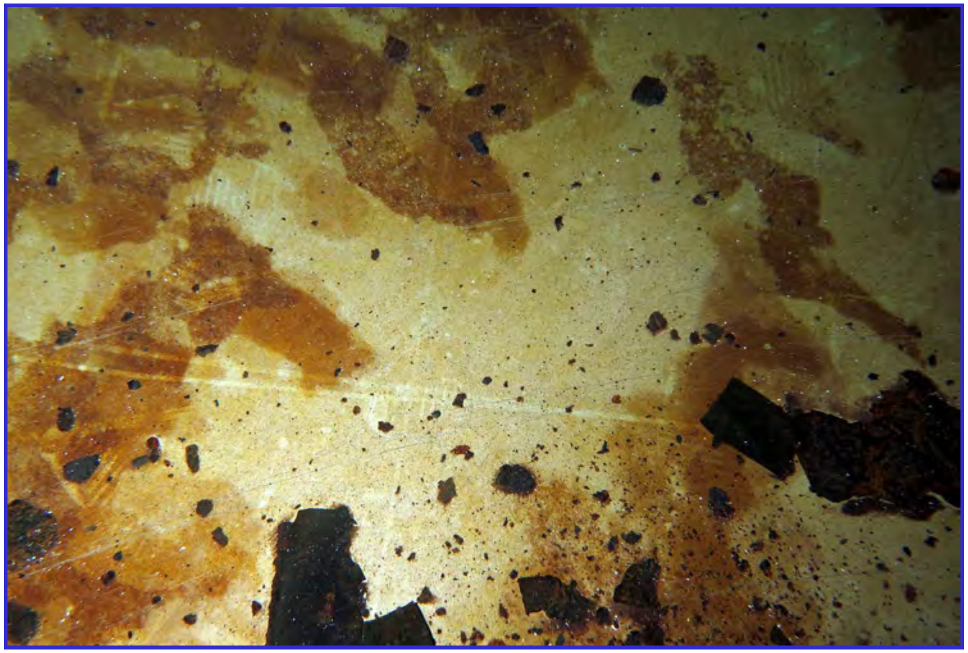
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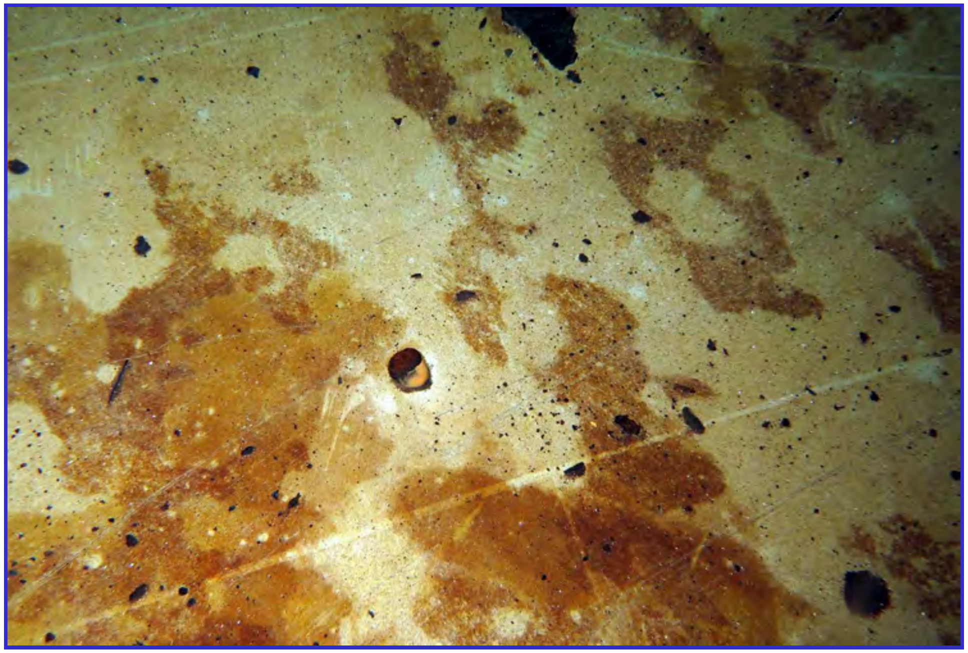
INTERIOR - Calaveras Public Utility District - Clear Well Tank - Maintenance Inspection -107

INTERIOR - Calaveras Public Utility District - Clear Well Tank - Maintenance Inspection -108

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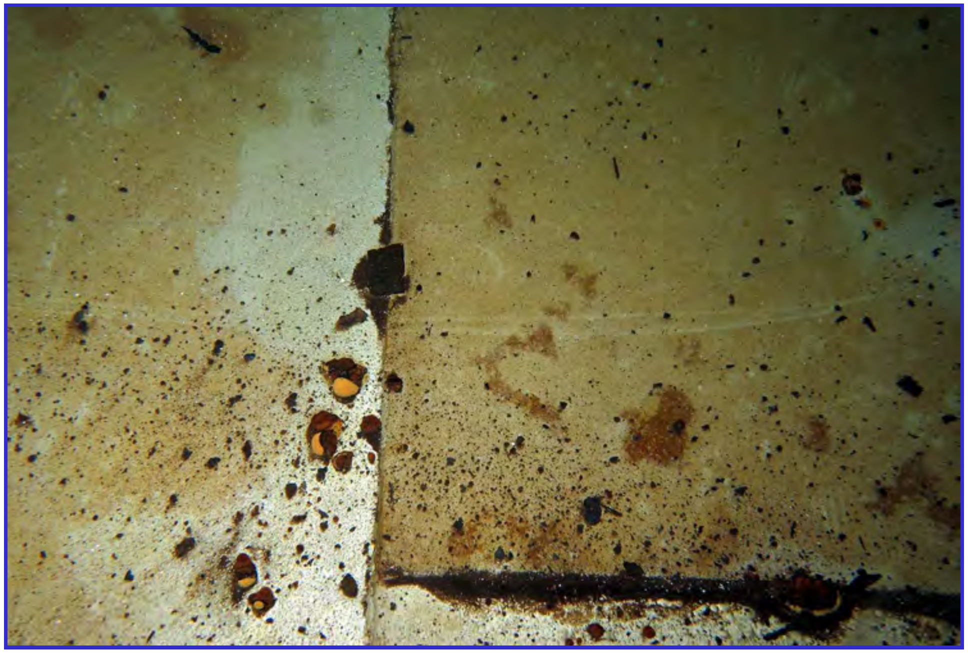
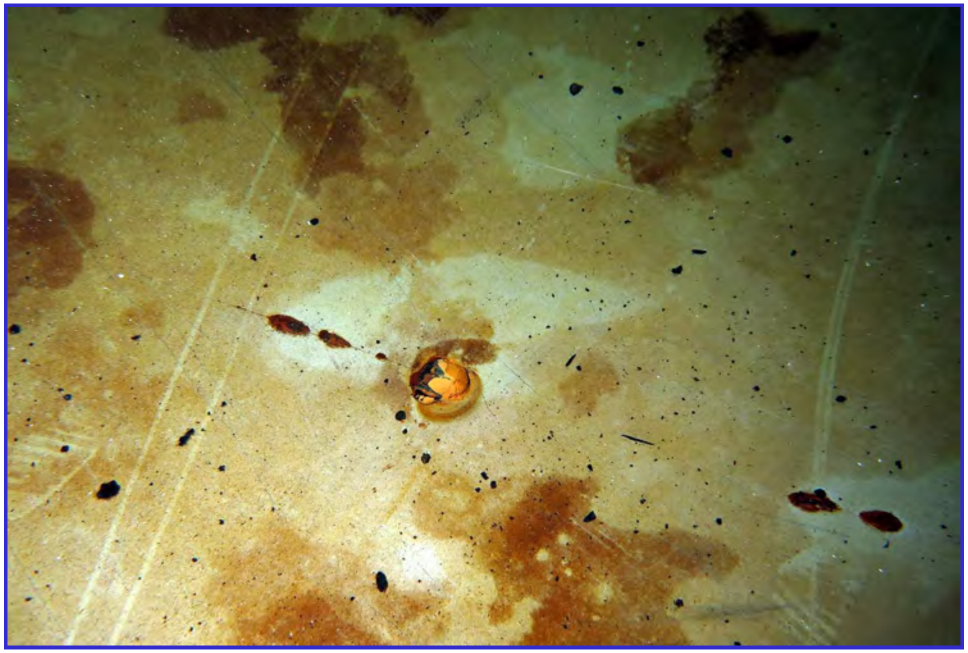
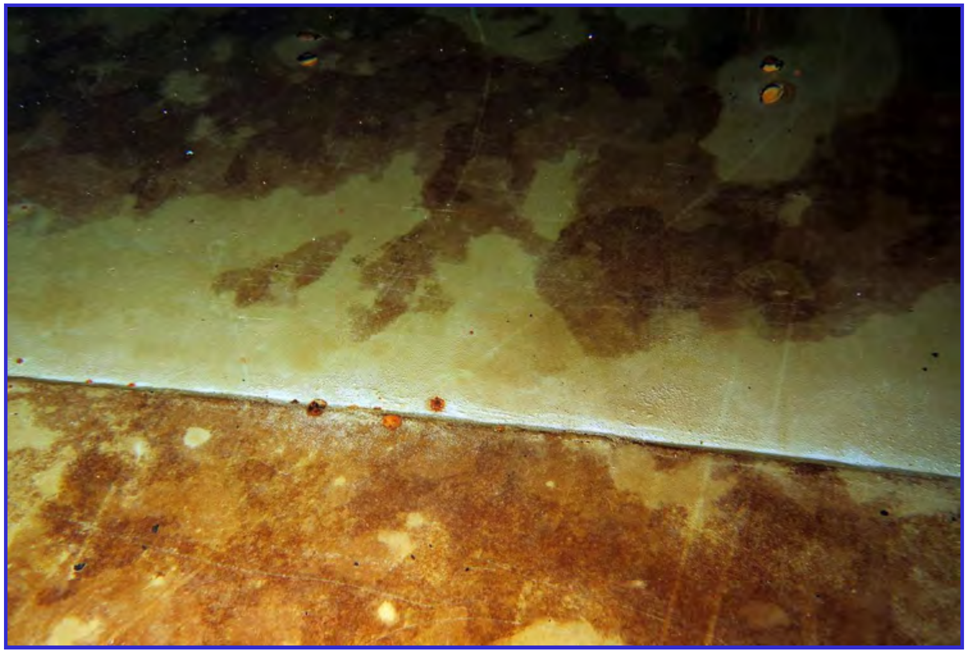


INTERIOR - Calaveras Public Utility District - Clear Well Tank - Maintenance Inspection -110

INTERIOR - Calaveras Public Utility District - Clear Well Tank - Maintenance Inspection -111

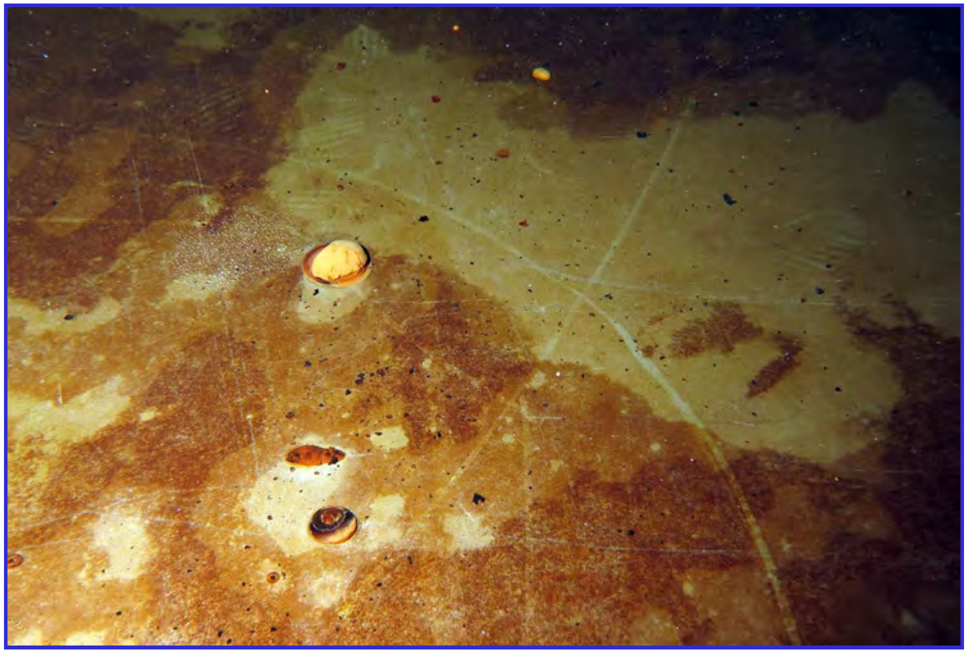


INTERIOR - Calaveras Public Utility District - Clear Well Tank - Maintenance Inspection -112



INTERIOR - Calaveras Public Utility District - Clear Well Tank - Maintenance Inspection -113

INTERIOR - Calaveras Public Utility District - Clear Well Tank - Maintenance Inspection -114



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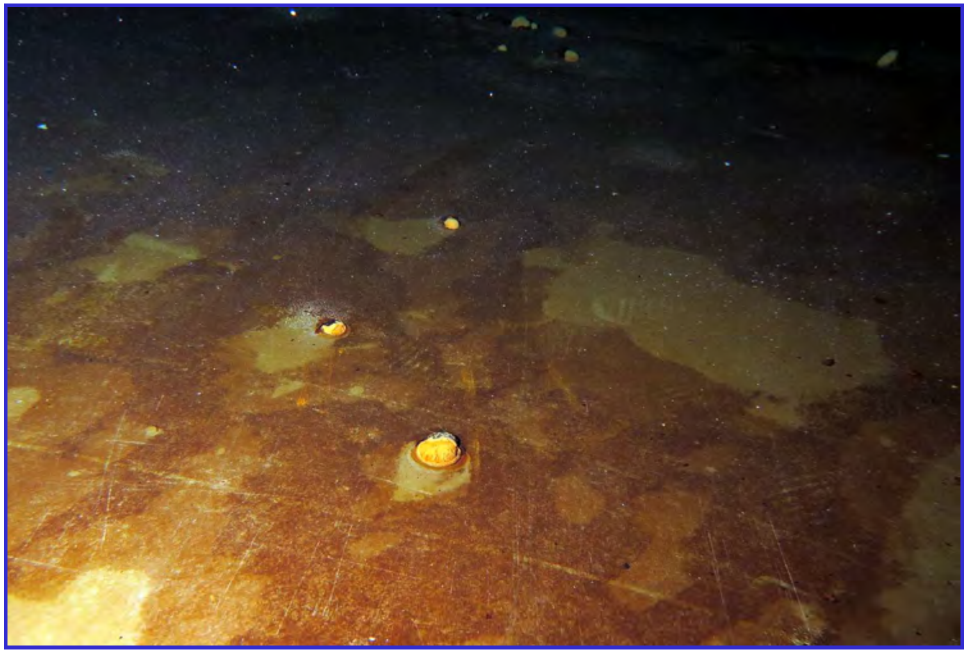
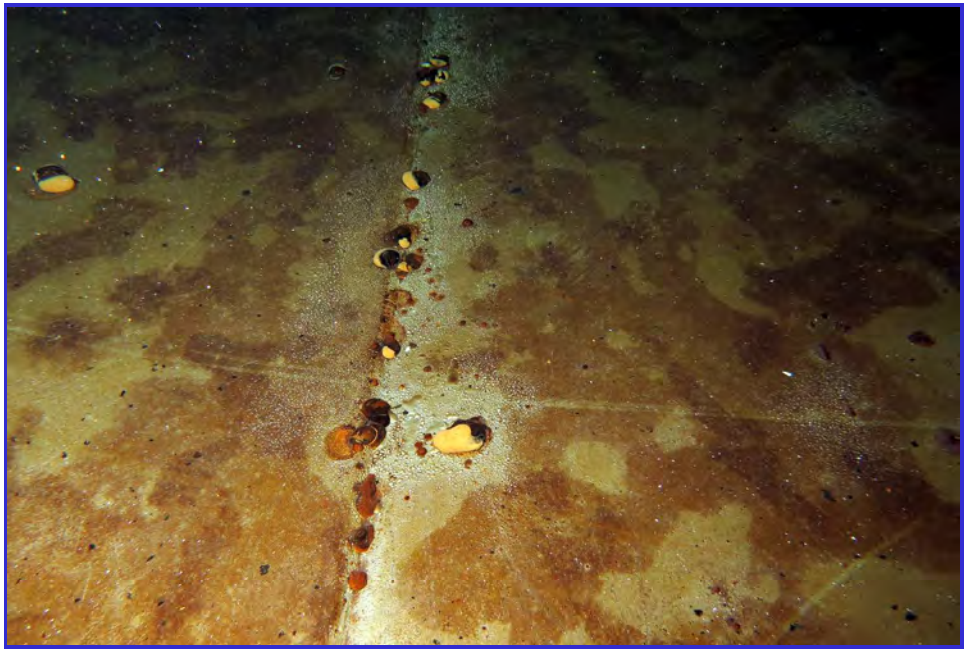
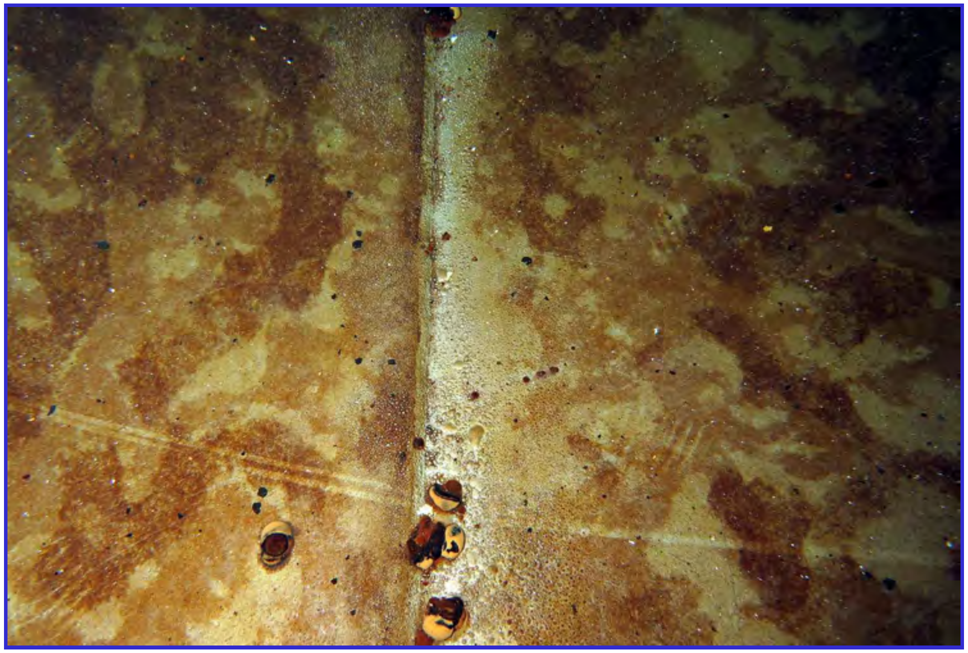


INTERIOR - Calaveras Public Utility District - Clear Well Tank - Maintenance Inspection -116

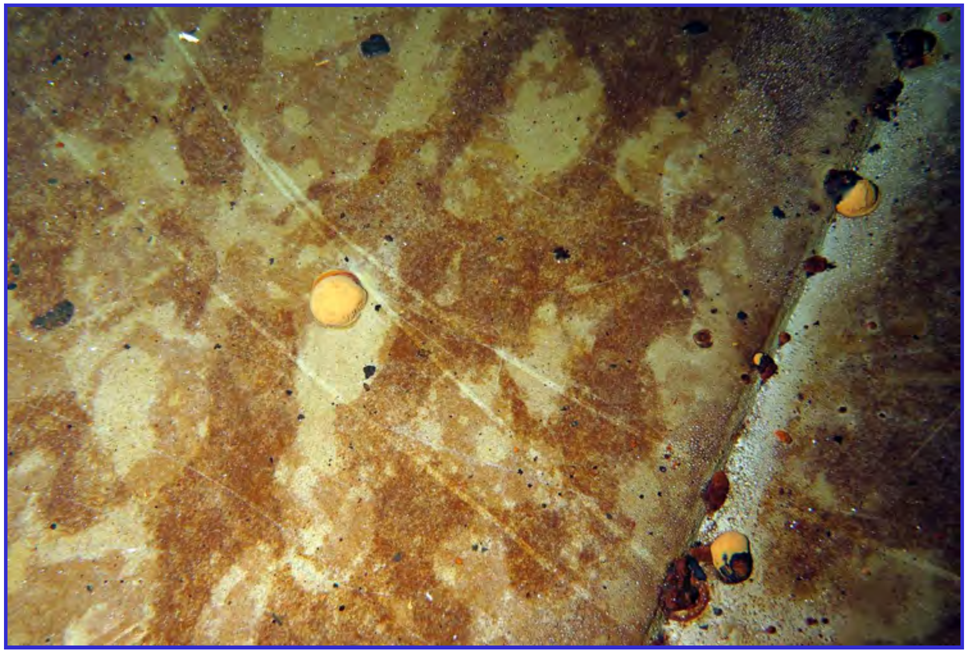
INTERIOR - Calaveras Public Utility District - Clear Well Tank - Maintenance Inspection -117



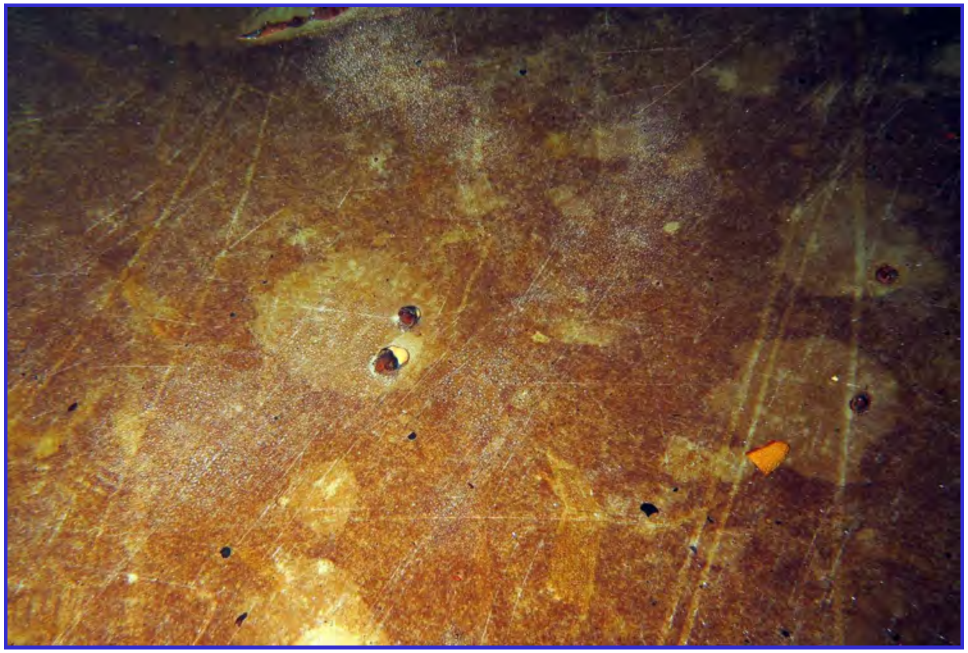
INTERIOR - Calaveras Public Utility District - Clear Well Tank - Maintenance Inspection -118



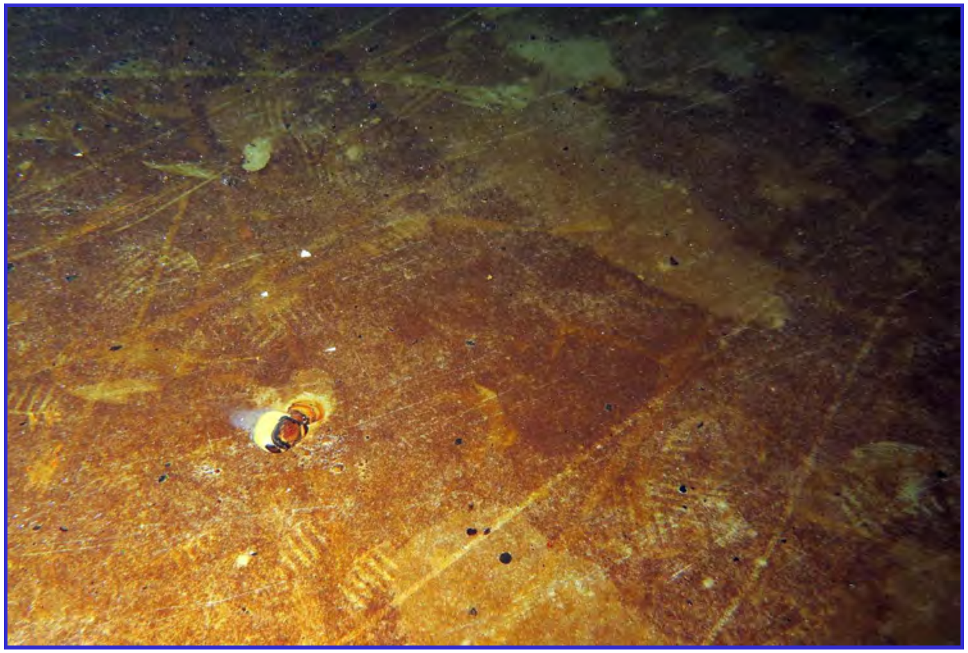
INTERIOR - Calaveras Public Utility District - Clear Well Tank - Maintenance Inspection -119



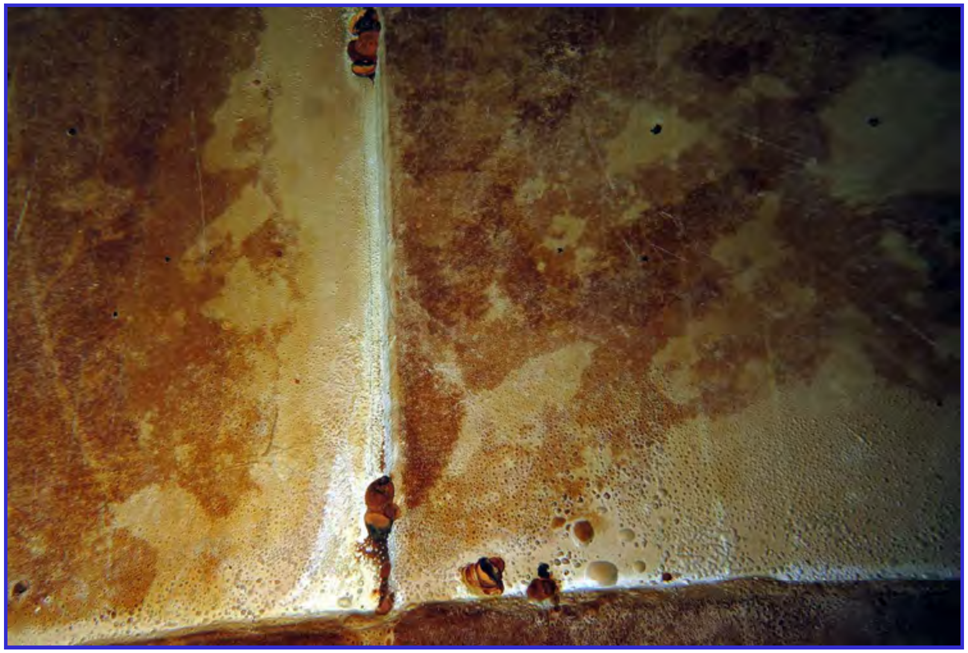
INTERIOR - Calaveras Public Utility District - Clear Well Tank - Maintenance Inspection -120



INTERIOR - Calaveras Public Utility District - Clear Well Tank - Maintenance Inspection -121



INTERIOR - Calaveras Public Utility District - Clear Well Tank - Maintenance Inspection -122



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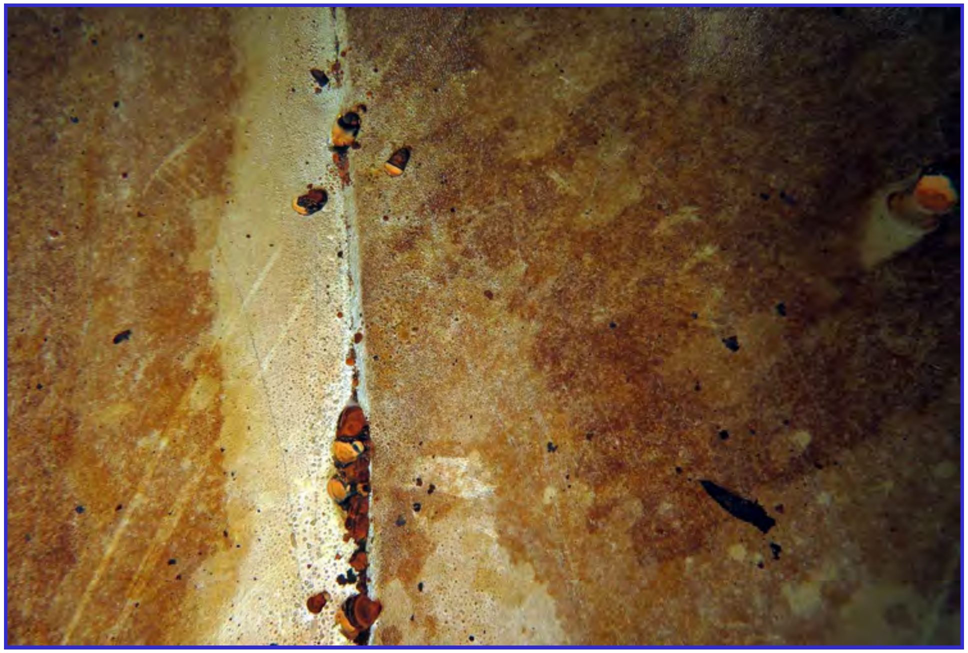

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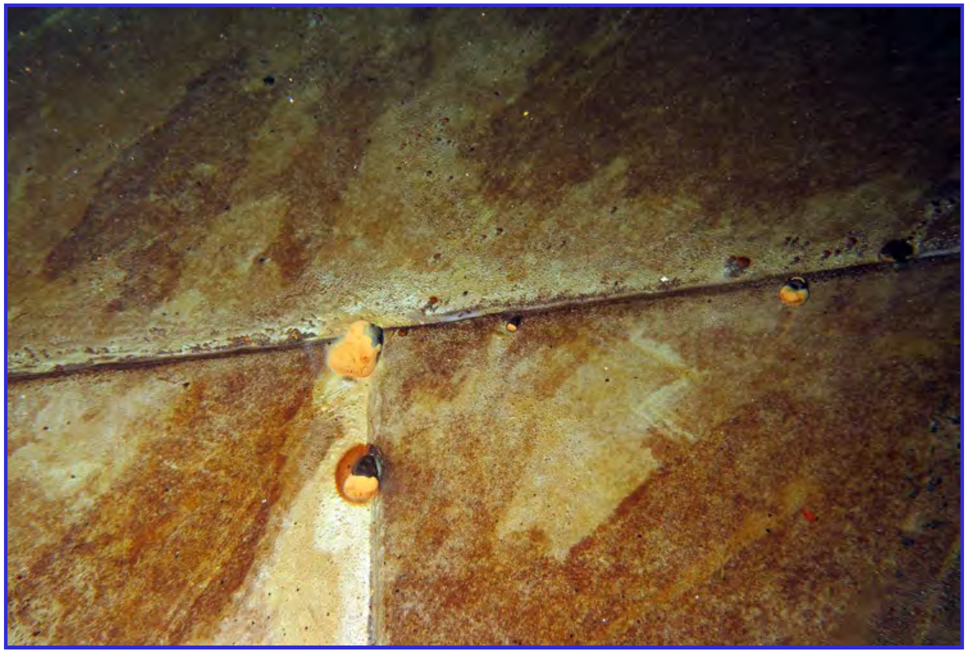
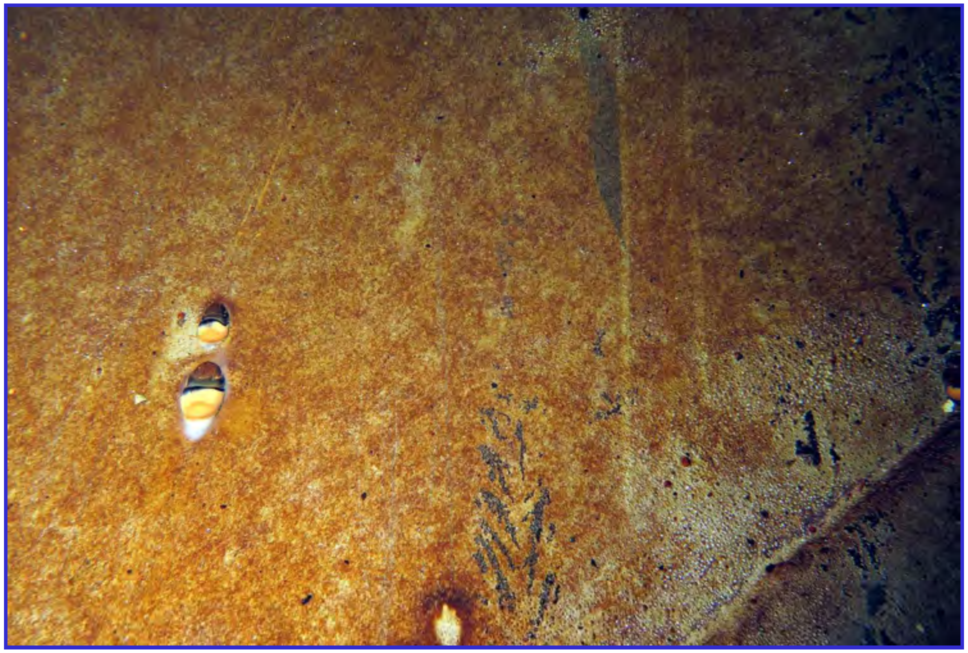
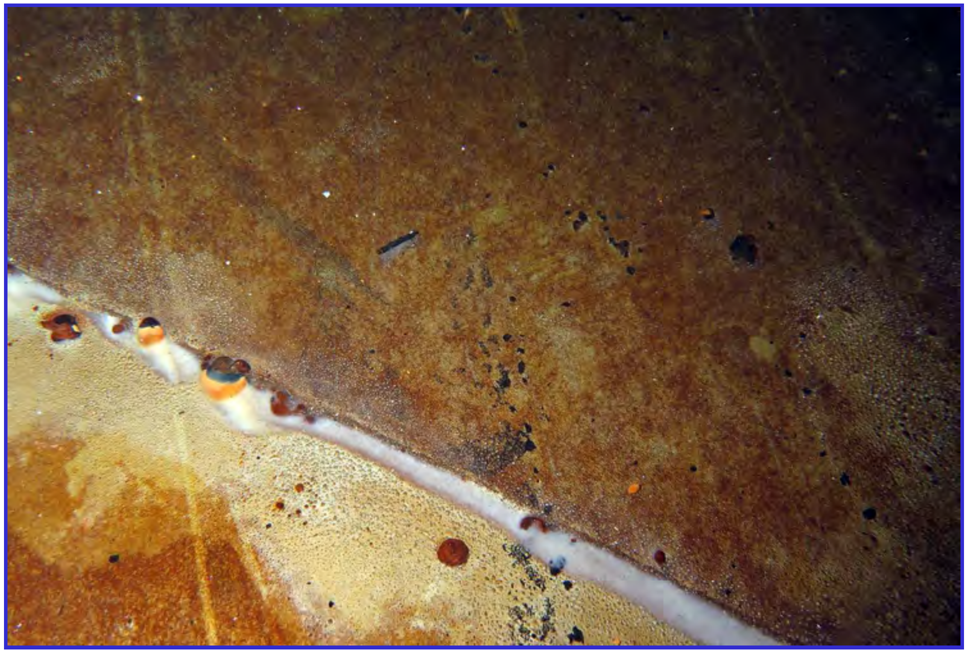


INTERIOR - Calaveras Public Utility District - Clear Well Tank - Maintenance Inspection -125



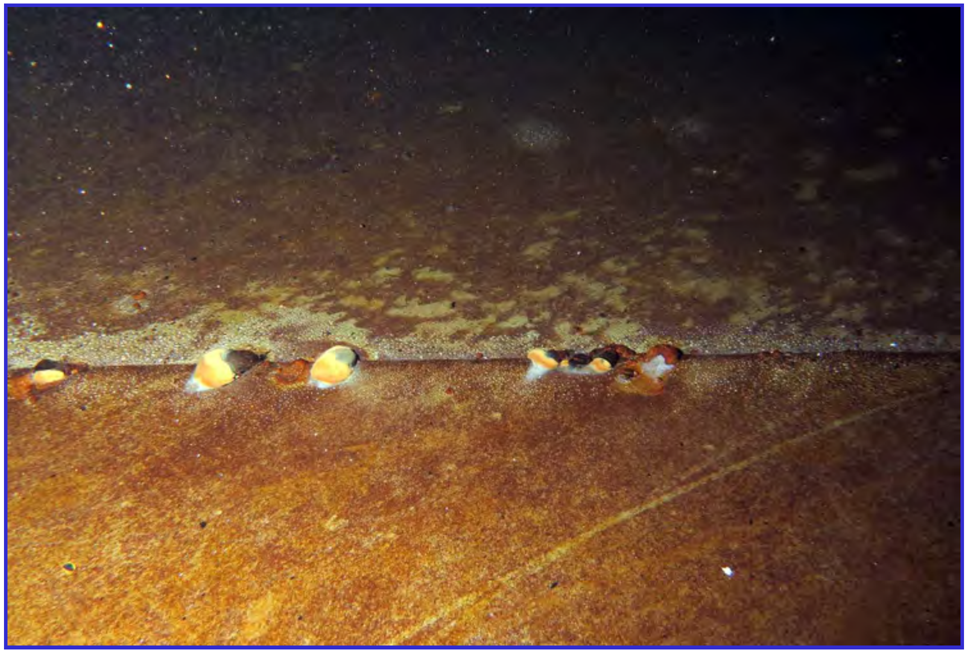
INTERIOR - Calaveras Public Utility District - Clear Well Tank - Maintenance Inspection -126



INTERIOR - Calaveras Public Utility District - Clear Well Tank - Maintenance Inspection -127

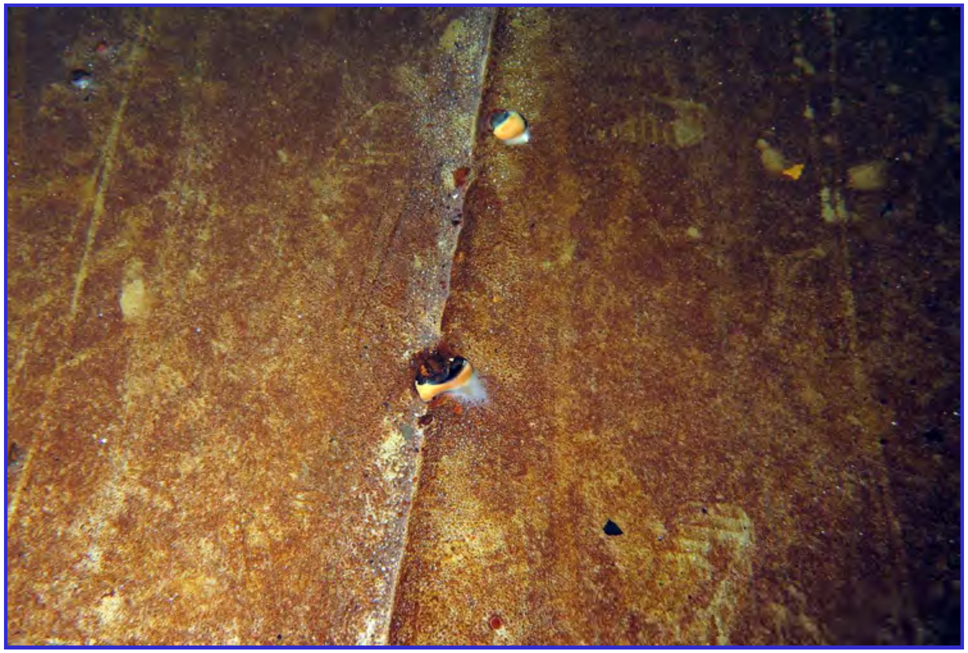
INTERIOR - Calaveras Public Utility District - Clear Well Tank - Maintenance Inspection -128

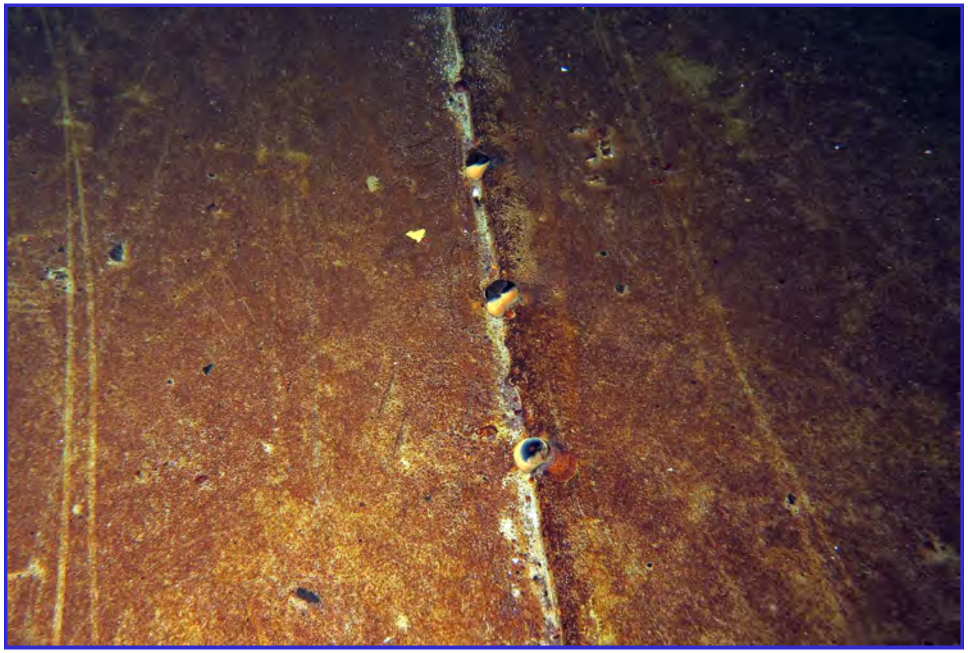
INTERIOR - Calaveras Public Utility District - Clear Well Tank - Maintenance Inspection -129



INTERIOR - Calaveras Public Utility District - Clear Well Tank - Maintenance Inspection -130

INTERIOR - Calaveras Public Utility District - Clear Well Tank - Maintenance Inspection -131

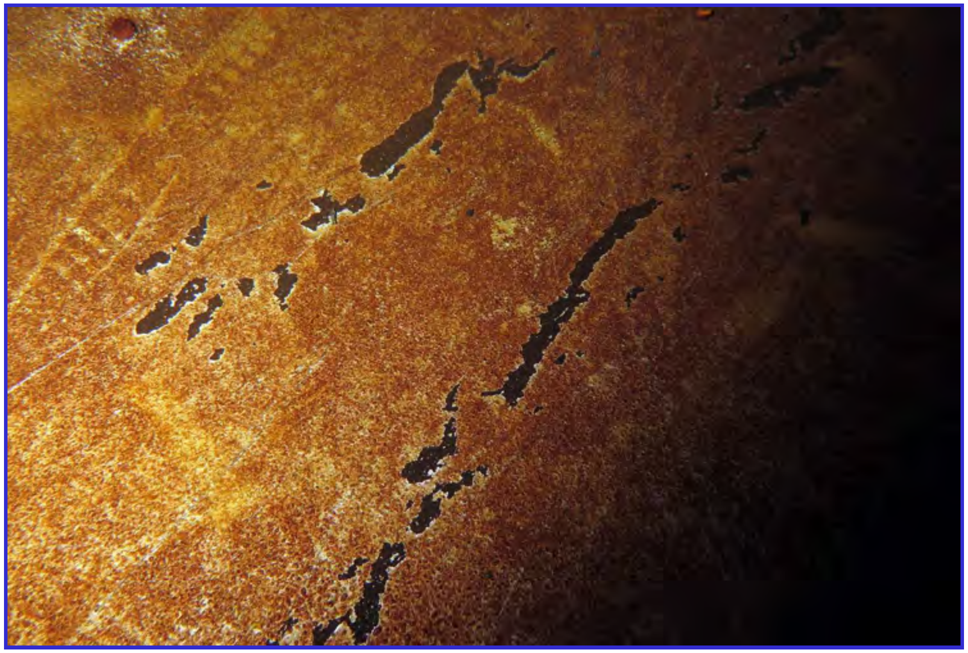

INTERIOR - Calaveras Public Utility District - Clear Well Tank - Maintenance Inspection -132


INTERIOR - Calaveras Public Utility District - Clear Well Tank - Maintenance Inspection -133


INTERIOR - Calaveras Public Utility District - Clear Well Tank - Maintenance Inspection -134

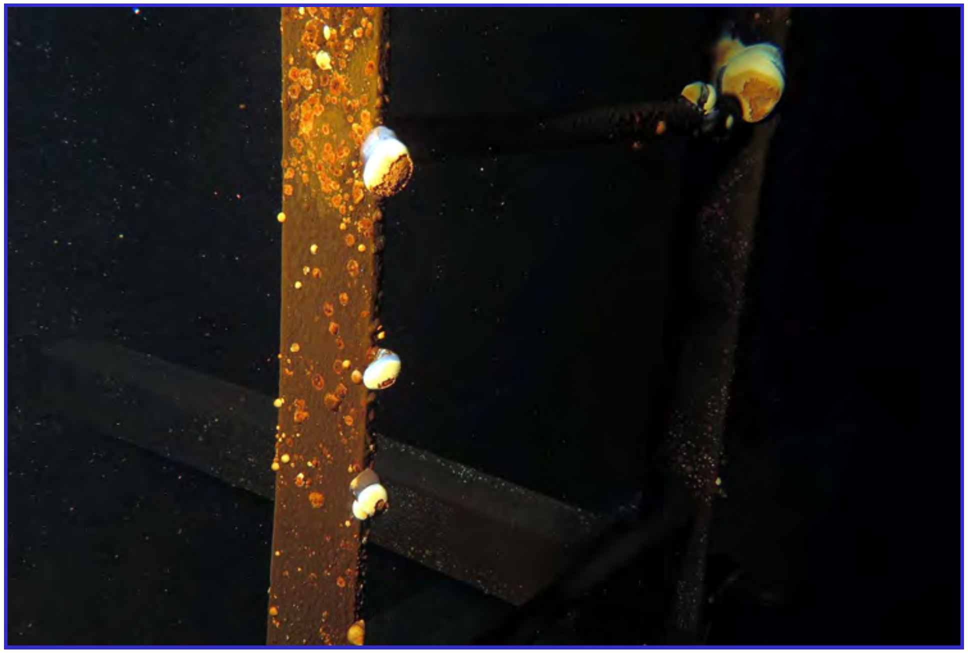

INTERIOR - Calaveras Public Utility District - Clear Well Tank - Maintenance Inspection -135

INTERIOR - Calaveras Public Utility District - Clear Well Tank - Maintenance Inspection -136



INTERIOR - Calaveras Public Utility District - Clear Well Tank - Maintenance Inspection -137

INTERIOR - Calaveras Public Utility District - Clear Well Tank - Maintenance Inspection -138

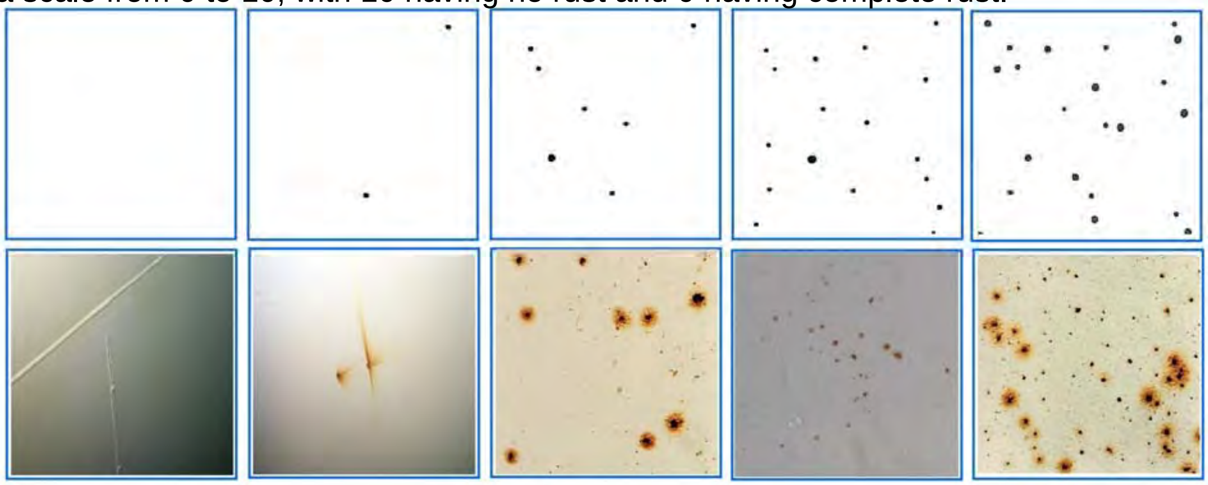


INTERIOR - Calaveras Public Utility District - Clear Well Tank - Maintenance Inspection -139

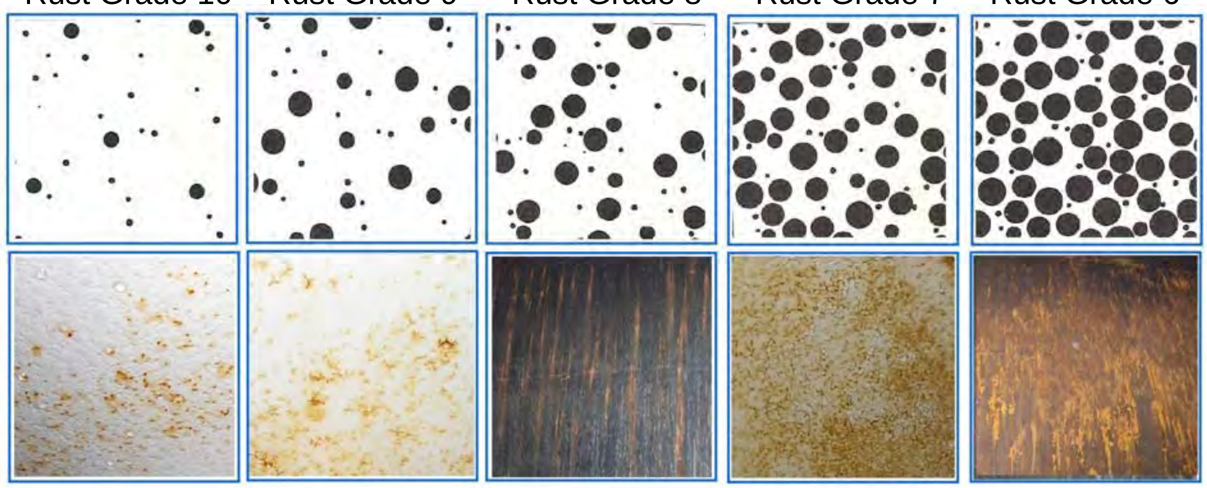
Chart 1 - Condition Rating The table below gives a basic description of the four different categories that CSI Services, Inc. uses to provide a general depiction of the condition of each defined area of a structure. The categories are Poor, Fair, Good, or Excellent. The development of these categories is based on historical knowledge and experience of various paint and lining systems over given periods of time in certain service environments. Basically, the rating is determined based on what should be expected of the paint or lining system at that point in its life cycle. As a result, different determinations are made for maintenance inspection versus warranty inspections. A detailed description of each rating with relative consideration addressed follows:

Rating	General Description of Conditions	
	Maintenance Inspection	**Warranty Inspection**
Poor	This condition is usually prioritized for rework in the short-term. Typically, these surfaces have considerably more coating defects and/or corrosion than what is expected for the age of the system.	This condition identifies an area with wholesale coating defects or corrosion concerns that will typically require significant removal and replacement of the coatings in the area.
Fair	Typically, these surfaces have a level of coating defects and/or corrosion that is slightly worse than what should be expected for the age of the system. This condition is placed on a short-term monitoring schedule.	This condition identifies an area with partial coating defects or corrosion concerns that will require significant rework.
Good	This condition is rated for areas without any considerable coating defects or corrosion. These surfaces are in a condition that is typical for the age of the coating system.	This condition identifies areas with coating defects or corrosion that is typically seen in one-year warranty inspections. Typically, only minor spot repairs are required.
Excellent	This condition is for areas without any considerable coating defects or corrosion. Typically, these surfaces are in a condition that is better than expected for the age of the system.	This condition identified areas that typically are in perfect condition and require no repair work.

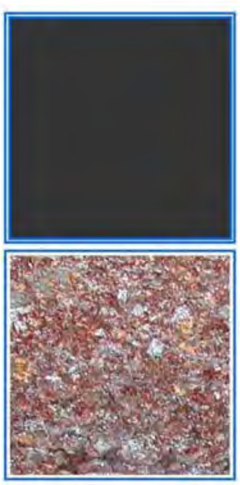
Chart 2 -Rust Grade The black and white figures below depict the standards referenced in ASTM D610 “Standard Test Method for Evaluating Degree of Rusting on Painted Surfaces.” Below each standard is a photographic depiction of each level of corrosion, as used by CSI Services, Inc. The standards depict the percentage of rust on a scale from 0 to 10, with 10 having no rust and 0 having complete rust.



Rust Grade 10 Rust Grade 9 Rust Grade 8 Rust Grade 7 Rust Grade 6



Rust Grade 5 Rust Grade 4 Rust Grade 3 Rust Grade 2 Rust Grade 1



Rust Grade 0

Rust Grade	Description
10	No rusting or less than 0.01% of surface rusted
9	Minute rusting, less than 0.03% of surface rusted
8	Few isolated rust spots, less than 0.1% of surface rusted
7	Less than 0.3% of surface rusted
6	Excessive rust spots, but less than1% of surface rusted
5	Rusting to the extent of 3% of surface rusted
4	Rusting to the extent of 10% of surface rusted
3	Approximately one-sixth of the surface rusted
2	Approximately one-third of the surface rusted
1	Approximately one-half of the surface rusted
0	Approximately 100% of the surface rusted

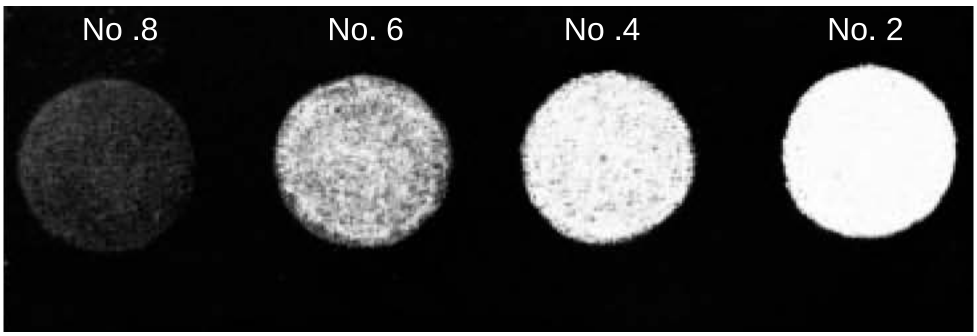
Chart 3 - Corrosion Grade The figure below depicts the photographic standards referenced by CSI Services, Inc. in the determination of the characteristics and stages of corrosion progression. This standard is used to better quantify the level of corrosion once it has progressed to Rust Grades 3, 2, 1, or 0 (see Chart 2). When applicable, CSI classifies an area as one or more of the five different Corrosion Grades. Corrosion Grades 1 through 5 are described below:

Grade	Description	Photo Examples
1	Light Rust - This condition involves relatively light colored rust that does not have any significant metal loss.	 
2	Dark Rust -This condition involves relatively dark colored, thicker rust that is progressing towards the next phase, significant metal loss.	 
3	Pitting - This condition involves isolated or widespread deep spot corrosion (pitting).	
4	Scale - Also known as lamellar or exfoliation corrosion. The edges of the affected area are leaf like and resemble the separated pages of a wetted book.	 
5	Structural Loss - This condition involves metal loss or failure where components will require structural consideration	 

The photos depicted are examples and were not taken on this project.

Chart 4 - Chalking The figure below depicts the photographic standards referenced in ASTM D4214 "Standard Test Method for Evaluating the Degree of Chalking of Exterior Paint Films," Method D659, Method C. Generally speaking, chalking is the degradation of a paint's binder leaving behind loose pigments as the binder reacts with the environment, primarily ultraviolet light and oxygen. Evaluating chalking is a means to measure the performance of a coating system and its life cycle projection. It is also important to quantify for consideration of future overcoating options. This test uses these pictorial standards to quantify the amount of chalking present on paint films. The depictions below represent the mount of colored chalk removed onto a cloth during the test. The scale ranges from 2 to 8 with the rating 2 having the most chalk.

Light Colored Paints



Dark Colored Paints

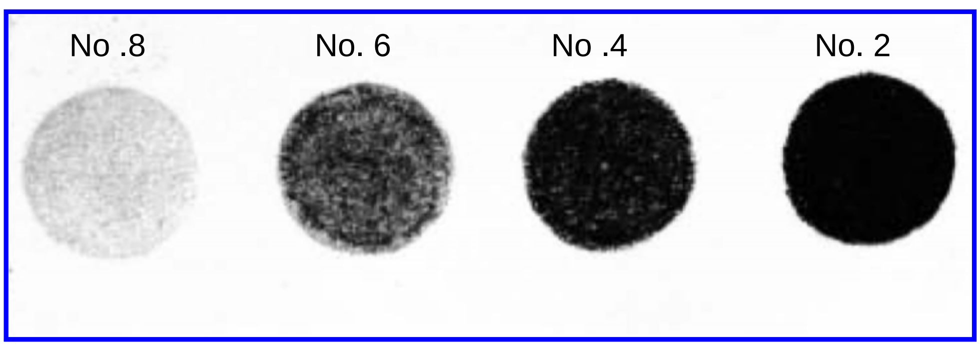
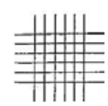
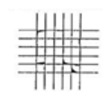
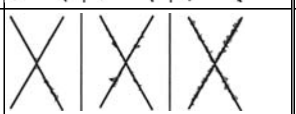
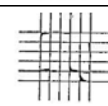
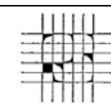
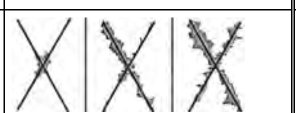
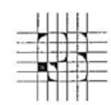
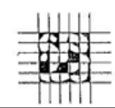
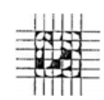
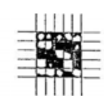
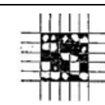


Chart 5 - Adhesion Rating The figures below depict the photographic standards and criteria referenced in ASTM D3359 “Standard Test Method for Evaluating Adhesion by Tape Test” and ASTM D6677 “Standard Test Method for Evaluating Adhesion by Knife.” Both Standards are used to assess the condition of a paint system for life-cycle projections. It is also used to evaluate an existing paint system’s ability to withstand the added stress that any overcoating strategies can create. Depending upon the thickness of the paint system, ASTM D3359 has two different test methods. The rating criteria for both standards follow:

ASTM D3359					
Method A			Method B		
Rating	**Observation**	**Surface of X-cut from which flaking/peeling has occurred**	**Rating**	**Percent Area Removed**	**Surface of cross-cut area from which flaking has occurred for six parallel cuts and adhesion range by percent**
5A	No peeling or removal	None	5B	0% none	
4A	Trace peeling or removal along incisions or their intersection		4B	Less than 5%	
3A	Jagged Removal along incisions up to 1/16” on either side		3B	5 – 15%	 
2A	Jagged removal along most of incisions up to 1/8” on either side		2B	15 – 35%	 
1A	Removal from most of the area of the X under the tape		1B	35-65%	 
0A	Removal beyond the area of the X		0B	Greater than 65%	

ASTM D6677	
Rating	Description
10	Fragments no larger than $\frac{1}{32}$” x $\frac{1}{32}$” can be removed with difficulty
8	Chips up to $\frac{1}{8}$” x $\frac{1}{8}$” can be removed with difficulty
6	Chips up to $\frac{1}{4}$” x $\frac{1}{4}$” can be removed with slight difficulty
4	Chips larger than $\frac{1}{4}$” x $\frac{1}{4}$” can be removed with slight pressure
2	Once coating removal is initiated by knife, it can be peeled at least $\frac{1}{4}$”
0	Coating can be peeled easily to length greater than $\frac{1}{4}$”

Chart 6 – Blistering Rating The figure below depicts the photographic standards referenced in ASTM D714 “Standard Test Method for Evaluating Degree of Blistering of Paints”. This test uses these pictorial standards to quantify both the size and density of blisters that may develop in linings. Although the standard uses a blister size scale of 0 to 10 this chart uses the most common sizes of blisters found in the field. The standard does not use a reference for the size of each of the blisters depicted. CSI used this scale as a means for further quantification by qualifying the largest blister depicted as being 1 inch in width (Blister Size No. 2) and the smallest blister being 1/32 of an inch in width (Blister Size No. 8).

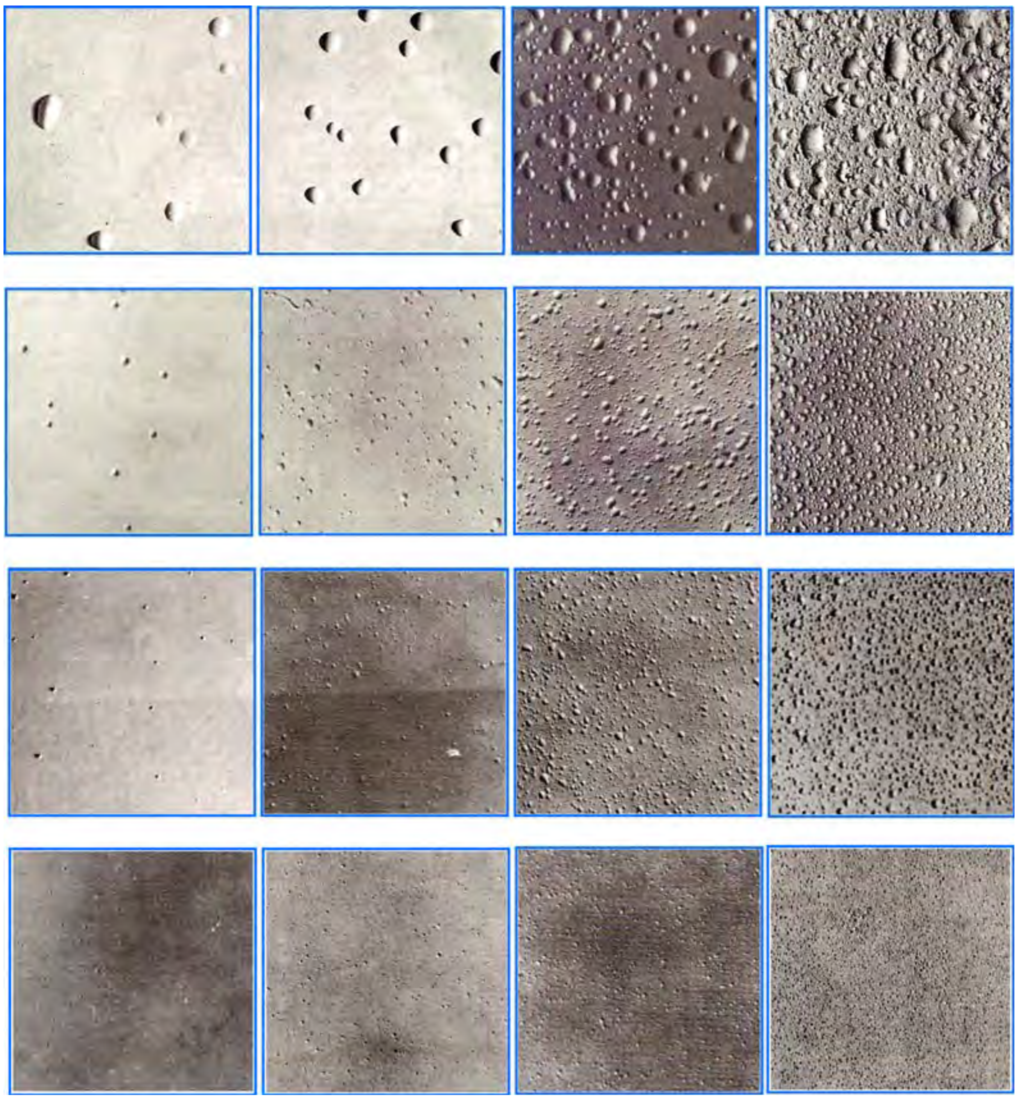
Few **Medium** **Medium Dense** **Dense**

Blister Size No. 2

Blister Size No. 4

Blister Size No. 6

Blister Size No. 8



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Providing Quality Technical Services to the Coating Industry

November 19, 2023

Via Email: asmith@pbieng.com

Ashley Smith, PE
Peterson Brustad Inc.
80 Blue Ravine Road, Suite 280
Folsom, CA 95630

Office: 916.608.2212
Cell: 530.200.6309

Subject: **Final Report - Maintenance Inspection**

Re: **CPUD – Golden Hills Reservoir**

Dear Ashley:

Please find attached the final report for the evaluation that was completed on the above referenced tank. Also attached is our invoice.

Thank you for your business and please let me know if you have any questions or comments about our findings. I can always be reached by cell at 951.609.6991 or by e-mail at rgordon@csiservices.biz.

Sincerely,
CSI Services, Inc.

N. Randy Gordon

N. Randy Gordon, PCS
Technical Services Manager

P. O. Box 801357, Santa Clarita, CA 91380 877.274.2422

Final Report
Maintenance Inspection
Golden Hills Reservoir
Calaveras Public Utility District

Prepared for:
Ashley Smith, PE
Peterson Brustad Inc.
80 Blue Ravine Road, Suite 280
Folsom, CA 95630

Prepared by:
CSI Services, Inc.

N. Randy Gordon, PCS
Technical Services Manager

PROTECTIVE COATING SPECIALIST
N. RANDY GORDON
No. 2018-621-011
Exp. 12-31-26
PCS
STATE OF CALIFORNIA

November 19, 2023

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Attachments

- Field Notes
- Exterior Photos
- Interior Photos
- CSI Chart 1 – General Description of Conditions
- CSI Chart 2 – Rust Grade Criteria
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- CSI Chart 5 – Coating Adhesion Criteria
- CSI Chart 6 – Coating Blistering Criteria

Introduction

Peterson Brustad Inc. authorized CSI Services, Inc. (CSI) to conduct a maintenance inspection on the Calaveras Public Utility District, Golden Hills Reservoir located at 4866 Lyle Court, Mokelumne Hill, CA. This report documents the findings of the inspection and services performed.

Any recommendations have been made in accordance with the applicable requirements of American Water Works Association's Standard (AWWA) D102 "Coating Steel Water Storage Tanks," AWWA Standard M42 "Steel Water Storage Tanks," and CSI's experience with evaluating over a thousand water storage facilities. A photo summary and narrated video are also included to document the condition of the tank.

The field-work was completed on August 10, 2023 by a team primarily comprised of Anthony Jackson, Steven Metcalf and Steven Metcalf Jr. The exterior shell observations were made mostly from grade level, while the exterior of the roof was examined close-up. The interior inspection was carried out with the tank’s water level at approximately 8 feet using special underwater diving equipment and techniques. Steve Metcalf was the site supervisor and Anthony Jackson was the lead diver. Mr. Randy Gordon, Technical Services Manager, reviewed the results of the field data and prepared recommendations for maintenance work. Mr. Gordon has over 30 years of experience through the evaluation of thousands of storage tanks and other structures. He is certified as an SSPC Protective Coating Specialist (PCS) and NACE/SSPC Level 3 Coating Inspector.

Summary

The 40+ year old coating system on the tank is in overall fair condition with localized dark corrosion. While the exterior paint system is severely weathered, it maintains excellent adhesion, making it a suitable candidate for overcoating. The exterior paint is believed to be the original system applied and very likely has high concentrations of heavy metals (e.g. lead, chromium, etc.) that will require special precautions to protect the workers and environment when it is disturbed.

The lining in the tank is in an overall unsatisfactory condition with widespread rust including undercutting, pitting and exfoliation. Pitting at the tank bottom was measured at 0.204” on a 0.250” sheet which indicates that the metal loss due to corrosion is close to compromising the steel. Blistering of the lining below the MWL is pervasive and widespread. The majority of the corrosion is in the upper part of the tank and includes structural loss. The most advanced corrosion spots below the CWL were patched during this inspection using NSF certified underwater curing epoxy. The existing lining conditions dictate that the existing exterior paint and interior lining systems should be removed and replaced within the next year to prevent further metal loss.

Background

The Golden Hills Reservoir is a welded steel on grade structure where the year of construction is unknown but estimated to be a 1970's era structure. The tank is approximately 20 feet in diameter by 16 feet high providing a nominal capacity of 50,000 gallons.

The tank shell has two courses that are connected to a roof with rafters, girders and one center column. The tank has one roof vent, one roof hatch, and one shell manway. There is one interior ladder and one exterior ladder. The exterior ladder has fall protection and a vandal deterrent. The tank is not seismically anchored to its gravel grade band foundation. There is no internal or external cathodic protection (CP) system associated with this tank. The tank has a full-travel water level indicator, rigid piping connections, and the overflow is external.

It is believed that the interior linings are the original coatings applied. The interior steel surfaces, including the roof and roof support members are coated with a coal tar epoxy system while the tank shell, floor, and appurtenances are coated with an Epoxy lining. The exterior roof, shell, and appurtenances are painted with what appears to be an alkyd system. The internal roof lap seams are not caulked.

Field Evaluation

The purpose of this survey was to assess the condition of the existing coatings and recommend maintenance coating work, where needed. The evaluation mainly involved visual observations, but also involved various testing procedures. Photographs and video were taken to document the field inspections, and a photo summary and narrated video is included within this report.

For survey purposes, the tank has been segmented into defined areas: exterior roof, exterior shell, interior roof, interior shell, and interior floor. The various appurtenances within each of these areas have also been evaluated. A rating system has been developed to quantify the condition of these various tank areas. Each of the rating criteria is found in the Attachments (Charts 1 through 6).

The condition of the coating systems was rated as being poor, fair, good, or excellent (Chart 1). The extent of any rust defects identified within each of the areas was generally determined using the guidelines set forth in ASTM D610 “Standard Test Method for Evaluating the Degree of Rusting of Painted Steel Surfaces” (Chart 2). Where applicable, the characteristic or stage of corrosion was determined in accordance with CSI Corrosion Grade criteria (Chart 3). The degree of paint chalking was determined in accordance with ASTM D4214 “Standard Test Method for Evaluating the Degree of Chalking of Exterior Paint Films,” Test Method D659, Method C (Chart 4). Coating adhesion was assessed in accordance with ASTM D3359 “Standard Test Method for Evaluating Adhesion by Tape Test, modified Method A and/or a modified version of ASTM D6677 “Standard Test Method for Evaluating Adhesion by Knife” (Chart 5). The modified version of ASTM D6677 was used in areas where destructive testing was not found to be practical. Any blistering that may have been present was rated in accordance with ASTM D714 “Standard Test Method for Evaluating the Degree of Blistering in Paints” (Chart 6), and the paint dry film thickness was measured with a Positector 6000FN3 Type II gage in accordance with the applicable guidelines set forth SSPC PA2. The visual observations and data collected from the various areas of the tank are found in the charts below:

Exterior

Close-up visual examination of the coating was limited to the first (lowest) shell course, upper shell areas adjacent to the ladder, and the roof. The exterior paint on the heavily weathered roof is in poor condition and the shell was in fair condition, both with moderate chalking (ASTM D4214, No. 8). Dark rust (CSI Corrosion Grade 2) was present in areas that had been mechanically damaged from operations or vandalism and areas where paint was peeling. The amount of rust on the tank was less than 0.1 percent of the overall surface area. Areas where paint was found to be cracking were rated a 2 in accordance with ASTM D661. The paint thickness was found to range from 4.0 to 5.0 mils, and the paint was estimated to exhibit satisfactory adhesion (ASTM D6677, 5A). Some of the specific data collected follows:

Exterior Paint					Overall Condition	Fair						
Paint Defects	**Roof Quadrant**				**Shell Quadrant**				**Tank Support**			
	Exterior		Poor		Exterior		Fair		Exterior		Fair	
	S	**W**	**N**	**E**	**S**	**W**	**N**	**E**	**S**	**W**	**N**	**E**
Rust spots (ASTM D610)	8	8	8	8	8	8	8	8	8	8	8	8
Corrosion Grade	2	2	2	2	2	2	2	2	2	2	2	2
Rusting at crevices												
Spot peeling												
Delamination												
Cracking (ASTM D661)												
Checking (ASTM D660)												
Chemical staining												
Chalking	8	8	8	8	8	8	8	8	8	8	8	8

Interior

The roof area is defined as those surfaces above the highest water level (HWL). Close-up visual examinations were made to all areas below the waterline and all other areas were assessed from the water level. The coating on the underside of the roof plates and roof support structure is in poor condition with corrosion common to the edges of the support member flanges and roof plates. Spot peeling and cracking was observed throughout, leading to lamellar or exfoliation corrosion and structural loss (CSI Corrosion Grade 2, 4, 5). The total amount of corrosion on the roof was rated to be approximately one sixth of the total surface (ASTM D610, 3), and there was a moderate amount of rust staining present at the faying surfaces of the roof structure.

The shell surfaces are covered with a dark sediment, but spot checking revealed the lining on the shell was found to be in poor condition with areas of dark rust (CSI Corrosion Grade 2), especially below the high-water level segment of the shell. The total amount of corrosion on the shell was rated to be excessive but less than 1 percent of the total surface (ASTM D610, 6) with rust nodules and pitting observed. Fields of intact and broken, medium dense blisters were observed (ASTM 714, 2-few).

The floor had sediment upon it, but spot checking revealed a coal tar epoxy system that was estimated to be in poor condition, (ASTM D610, 6) with fields of small, medium-dense blisters (ASTM 714, 2-few), and pitting that measured up to 0.204”. The pitting uncovered at the floor was patched during the inspection.

The data collected from the underwater inspection follows:

Interior Paint			Above Water Condition			Poor		Below Water Condition			Poor	
Paint Defects/Overall Grade	**Roof Quadrant**				**Shell Quadrant**				**Floor Quadrant**			
	Interior		Poor		Interior		Poor		Interior		Poor	
	S	**W**	**N**	**E**	**S**	**W**	**N**	**E**	**S**	**W**	**N**	**E**
Rust spots (ASTM D610)	3	3	3	3	6	6	6	6	6	6	6	6
Rust areas (ASTM D610)												
Corrosion Grade	2,3,4,5	2,3,4,5	2,3,4,5	2,3,4,5	2	2	2	2	2	2	2	2
Rust staining												
Rusting at crevices												
Spot peeling	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Delamination												
Cracking (ASTM D661)	2	2	2	2	2	2	2	2	2	2	2	2
Blistering (ASTM 714) Size/Densit					2/Few	2/Few	2/Few	2/Few	2/Few	2/Few	2/Few	2/Few
Pitting (Estimated Amount)									5	5	5	5
Pitting (Estimated Deepest Mils)									0.18	0.2	0.2	0.204

Dive Inspection Video

Click on link or cut and paste the external link: https://youtu.be/NH0eloaUTho

Discussion

The paint system on the exterior was found to be relatively thin and in poor condition on the roof and fair condition at the shell. All surfaces have isolated spot rust and areas of peeling, and the paint system was found to have significantly weathered from chalking. It was also noted that the underside of the center vent has heavy corrosion up to and including some metal loss.

Chalking is the term for the powdery characteristic of an aged coating that may also have a faded finish. Chalking is a result of the natural breakdown of a paint system's binder when it is exposed to sunlight. The binder (or resin) degrades in ultraviolet light, which leaves behind the unbound pigment or chalk. Aside from a faded appearance, chalking can result in corrosion as the film weathers (thins) away through cycles of wind and rain. As the paint endures years of direct sunlight, it begins to weather away, which results in the paint no longer providing enough barrier protection from corrosion. On this basis, it is recommended that a plan for recoating the tank with an industrial paint should be completed.

Generally speaking, there are four possible approaches to maintenance coating work. The coatings can be either completely removed and replaced (repainted), spot repaired, spot repaired and overcoated, or simply overcoated. In evaluating the condition of a coating to determine the best approach there are a number of different factors to consider. The first set of factors includes the determination of the coating's ability to withstand the added stress of an additional coat(s). Attributes impacting this decision

include film thickness and adhesion. If a film is too thick or has poor adhesion, the tension from the curing stresses and/or the weight of the additional paint can cause the existing system to disbond. The second set of factors to consider when determining what maintenance coating approach to take is the amount of surface area requiring repair, the overall difficulty in providing access to the structure, and whether the coating system contains heavy metals. The final factor is the condition of the substrate.

When considering whether a spot repair approach is a viable option, a good rule of thumb is that up to 10 percent of the surface area requiring repair is the point at which making spot repairs with overcoat becomes a diminishing return. With 10 percent rusting, overcoating may be an option if the adhesion is better than fair. If there is more than 10 percent rusting and the substrate is free of mill scale, overcoating may be considered an option if the adhesion is satisfactory. Once the amount of surface area exceeds this range, the cost of cleaning and coating the individual rust spots approaches (or exceeds) the total cost of removal and replacement.

On this basis, it is recommended that the tank exterior paint system be spot repaired and overcoated within the next 4 to 6 years before any significant metal loss develops.

At interior surfaces, the tank lining system was found to have widespread dark corrosion above the highest water level (HWL) with lamellar and/or exfoliation corrosion common to edges and structural loss at the rafters connected to the dollar plate. A significant amount of corrosion was found below HWL with pitting and medium dense patches of broken and unbroken blisters.

Exfoliation corrosion is a form of intergranular corrosion which involves selective attack of a metal at or adjacent to grain boundaries. In this process, corrosion products force metal to move away from the body of the material, giving rise to a layered, laminar appearance. Exfoliation corrosion is also known as layer corrosion or lamellar corrosion.

Since all of the blisters were underwater and below the common water level, it is presumed that the blisters are a result of osmotic forces. Osmotic blistering is typically caused when coatings that are to be placed into immersion service are applied too thick, overcoated too soon, under colder weather conditions, and/or over contaminated surfaces. One form of osmotic blistering is solvent entrapment. Solvents are added to coatings to act as a vehicle during application. When coatings are applied too thick the coating solvents that were designed to be released during application are locked in-place when the catalyzed coating reaches a full chemical cure. Additionally, if coatings are applied under cold or cooler conditions, the solvents have a difficult time escaping from the film before it gets hard. Blisters that result from solvent entrapment tend to be localized to the coolest and lowest areas of a tank. Solvent vapors are typically heavier than air, and the lowest portion of a tank tends to become saturated with these gases

without proper ventilation at the time of application. Coated over contamination creates a source for osmotic forces. This contamination attracts fluid that creates pressures that exceed the film's ability to bond, creating blisters.

Isolated corrosion pits can develop within a coating system that may have only a few small breaks that were not corrected through periodic maintenance repairs. If the remaining, adjacent coating has excellent adhesion, it will inhibit undercutting corrosion. As a result, the corrosion forces will have a tendency to concentrate on the exposed bare metal, which results in pitting. Pitting can be critical in some instances. The maximum corrosion rate for steel in fresh water is typically no more than 30 mils per year (MPY). As a result, the pitting can develop into a perforation if not repaired. If a thru-hole develops within a tank bottom, the isolated issue can develop into a much larger corrosion problem. Corrosion requires oxygen to advance, and the underside of the tank bottoms are considered a dead-air space. As a result, the bottom of tank floors are typically not coated. A perforation or thru-hole with even a small trickle of water will reintroduce oxygen into the environment creating active corrosion that is difficult to identify until the steel floor plate requires replacement.

Industrial paint systems such as those applied to industrial facilities (i.e. piping, structural steel, storage tanks) typically have a life expectancy of 25 to 35 years before any spot maintenance coating repairs are required. The failed interior lining system is estimated to be 40+ years old and cannot be spot repaired. The characteristics of the coating defects indicate that the lining failed many years ago.

A common tank design in the past was to run tank piping up through the tank bottom. This design can help prevent piping from obstructing outside areas of the tank but can be problematic during a seismic event. During an earthquake, there is the potential for the tank bottom to move at a different rate than the below grade piping. Past seismic events have resulted in piping connections being sheared or cracked, which resulted in a loss of water capacity during times when it was most needed during the emergency. Moving tank piping to the shell to include flexible connections for inlet/outlets is a better design when considering this issue.

Recommendations

The following activities are recommended for remedial work:

Exterior

Within the next four to six years, spot repair and overcoat the exterior coating. This work should include the following:

1) This work should include cleaning all surfaces in accordance with SSPC's Surface Preparation Standard No. 15, "Commercial Power Tool Cleaning" followed by 4-6 mils of an industrial epoxy primer and 3-5 mils of a polyurethane finish coat.

2) Test the paint system for heavy metals to determine if any special actions are required to protect workers and the environment during paint disturbance.

Interior

As soon as possible, remove and replace the interior lining. This work should include the following:

3) Remove and replace the lining system at all interior surfaces. This work should include cleaning all surfaces in accordance with SSPC's Surface Preparation Standard No. 10 "Near-White Metal Blast Cleaning" (SSPC-SP10) followed by three 4 to 6 mil coats of an NSF Certified epoxy lining.

4) Caulk all crevices in the tank such as roof lap seams.

5) Anticipate the need for structural repairs (welding, grinding, etc.)

6) Consider retrofitting the tank piping to include flexible couplings and the relocation of tank bottom connections to the lower shell.

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Field Water Tank Dive Inspection Report

Tank Name:	Golden Hills	Dive Supervisor:	Steven Metcalf
Tank Owner/Client:	CPUD	Dive Leader:	Anthony Jackson
Client Contact:	Ashley Smith	Dive Tender	Steven Metclaf Jr.

Scope Maintenance Inspection

Site Information

Item	Description
Cross Street	Lombardi Dr
Tank Location	4866 Lyle Ct Mokelumne Hill CA
GPS Coordinates	38.25771 -120.70483
Nearest Structures	None
Surrounding Site	Gravel

Item		Notes
Perimeter Fencing	Yes	No Comments
Site secured on arrival	Yes	No Comments
Overhead Power Lines	No	None
Antenna on Tank	No	None
Roof Accessible	Yes	No Comments

Interior Structural Characteristics

Item	Data	
Roof Structure	Rafters and Center Column	
Column Design	Pipe	
Upper Center Column	Dollar Plate	
Column Base Design	Free Plate	
Connections	Welded	
Overflow Design	Stubs	
Inlet Interior Design	Roof Stub	
Lining Type/Original	Epoxy	Yes

Item	Data			
Outlet Design	Floor Stub			
No. Interior Ladder	Yes	One		
CP System/Type	No	None		
Water Depth	8			
Water Agitator	No	None		
Barrier Walls	No			
No. of Columns	One Column			
Caulking	Roof	No	Columns	No

Exterior Structural Characteristics

Item	Data	
Capacity (gallons)	50,000	
Diameter (feet)	20	
Height (feet)	16	
Erection Year	Unknown	
Contract No.	Unknown	
Tank Type	Welded Steel	
Tank Profile	on grade	
Tank Geometry	Cylinder	
Number of Courses	Two	
Height of Each Course	8 Ft	
Roof Design	Pitched Roof with Nuckle	
No. Shell Manways	Two Shell Manways	
Type of Manways	Round	
Manway Cover Design	Bolted Circle	
Diameter of Manways	20 in	
No. Roof Hatches/Location	One	Near Edge
Hatch Design	Square Shoe Box	
Size of Roof Hatch	24 in	
No. Roof Vents/Location	One	Center
Roof Vent Design	Elbow	
Construction Co.	Unknown	

Item	Data	
Center Roof Vent Size	4 in	
Roof Vent Sealed	Yes	Satisfactory
Roof Rail System	Yes	No Comments
Roof Rail Satisfactory	Yes	No Comments
Rail Location	Top of Ladder	
No. & Type Roof Access	One	Ladder
Exterior Vandal Deterrent	Yes	
Ext Ladder Satisfactory	One	Yes
Ext Ladder Fall Prevent	Yes	
Roof Tie-Off Present	Yes	
Tank Piping	Floor Inlet and Outlet	
Inlet Diameter	Shell Inlet and Outlet	
Outlet Diameter	4 in	
Flexible Pipe Coupling	4 in	
Overflow Pipe Diameter	4 in	
Overflow Exterior Design	To Ground	
Drain Location	Floor	
Tank Foundation	Concrete Ring Wall	
Water Level Indicator	Yes	
Tank Type	Potable	
Lining Type/Original	Polyurethane	No

Miscellaneous Notes

EXTERIOR - CPUD - Golden Hills - Maintenance Inspection

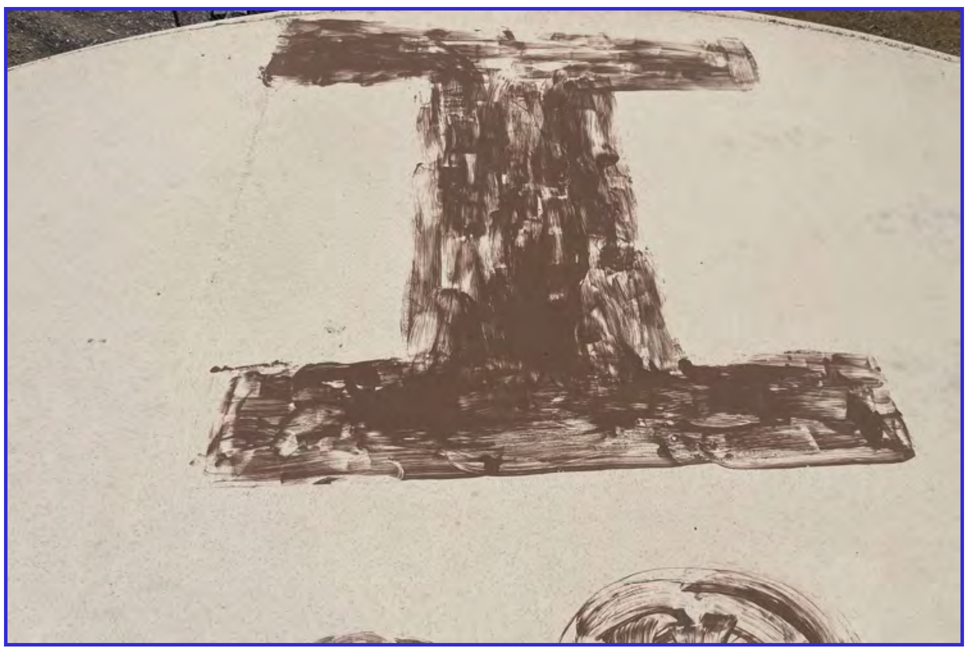
EXTERIOR - CPUD - Golden Hills - Maintenance Inspection -001

EXTERIOR - CPUD - Golden Hills - Maintenance Inspection -002

EXTERIOR - CPUD - Golden Hills - Maintenance Inspection -003

EXTERIOR - CPUD - Golden Hills - Maintenance Inspection -004

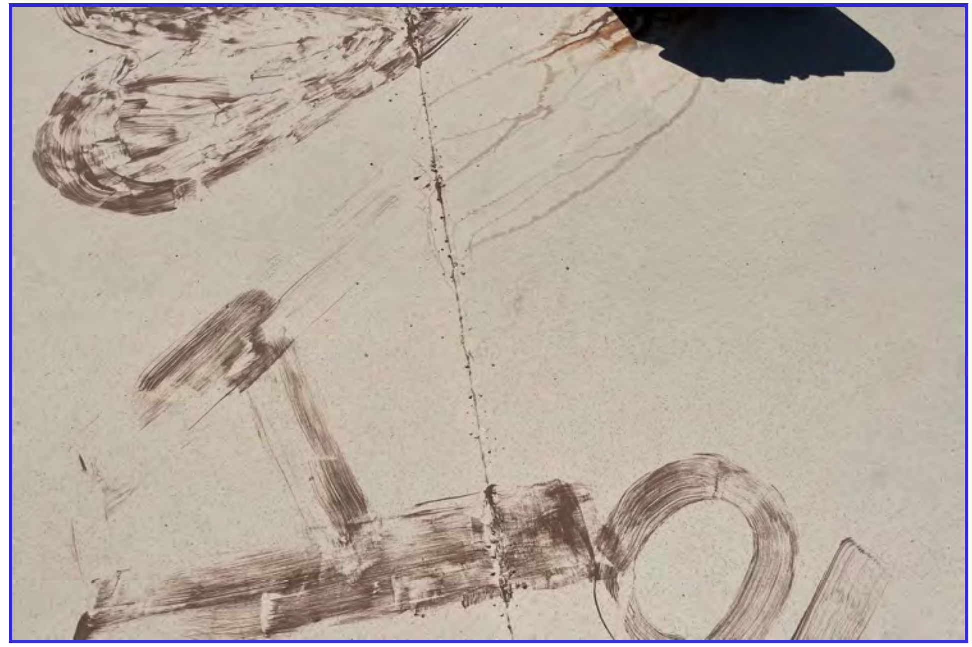
EXTERIOR - CPUD - Golden Hills - Maintenance Inspection -005



EXTERIOR - CPUD - Golden Hills - Maintenance Inspection -006

EXTERIOR - CPUD - Golden Hills - Maintenance Inspection -007

EXTERIOR - CPUD - Golden Hills - Maintenance Inspection -008



EXTERIOR - CPUD - Golden Hills - Maintenance Inspection -009

EXTERIOR - CPUD - Golden Hills - Maintenance Inspection -010

EXTERIOR - CPUD - Golden Hills - Maintenance Inspection -011

EXTERIOR - CPUD - Golden Hills - Maintenance Inspection -012

EXTERIOR - CPUD - Golden Hills - Maintenance Inspection -013

EXTERIOR - CPUD - Golden Hills - Maintenance Inspection -014

EXTERIOR - CPUD - Golden Hills - Maintenance Inspection -015

EXTERIOR - CPUD - Golden Hills - Maintenance Inspection -016

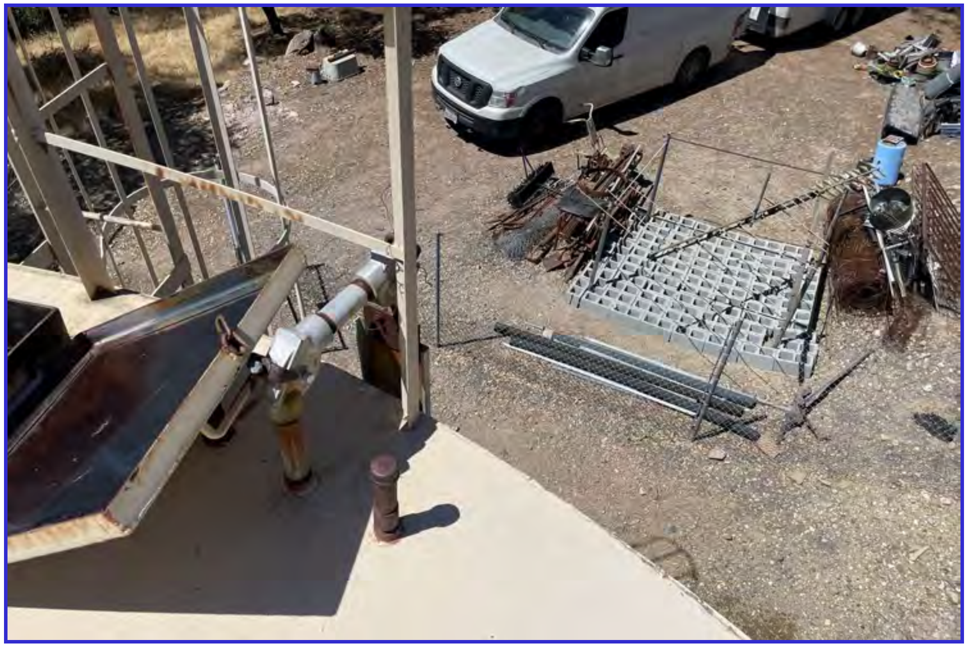
EXTERIOR - CPUD - Golden Hills - Maintenance Inspection -017

EXTERIOR - CPUD - Golden Hills - Maintenance Inspection -018

EXTERIOR - CPUD - Golden Hills - Maintenance Inspection -019

EXTERIOR - CPUD - Golden Hills - Maintenance Inspection -020

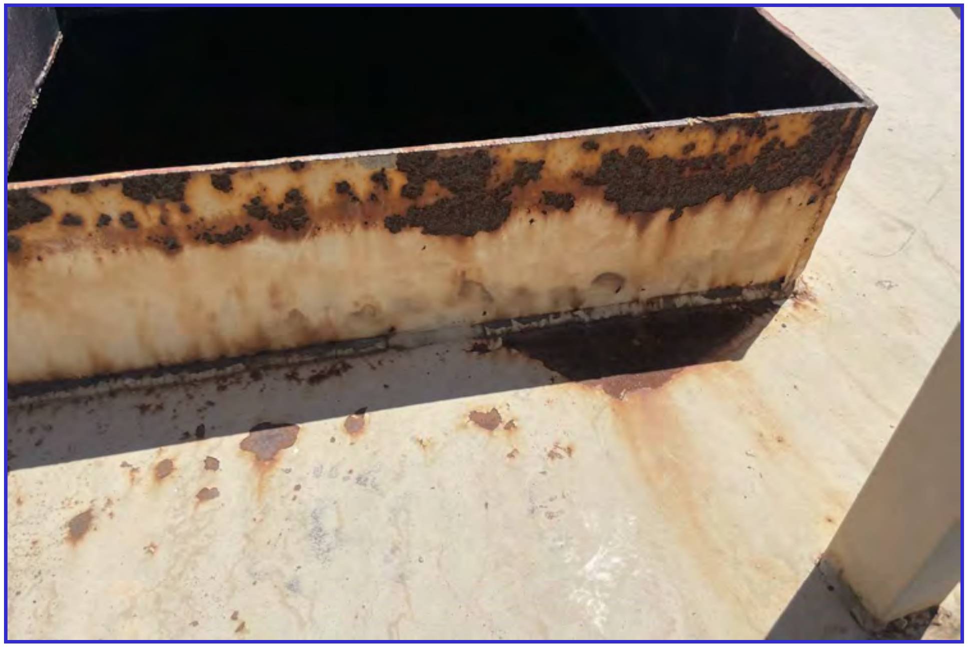
EXTERIOR - CPUD - Golden Hills - Maintenance Inspection -021



EXTERIOR - CPUD - Golden Hills - Maintenance Inspection -022

EXTERIOR - CPUD - Golden Hills - Maintenance Inspection -023

EXTERIOR - CPUD - Golden Hills - Maintenance Inspection -024

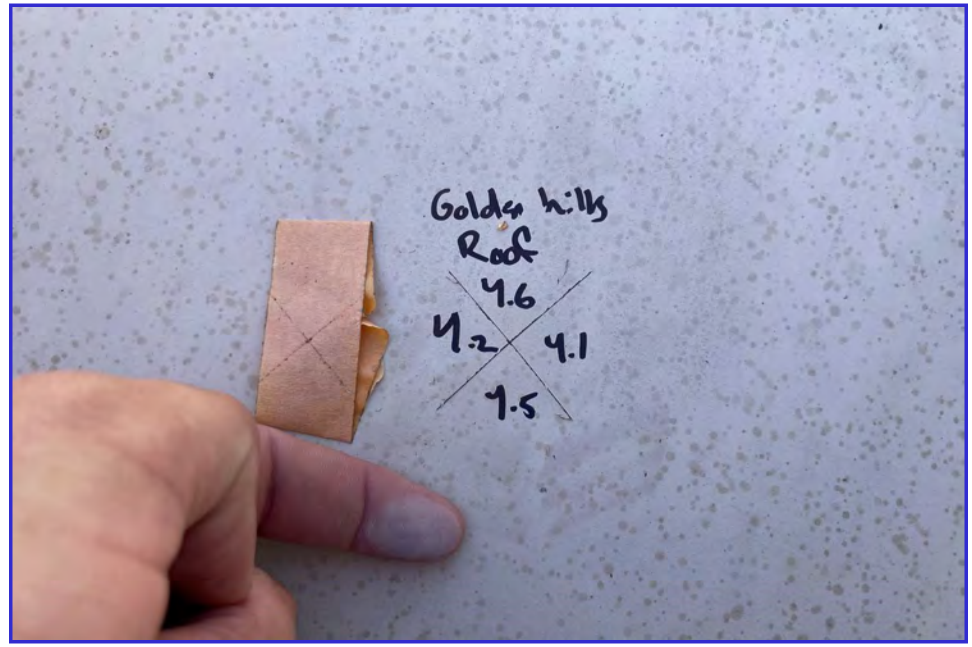


EXTERIOR - CPUD - Golden Hills - Maintenance Inspection -025

EXTERIOR - CPUD - Golden Hills - Maintenance Inspection -026

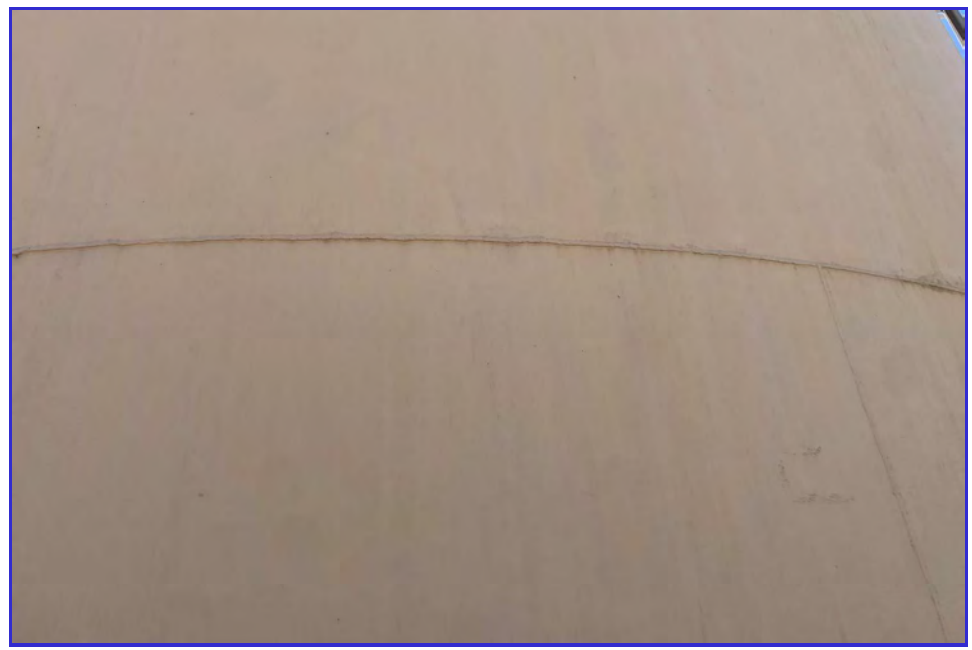
EXTERIOR - CPUD - Golden Hills - Maintenance Inspection -027

EXTERIOR - CPUD - Golden Hills - Maintenance Inspection -028

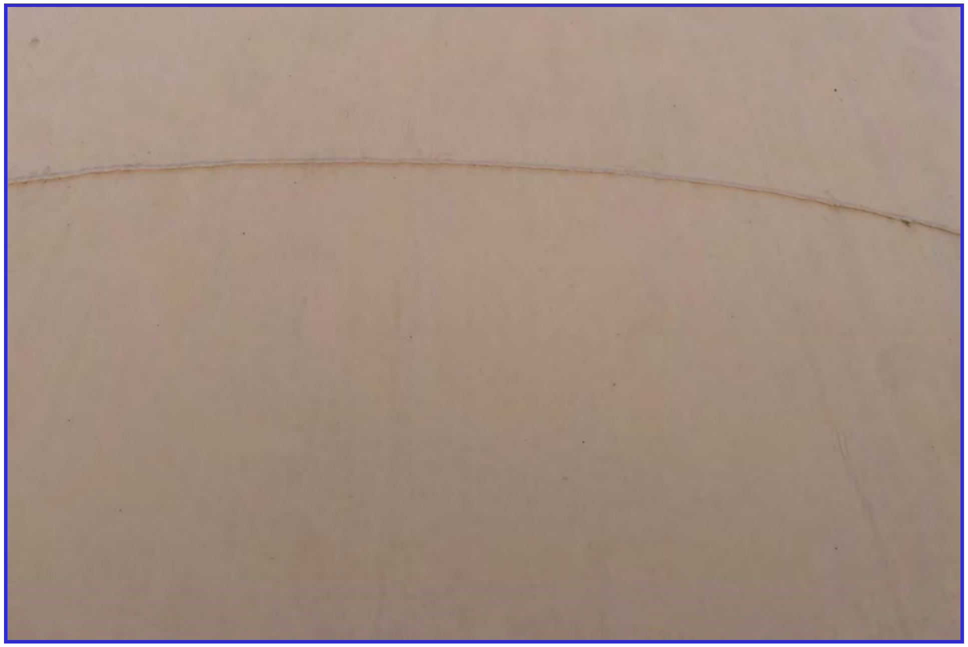


EXTERIOR - CPUD - Golden Hills - Maintenance Inspection -029

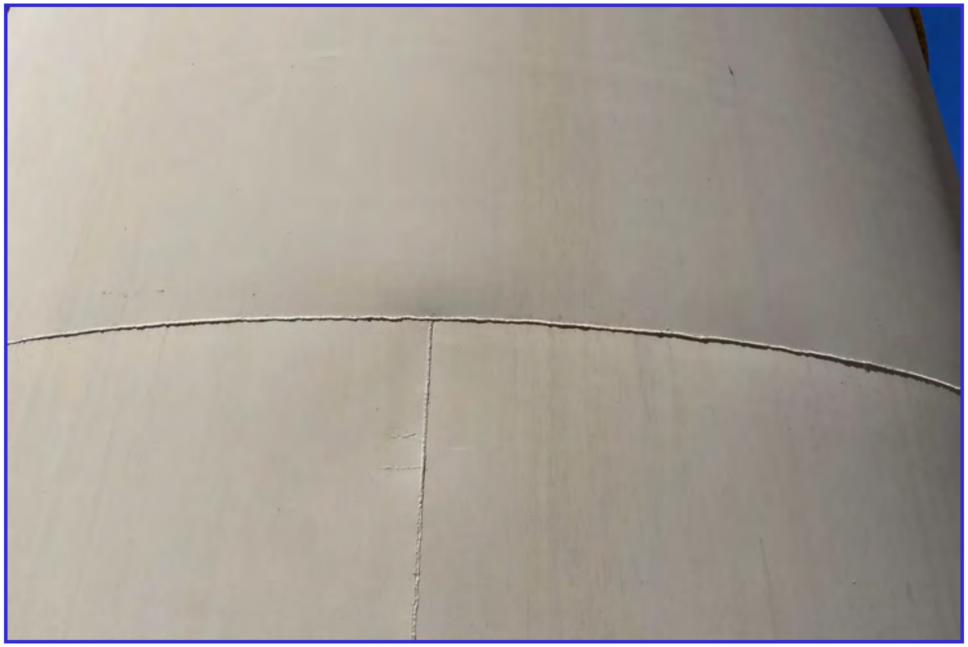
EXTERIOR - CPUD - Golden Hills - Maintenance Inspection -030



EXTERIOR - CPUD - Golden Hills - Maintenance Inspection -031



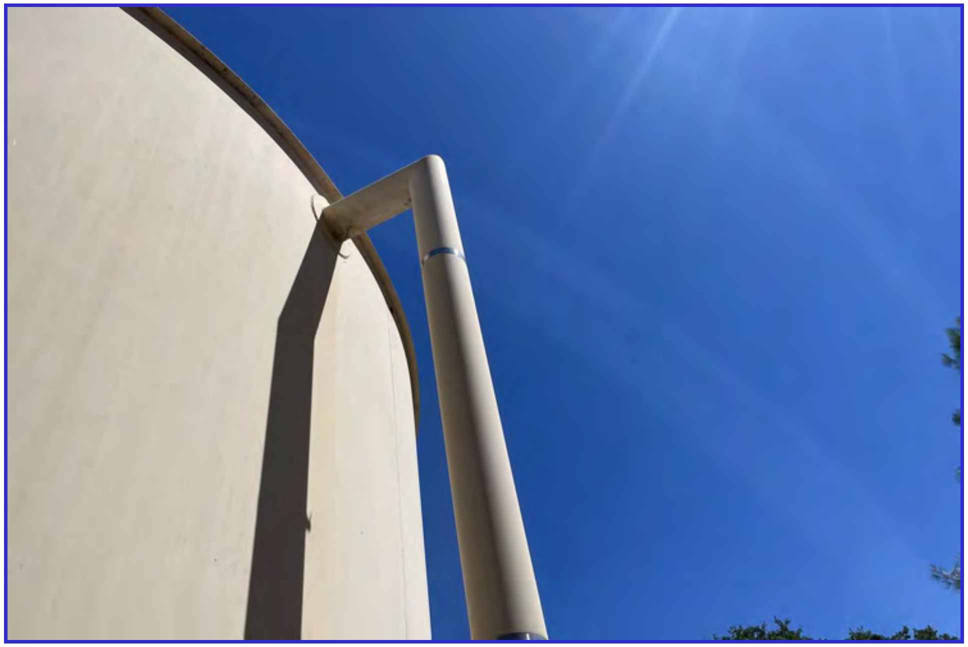
EXTERIOR - CPUD - Golden Hills - Maintenance Inspection -032



EXTERIOR - CPUD - Golden Hills - Maintenance Inspection -033

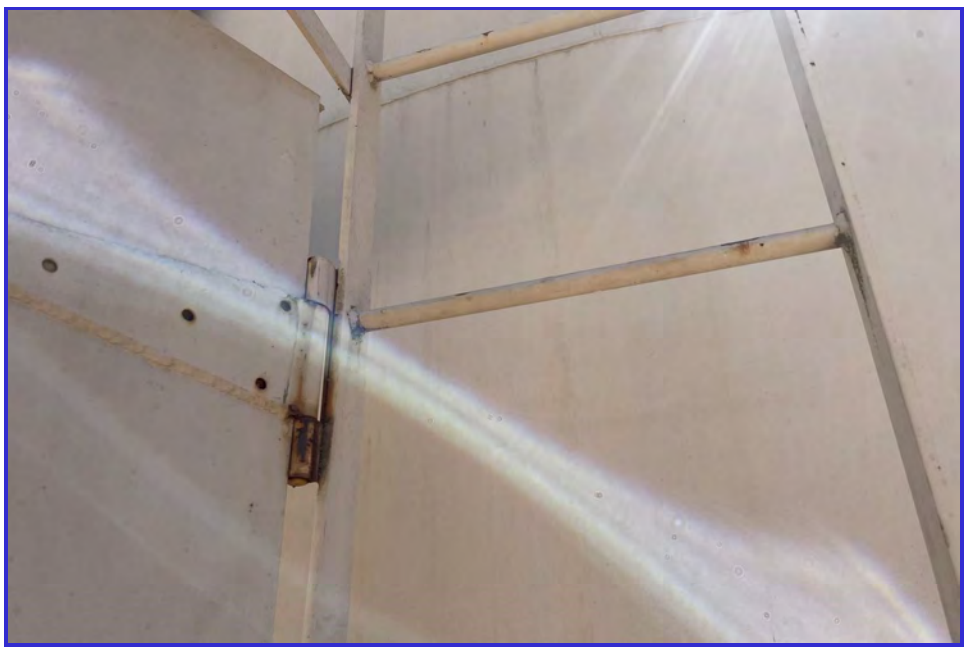
EXTERIOR - CPUD - Golden Hills - Maintenance Inspection -034

EXTERIOR - CPUD - Golden Hills - Maintenance Inspection -035



EXTERIOR - CPUD - Golden Hills - Maintenance Inspection -036

EXTERIOR - CPUD - Golden Hills - Maintenance Inspection -037



EXTERIOR - CPUD - Golden Hills - Maintenance Inspection -038

EXTERIOR - CPUD - Golden Hills - Maintenance Inspection -039

EXTERIOR - CPUD - Golden Hills - Maintenance Inspection -040

EXTERIOR - CPUD - Golden Hills - Maintenance Inspection -041

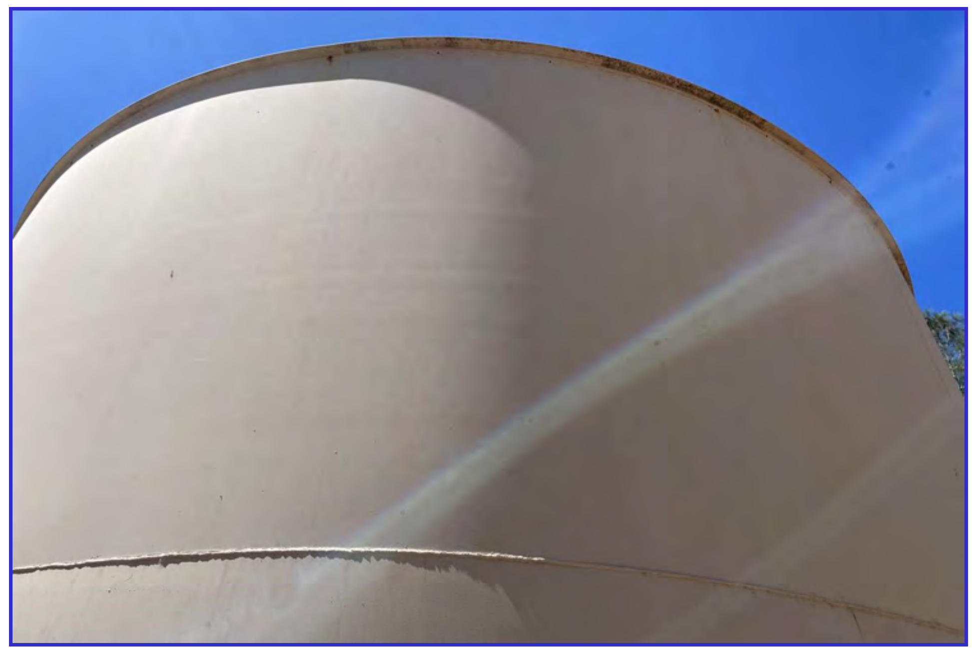
EXTERIOR - CPUD - Golden Hills - Maintenance Inspection -042

EXTERIOR - CPUD - Golden Hills - Maintenance Inspection -043

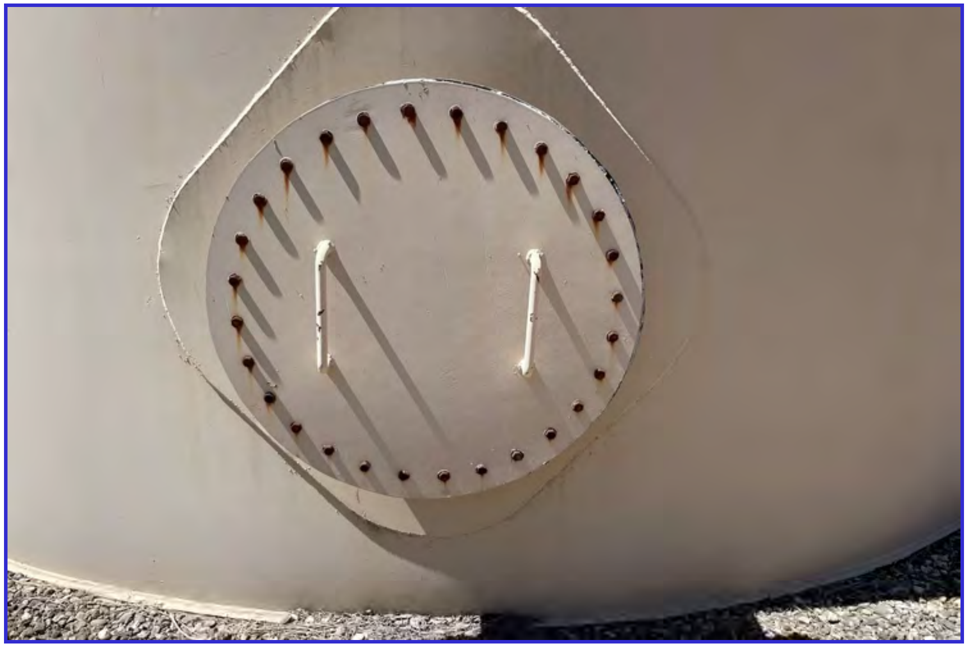
EXTERIOR - CPUD - Golden Hills - Maintenance Inspection -044

EXTERIOR - CPUD - Golden Hills - Maintenance Inspection -045

EXTERIOR - CPUD - Golden Hills - Maintenance Inspection -046



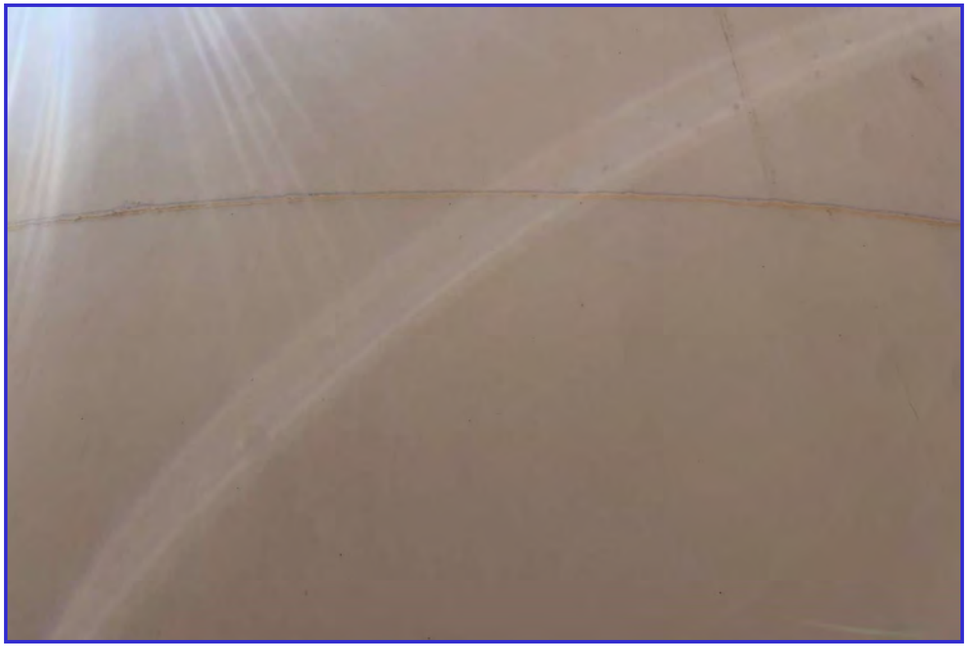
EXTERIOR - CPUD - Golden Hills - Maintenance Inspection -047



EXTERIOR - CPUD - Golden Hills - Maintenance Inspection -048

EXTERIOR - CPUD - Golden Hills - Maintenance Inspection -049

EXTERIOR - CPUD - Golden Hills - Maintenance Inspection -050



EXTERIOR - CPUD - Golden Hills - Maintenance Inspection -051

EXTERIOR - CPUD - Golden Hills - Maintenance Inspection -052

EXTERIOR - CPUD - Golden Hills - Maintenance Inspection -053

EXTERIOR - CPUD - Golden Hills - Maintenance Inspection -054

EXTERIOR - CPUD - Golden Hills - Maintenance Inspection -055

EXTERIOR - CPUD - Golden Hills - Maintenance Inspection -056

EXTERIOR - CPUD - Golden Hills - Maintenance Inspection -057

EXTERIOR - CPUD - Golden Hills - Maintenance Inspection -058

EXTERIOR - CPUD - Golden Hills - Maintenance Inspection -059

EXTERIOR - CPUD - Golden Hills - Maintenance Inspection -060

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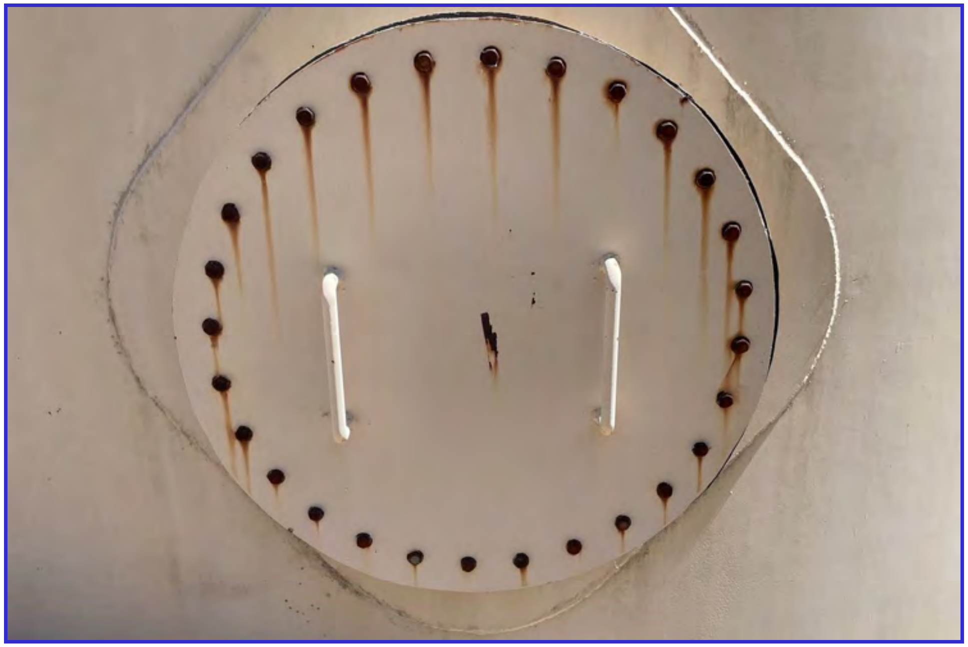
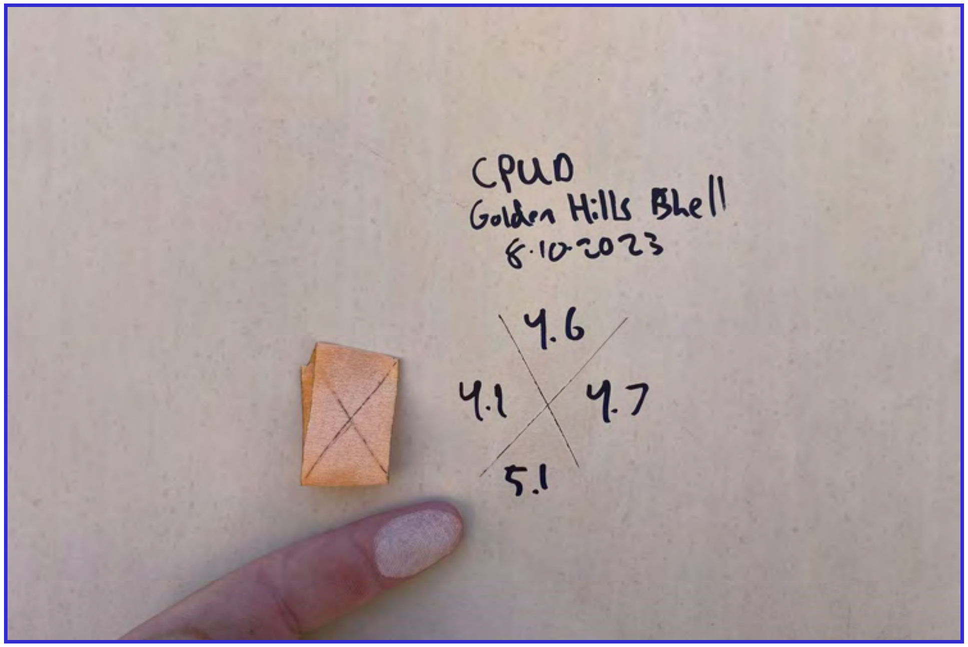
EXTERIOR - CPUD - Golden Hills - Maintenance Inspection -062

EXTERIOR - CPUD - Golden Hills - Maintenance Inspection -063

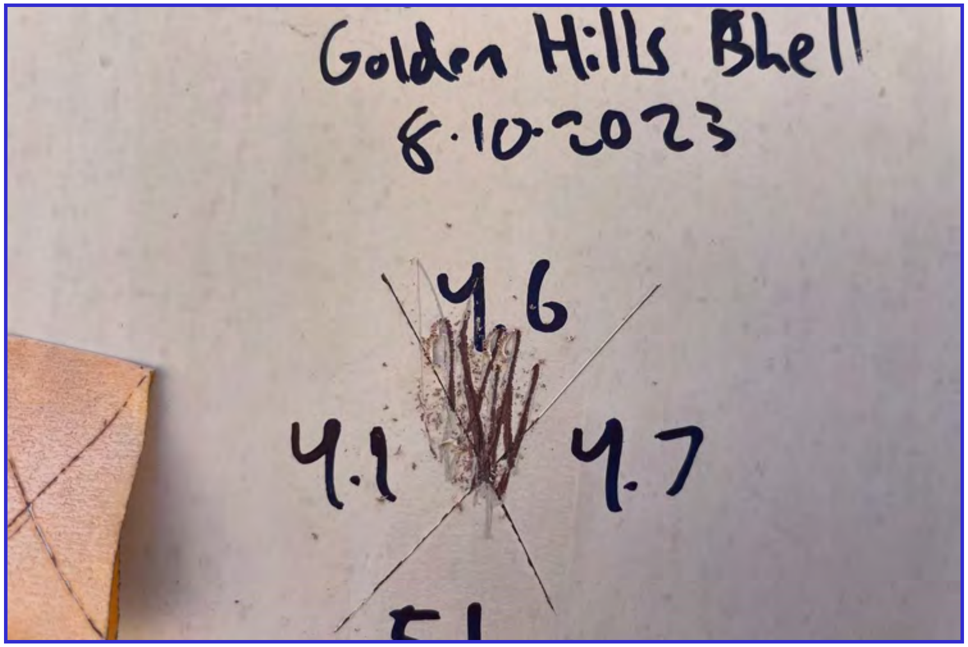


EXTERIOR - CPUD - Golden Hills - Maintenance Inspection -064

EXTERIOR - CPUD - Golden Hills - Maintenance Inspection -065

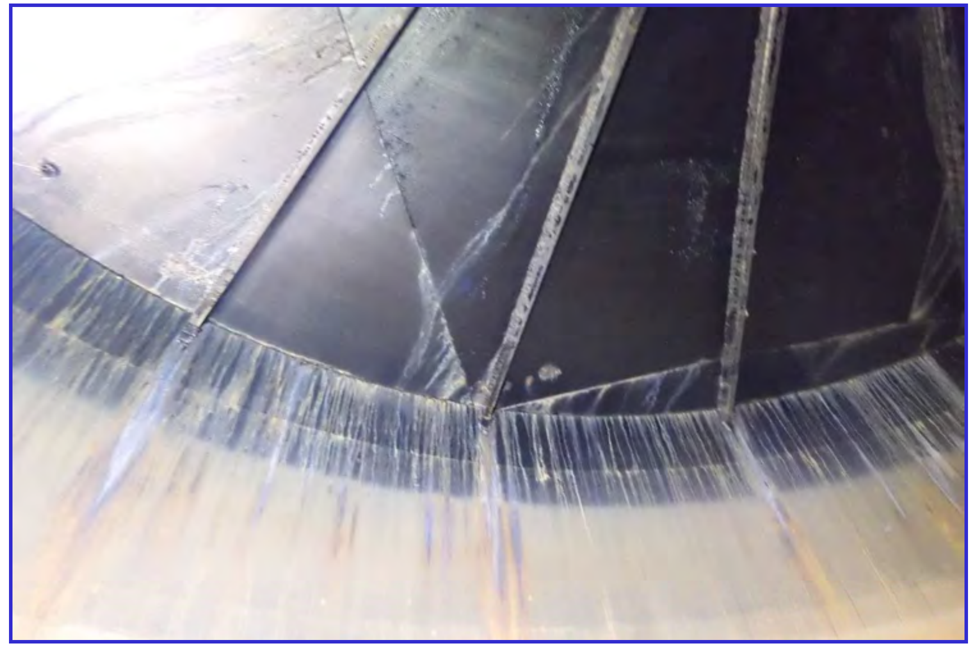


EXTERIOR - CPUD - Golden Hills - Maintenance Inspection -066

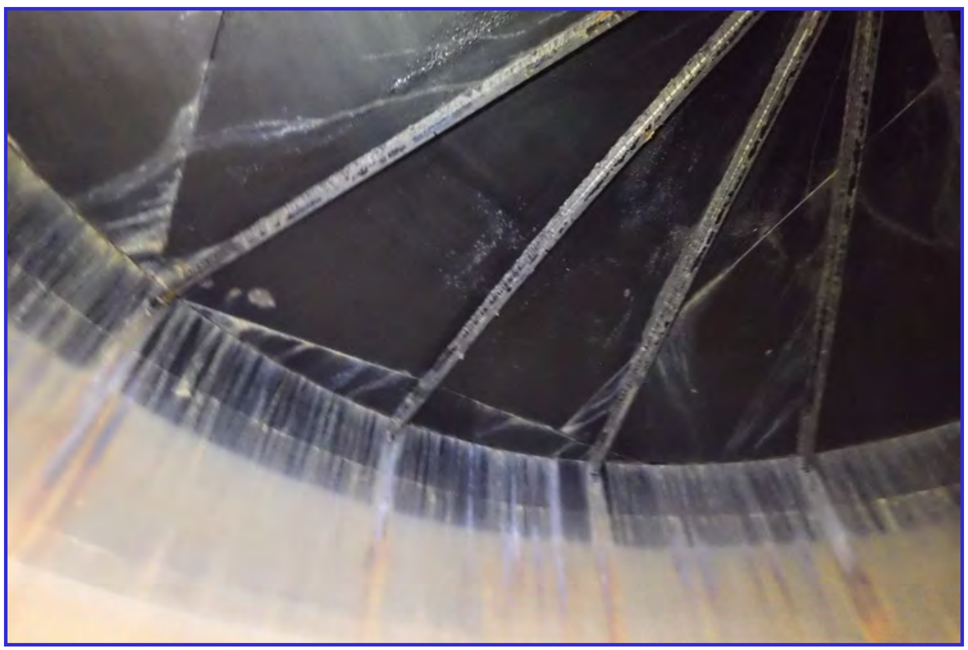


EXTERIOR - CPUD - Golden Hills - Maintenance Inspection -067

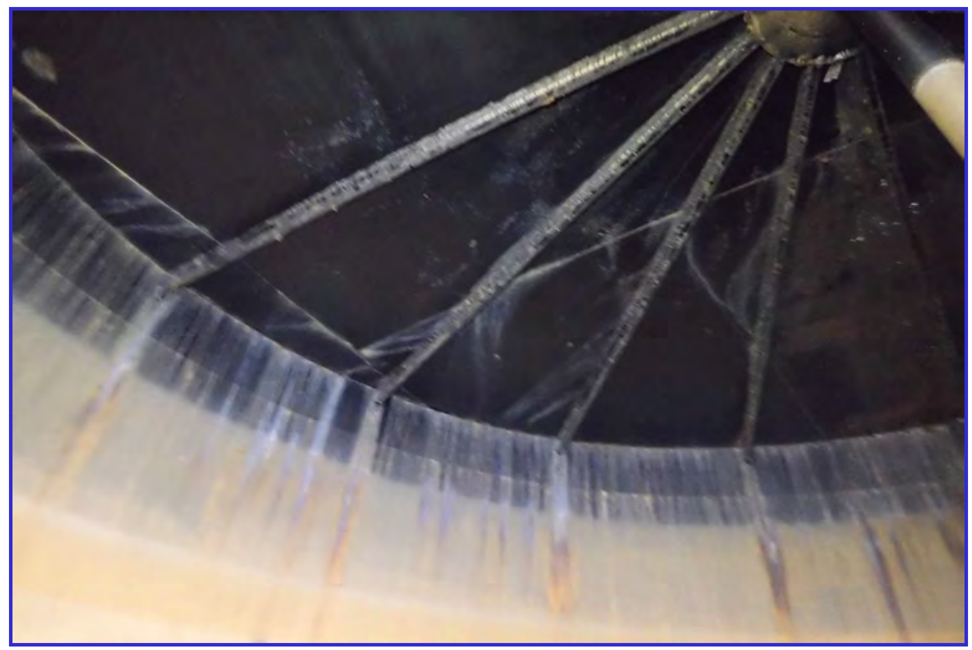
INTERIOR - CPUD - Golden Hills - Maintenance Inspection



INTERIOR - CPUD - Golden Hills - Maintenance Inspection -001



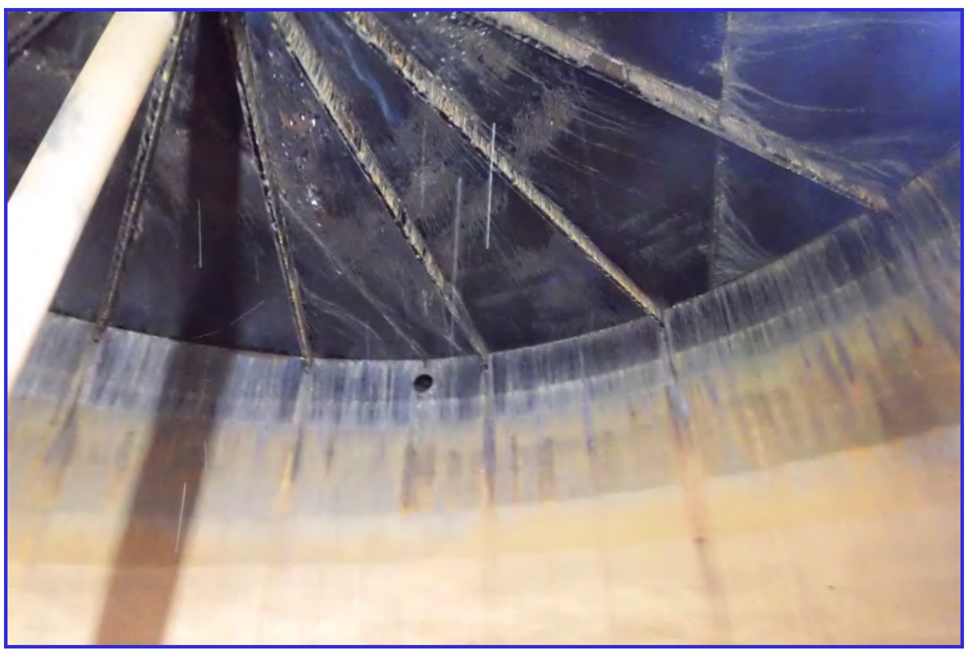
INTERIOR - CPUD - Golden Hills - Maintenance Inspection -002



INTERIOR - CPUD - Golden Hills - Maintenance Inspection -003

INTERIOR - CPUD - Golden Hills - Maintenance Inspection -004

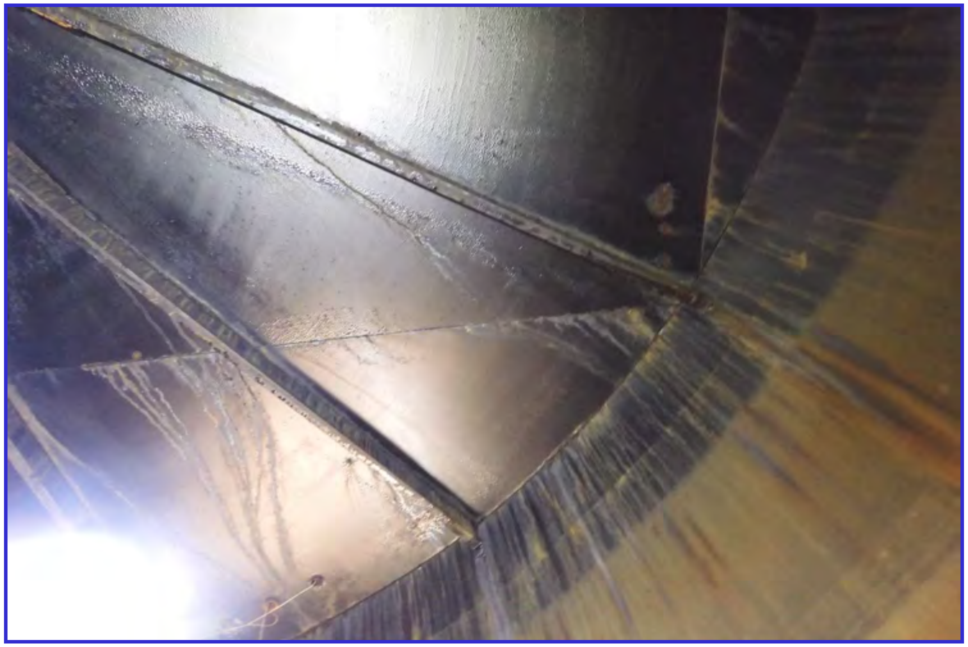
INTERIOR - CPUD - Golden Hills - Maintenance Inspection -005



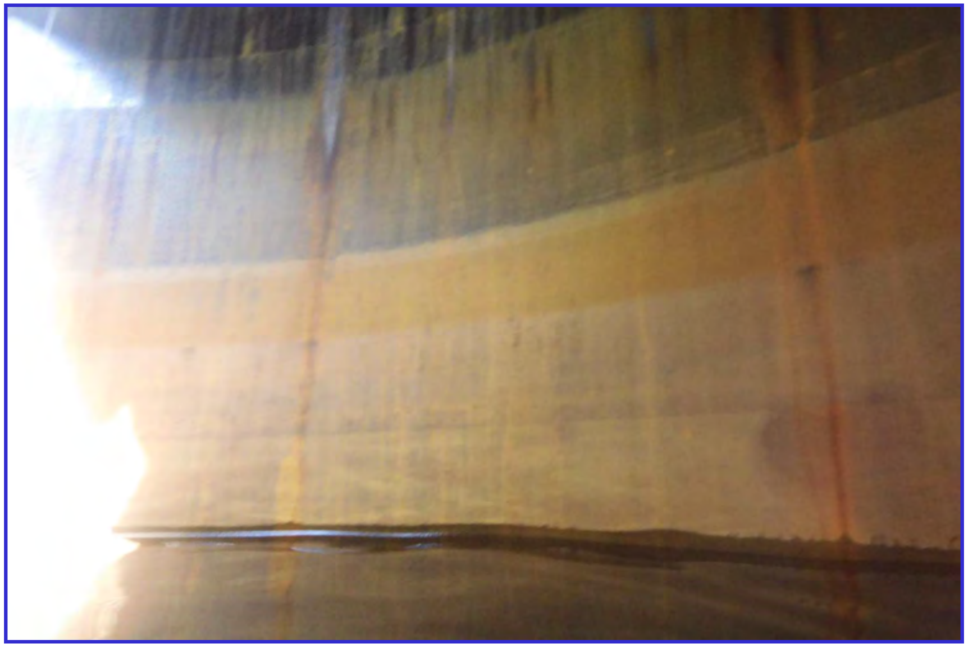
INTERIOR - CPUD - Golden Hills - Maintenance Inspection -006

INTERIOR - CPUD - Golden Hills - Maintenance Inspection -007

INTERIOR - CPUD - Golden Hills - Maintenance Inspection -008



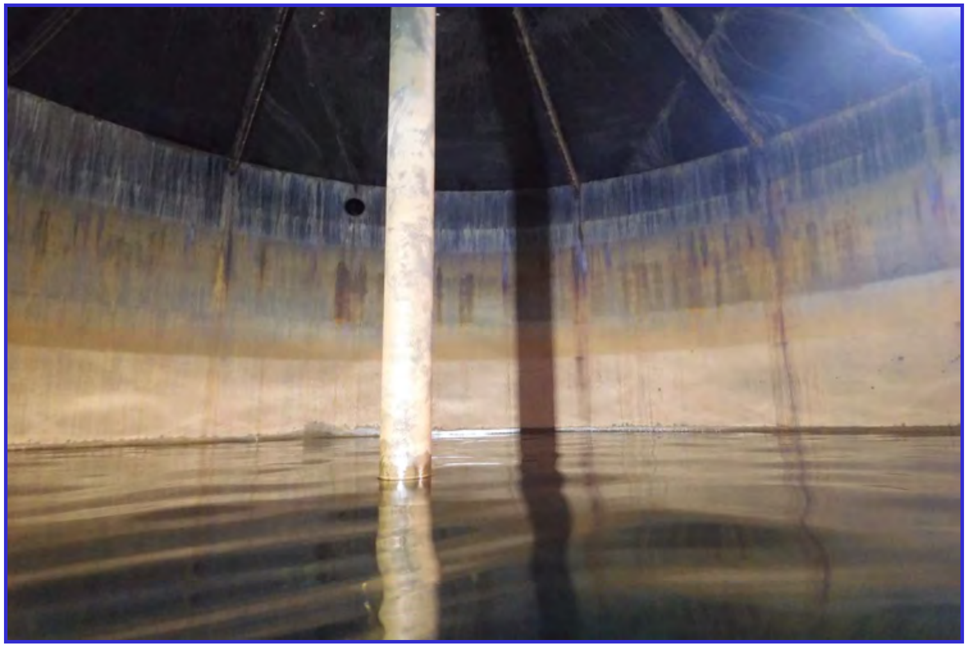
INTERIOR - CPUD - Golden Hills - Maintenance Inspection -009



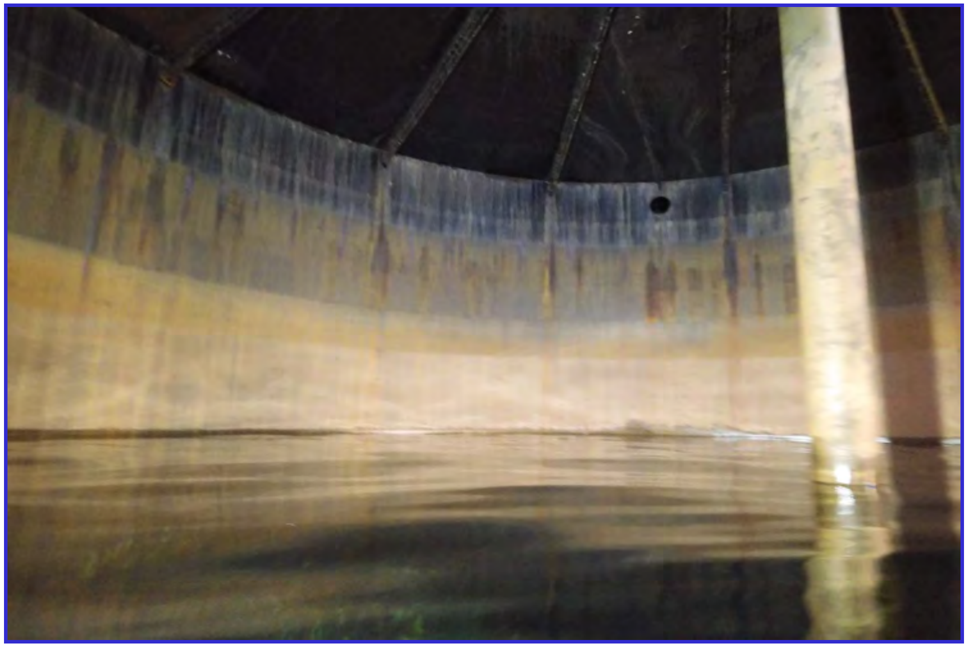
INTERIOR - CPUD - Golden Hills - Maintenance Inspection -010

INTERIOR - CPUD - Golden Hills - Maintenance Inspection -011

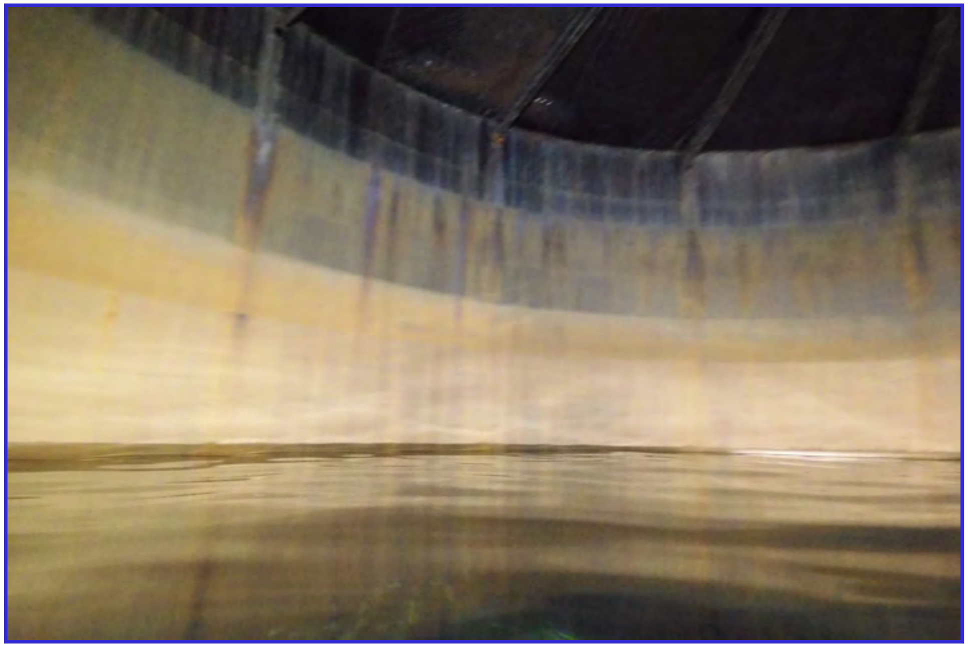
INTERIOR - CPUD - Golden Hills - Maintenance Inspection -012



INTERIOR - CPUD - Golden Hills - Maintenance Inspection -013



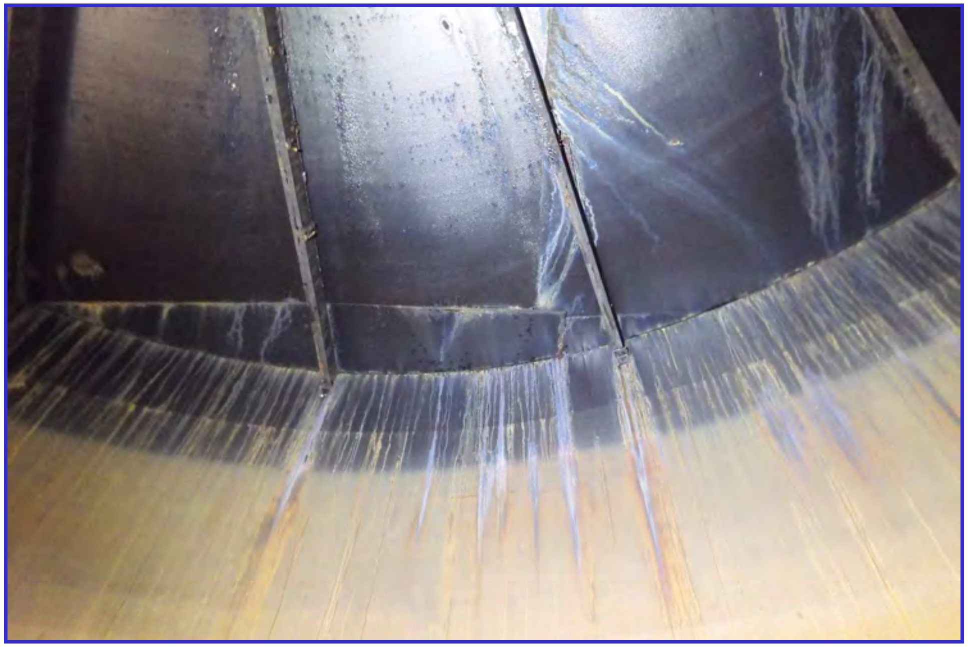
INTERIOR - CPUD - Golden Hills - Maintenance Inspection -014



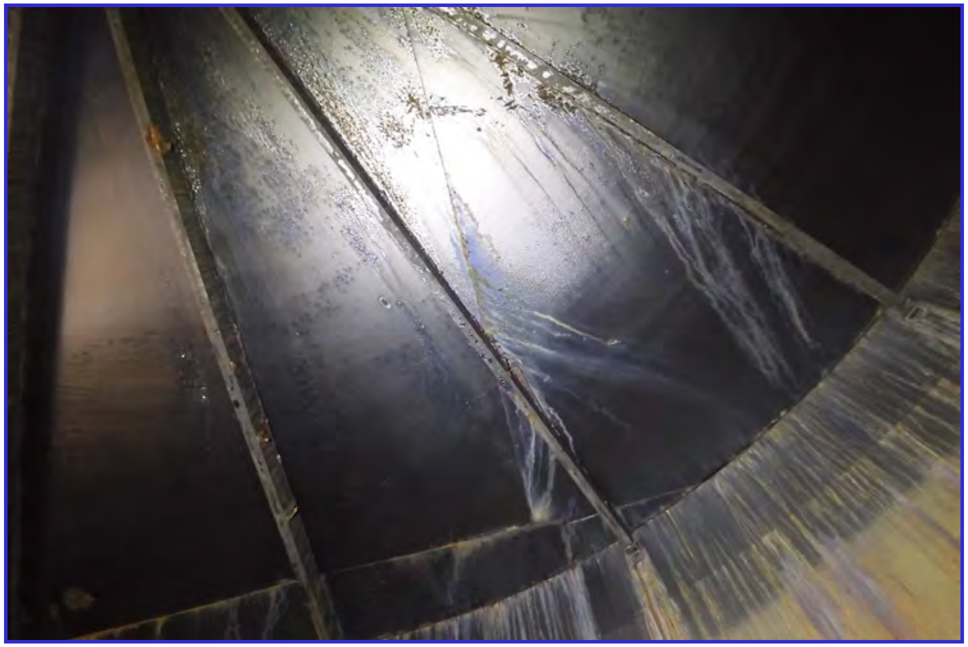
INTERIOR - CPUD - Golden Hills - Maintenance Inspection -015

INTERIOR - CPUD - Golden Hills - Maintenance Inspection -016

INTERIOR - CPUD - Golden Hills - Maintenance Inspection -017

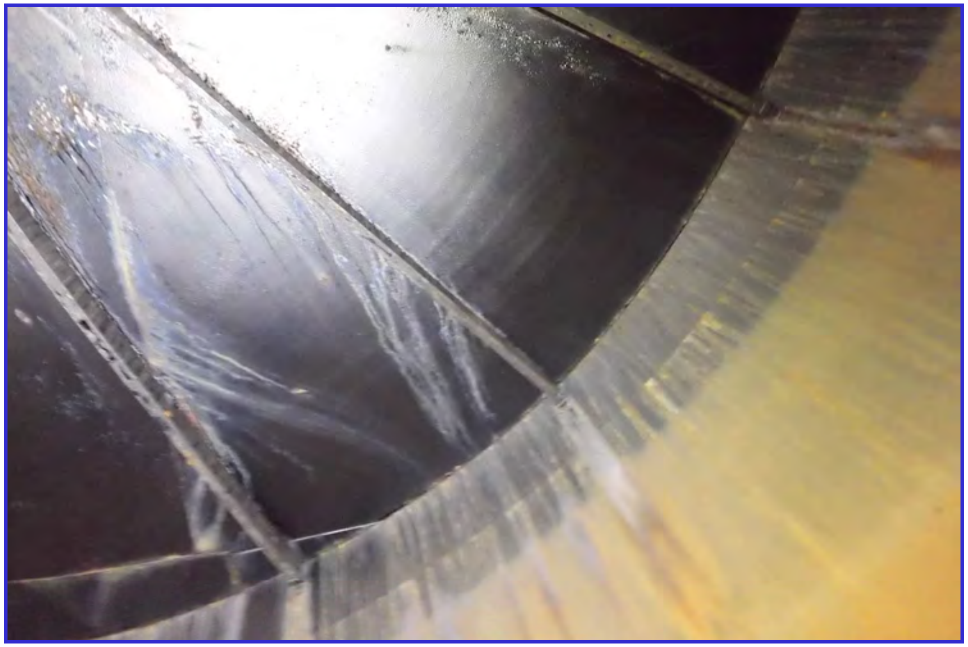


INTERIOR - CPUD - Golden Hills - Maintenance Inspection -018

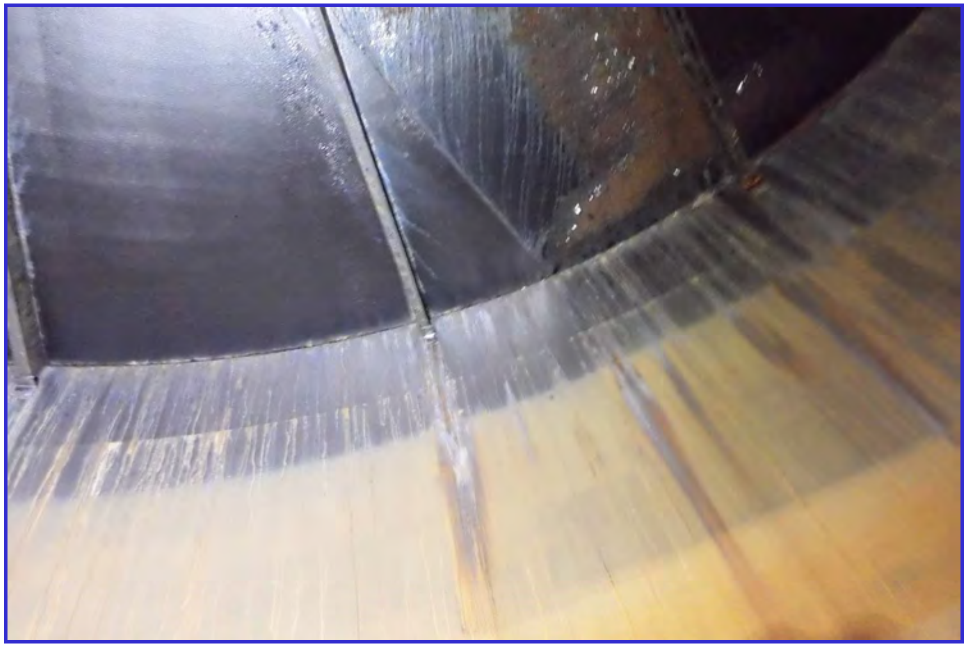


INTERIOR - CPUD - Golden Hills - Maintenance Inspection -019

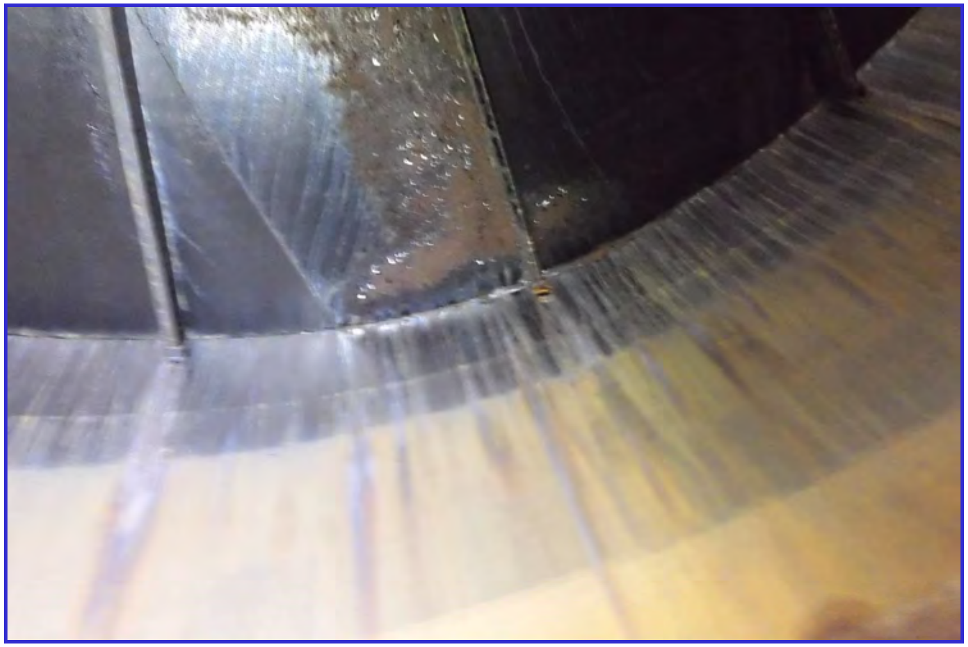
INTERIOR - CPUD - Golden Hills - Maintenance Inspection -020



INTERIOR - CPUD - Golden Hills - Maintenance Inspection -021



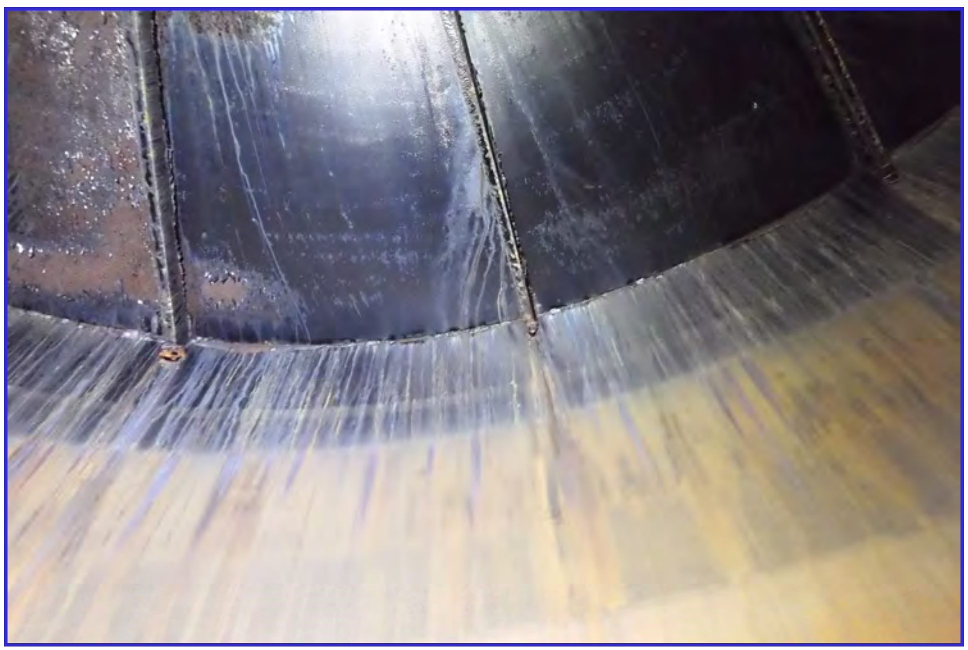
INTERIOR - CPUD - Golden Hills - Maintenance Inspection -022



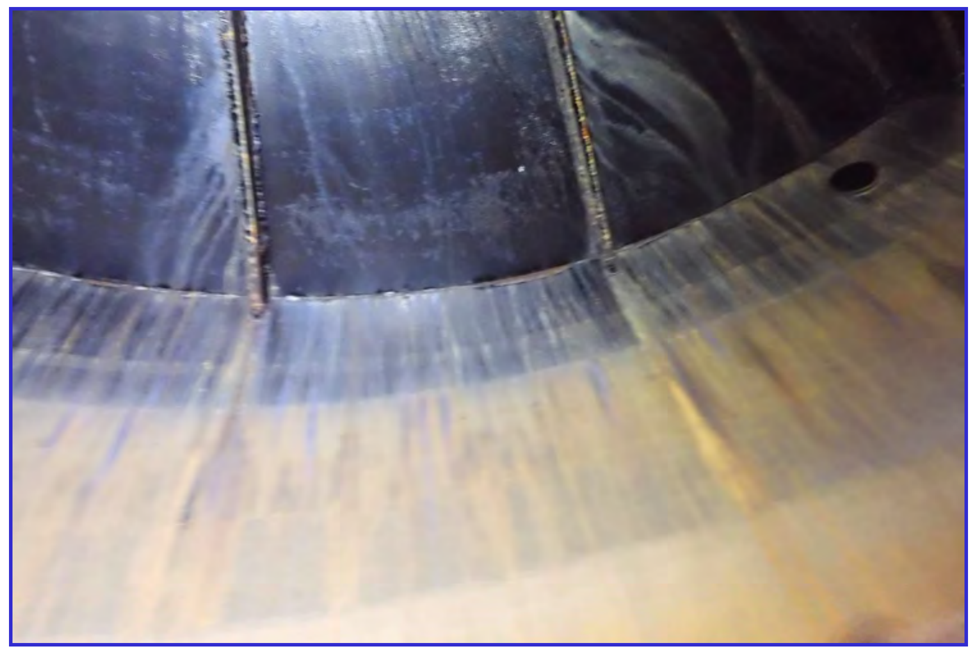
INTERIOR - CPUD - Golden Hills - Maintenance Inspection -023

INTERIOR - CPUD - Golden Hills - Maintenance Inspection -024

INTERIOR - CPUD - Golden Hills - Maintenance Inspection -025



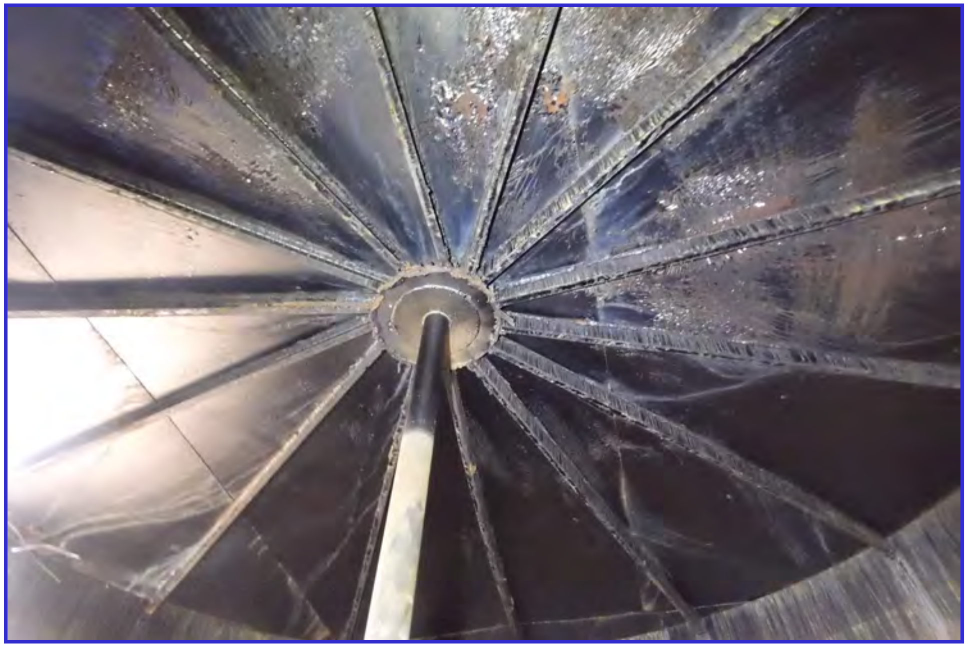
INTERIOR - CPUD - Golden Hills - Maintenance Inspection -026



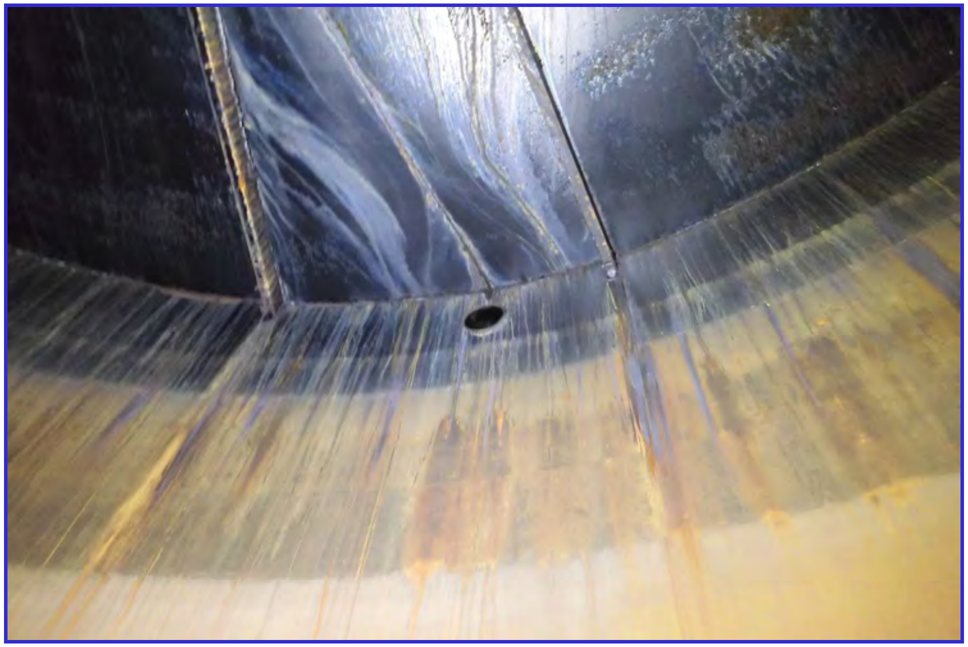
INTERIOR - CPUD - Golden Hills - Maintenance Inspection -027

INTERIOR - CPUD - Golden Hills - Maintenance Inspection -028

INTERIOR - CPUD - Golden Hills - Maintenance Inspection -029

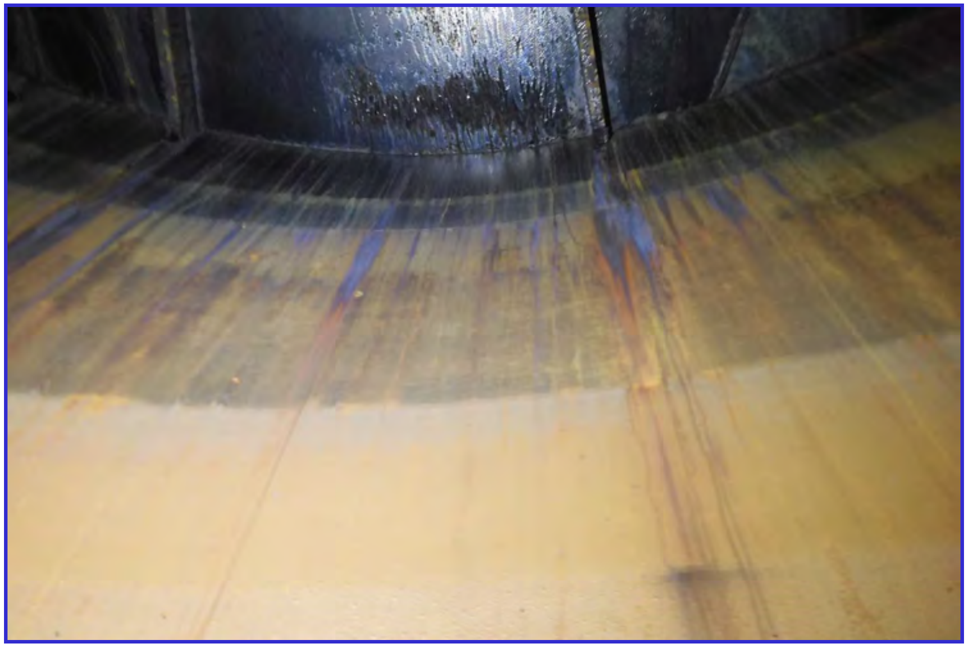


INTERIOR - CPUD - Golden Hills - Maintenance Inspection -030

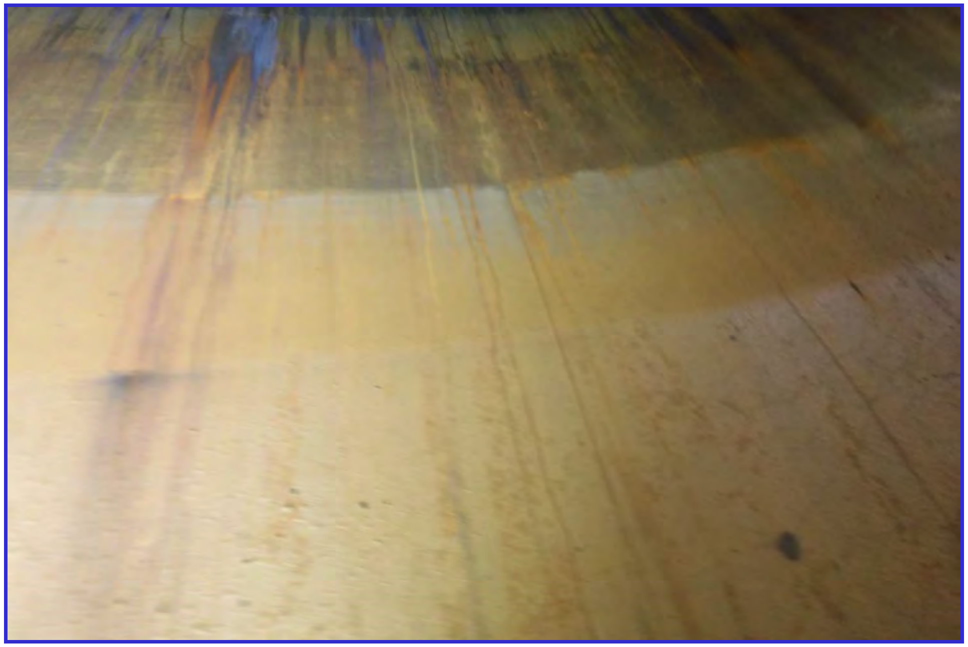


INTERIOR - CPUD - Golden Hills - Maintenance Inspection -031

INTERIOR - CPUD - Golden Hills - Maintenance Inspection -032



INTERIOR - CPUD - Golden Hills - Maintenance Inspection -033

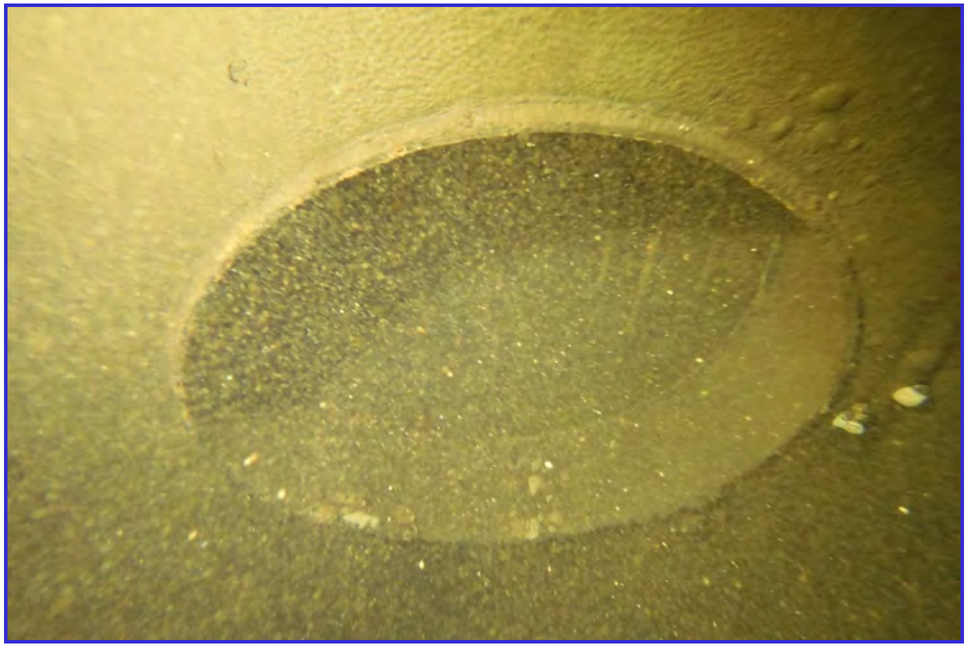


INTERIOR - CPUD - Golden Hills - Maintenance Inspection -034

INTERIOR - CPUD - Golden Hills - Maintenance Inspection -035

INTERIOR - CPUD - Golden Hills - Maintenance Inspection -036

INTERIOR - CPUD - Golden Hills - Maintenance Inspection -037



INTERIOR - CPUD - Golden Hills - Maintenance Inspection -038

INTERIOR - CPUD - Golden Hills - Maintenance Inspection -039

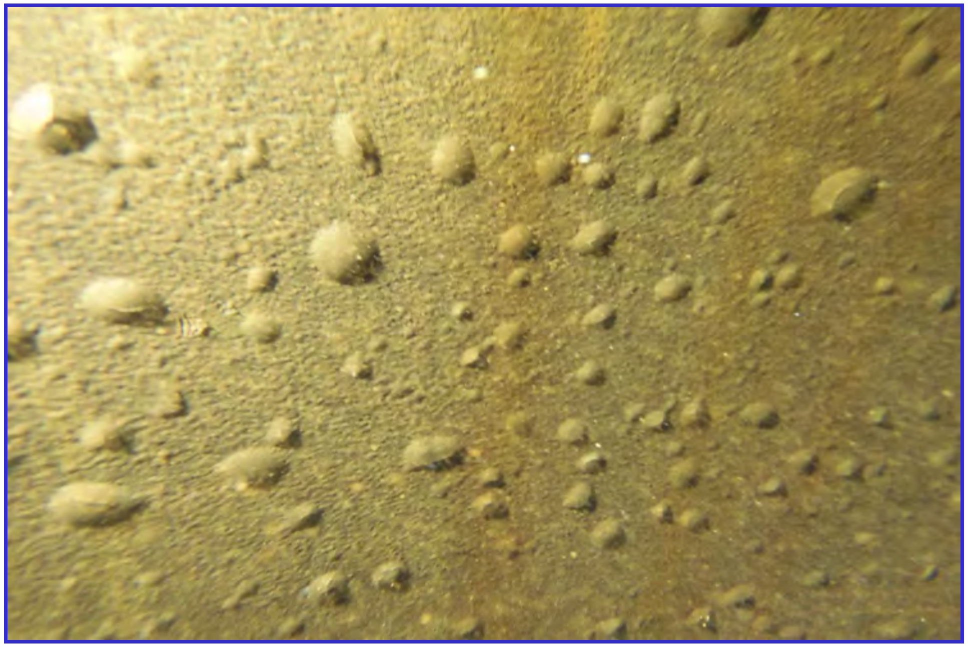
INTERIOR - CPUD - Golden Hills - Maintenance Inspection -040

INTERIOR - CPUD - Golden Hills - Maintenance Inspection -041

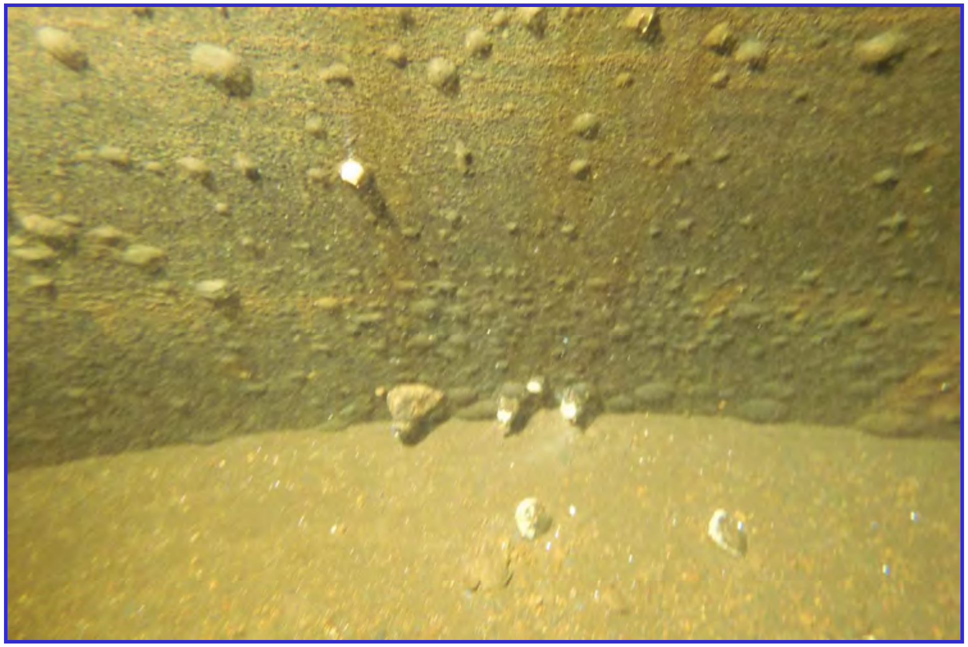
INTERIOR - CPUD - Golden Hills - Maintenance Inspection -042

INTERIOR - CPUD - Golden Hills - Maintenance Inspection -043

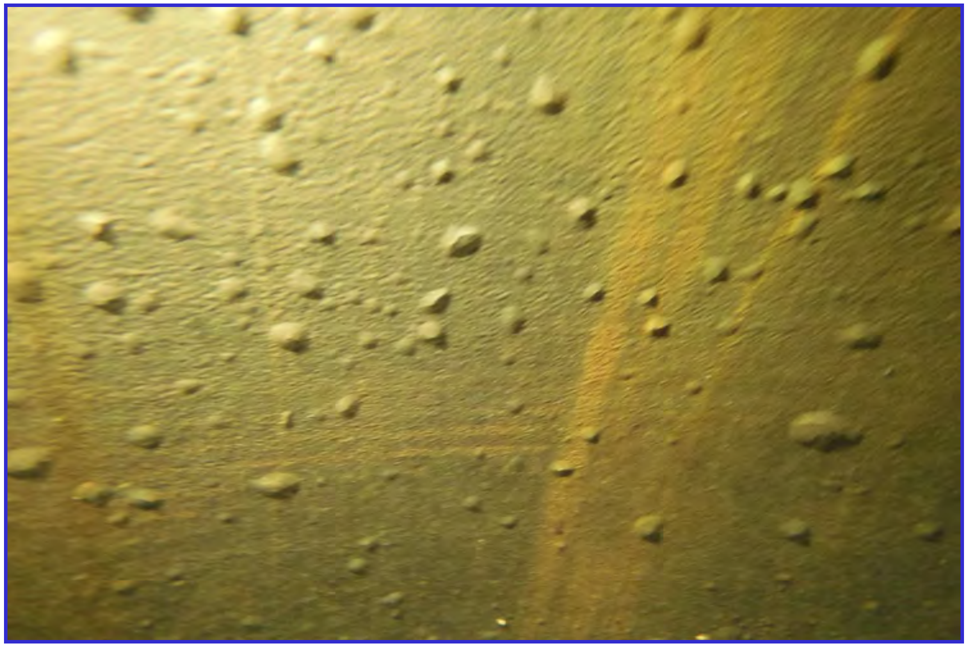
INTERIOR - CPUD - Golden Hills - Maintenance Inspection -044



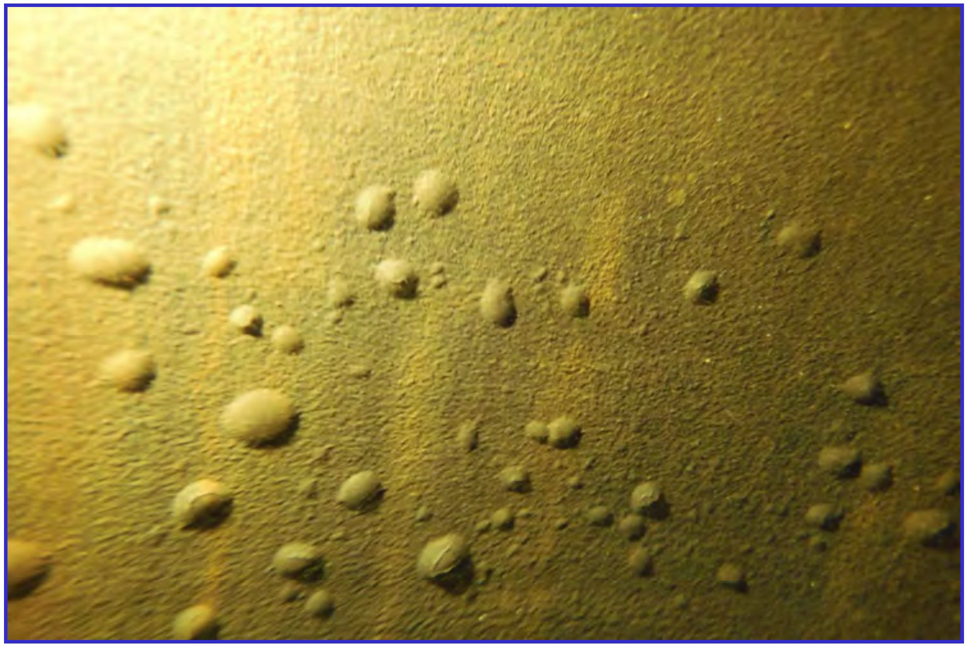
INTERIOR - CPUD - Golden Hills - Maintenance Inspection -045



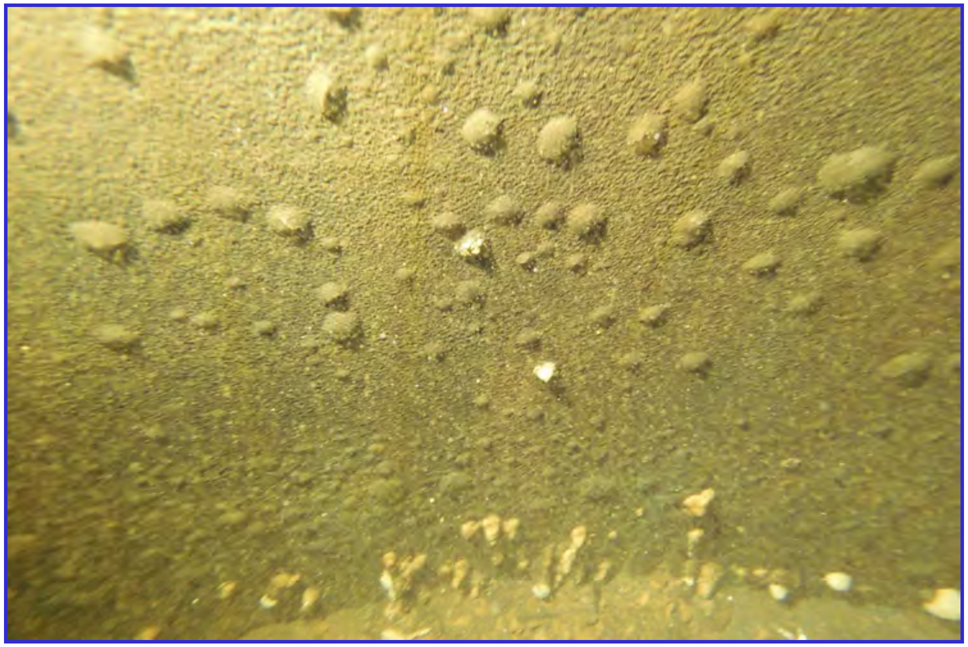
INTERIOR - CPUD - Golden Hills - Maintenance Inspection -046



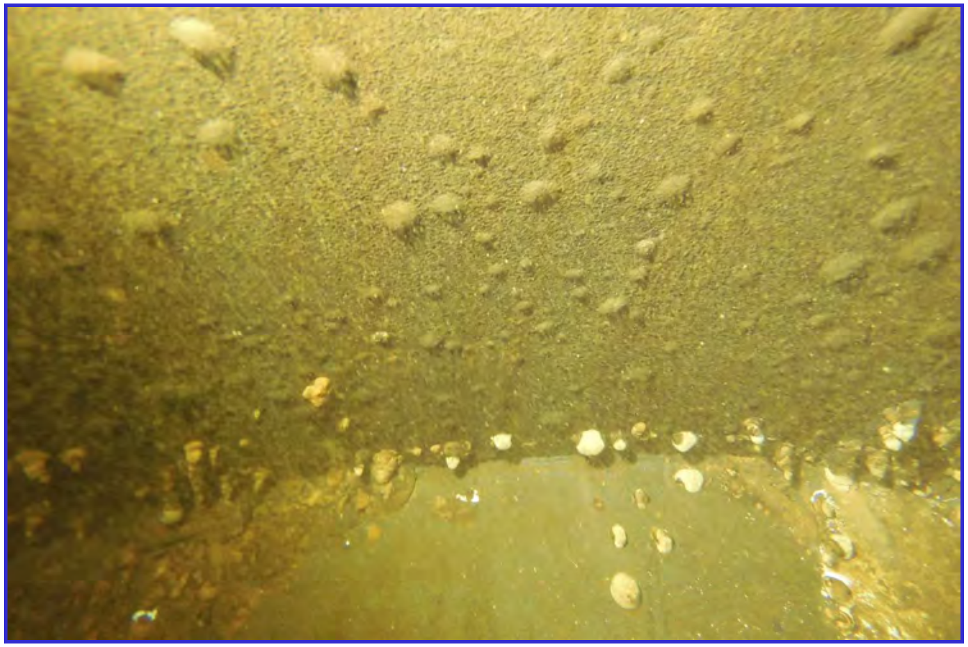
INTERIOR - CPUD - Golden Hills - Maintenance Inspection -047



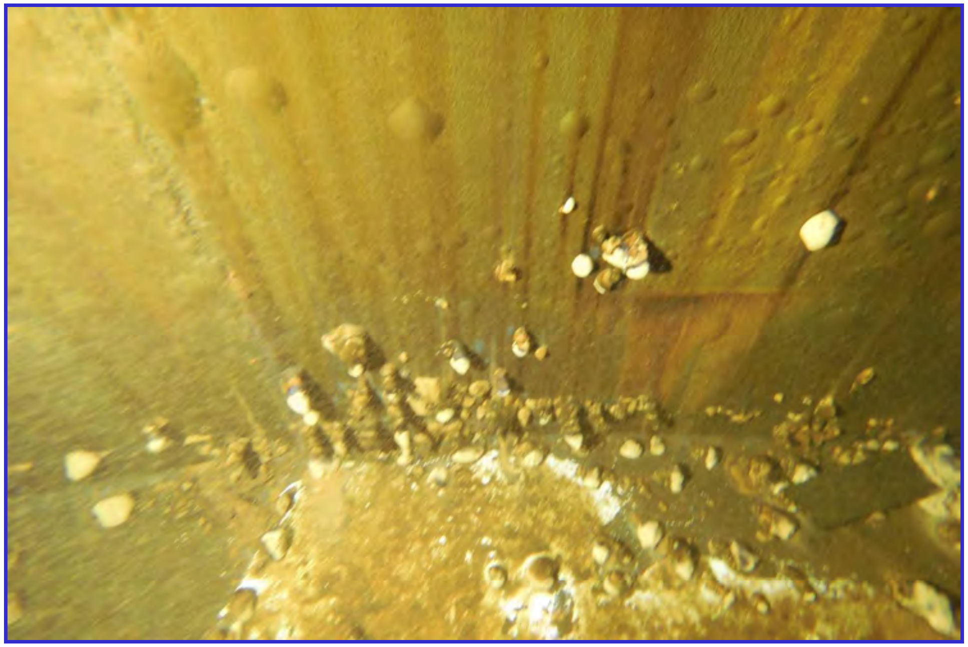
INTERIOR - CPUD - Golden Hills - Maintenance Inspection -048



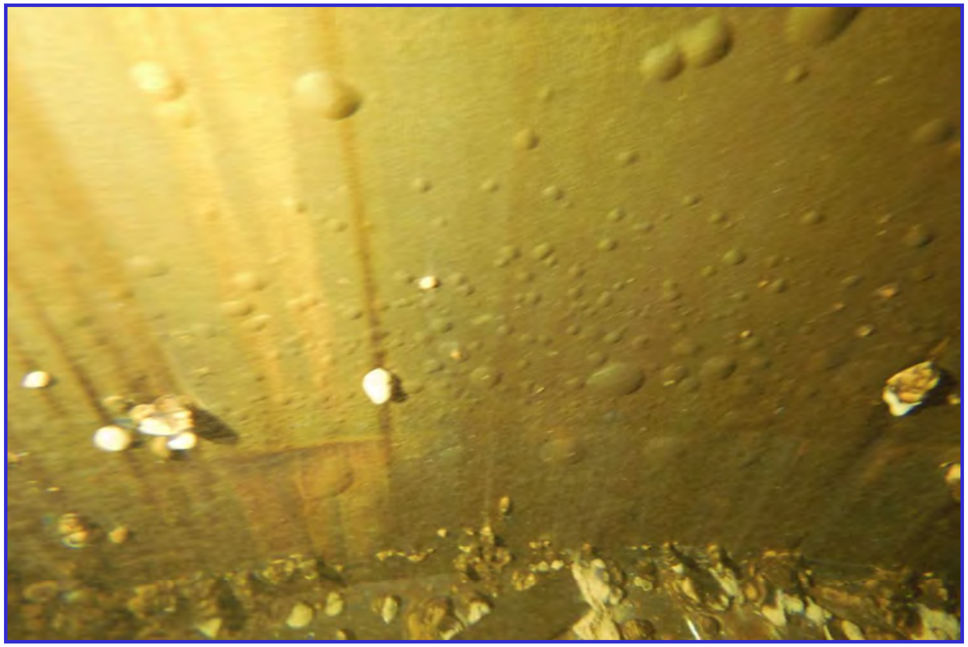
INTERIOR - CPUD - Golden Hills - Maintenance Inspection -049



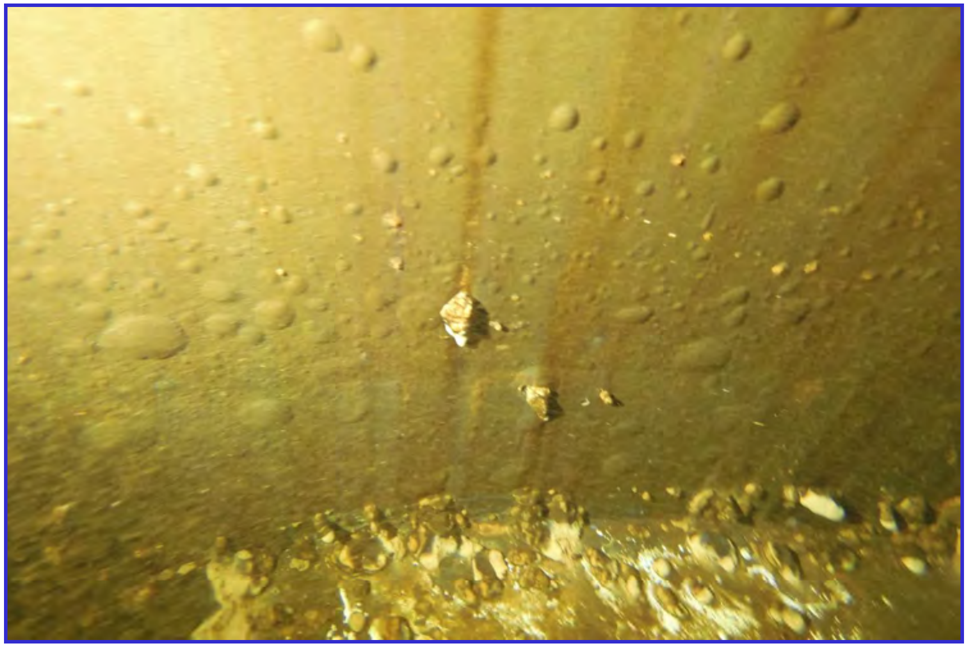
INTERIOR - CPUD - Golden Hills - Maintenance Inspection -050



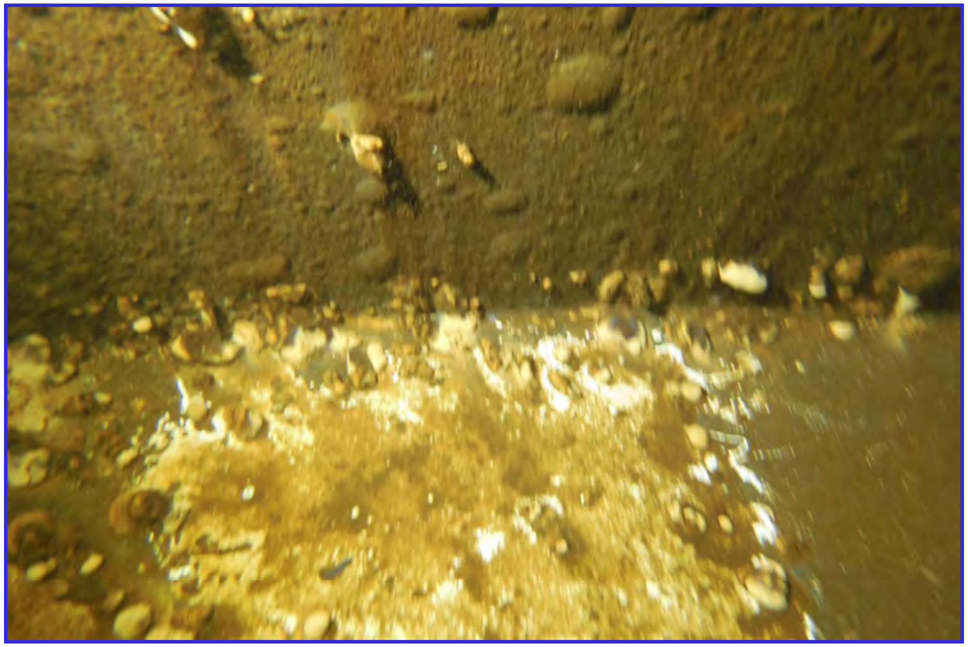
INTERIOR - CPUD - Golden Hills - Maintenance Inspection -051



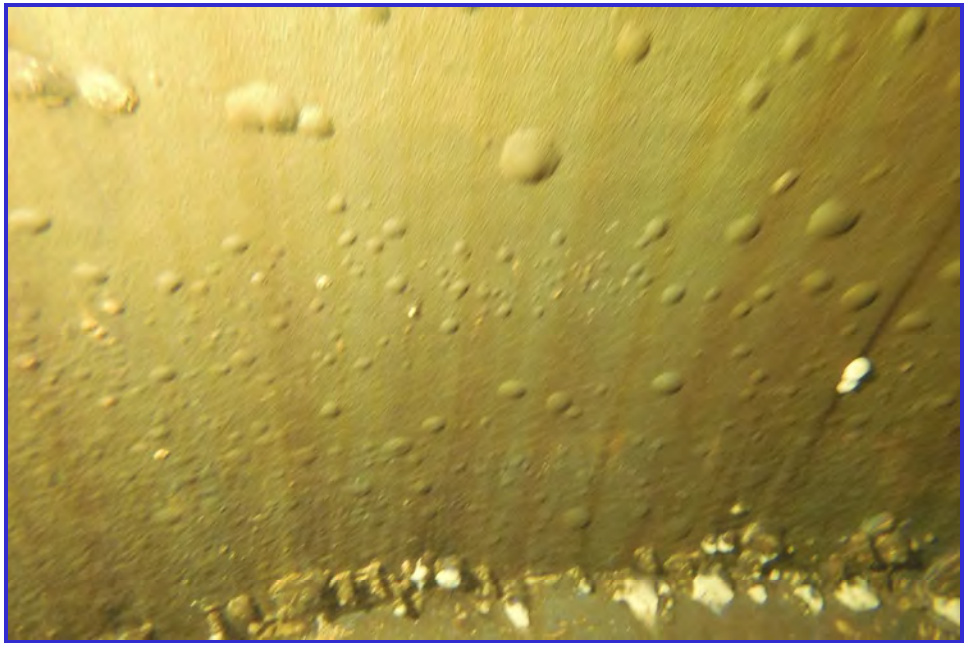
INTERIOR - CPUD - Golden Hills - Maintenance Inspection -052



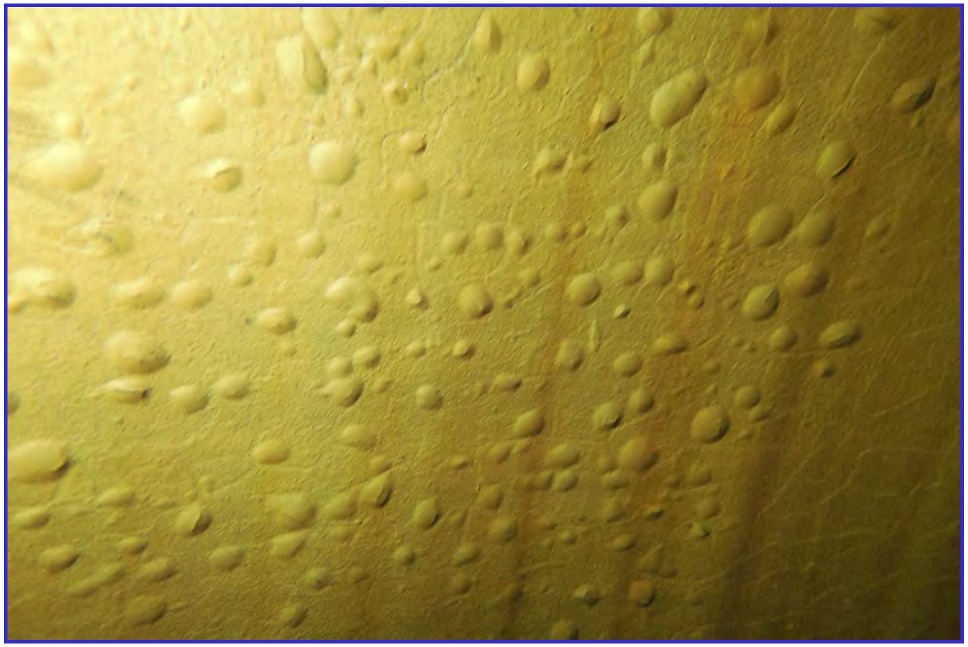
INTERIOR - CPUD - Golden Hills - Maintenance Inspection -053



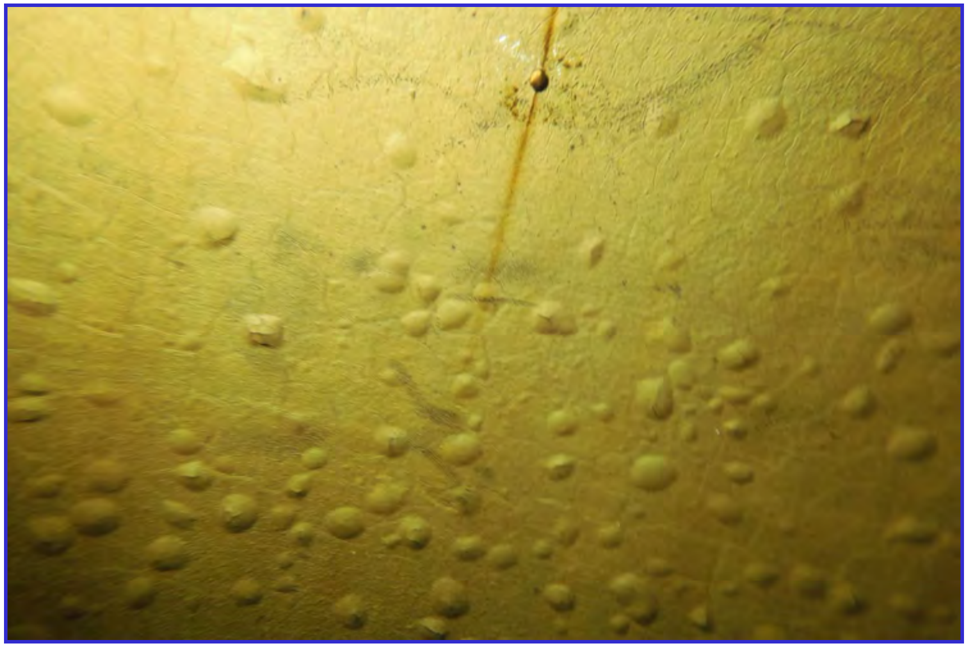
INTERIOR - CPUD - Golden Hills - Maintenance Inspection -054



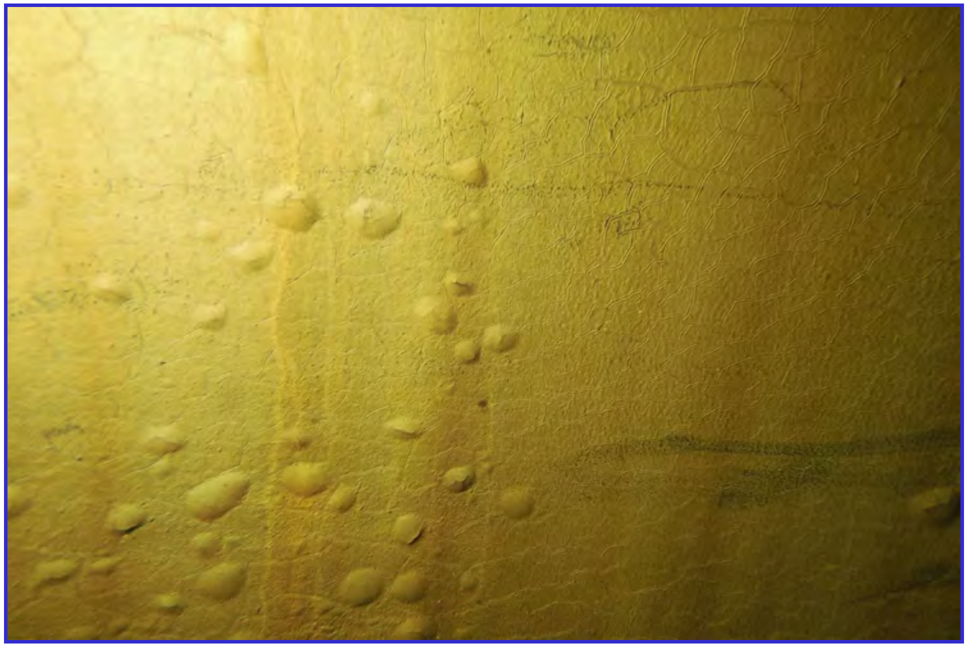
INTERIOR - CPUD - Golden Hills - Maintenance Inspection -055



INTERIOR - CPUD - Golden Hills - Maintenance Inspection -056

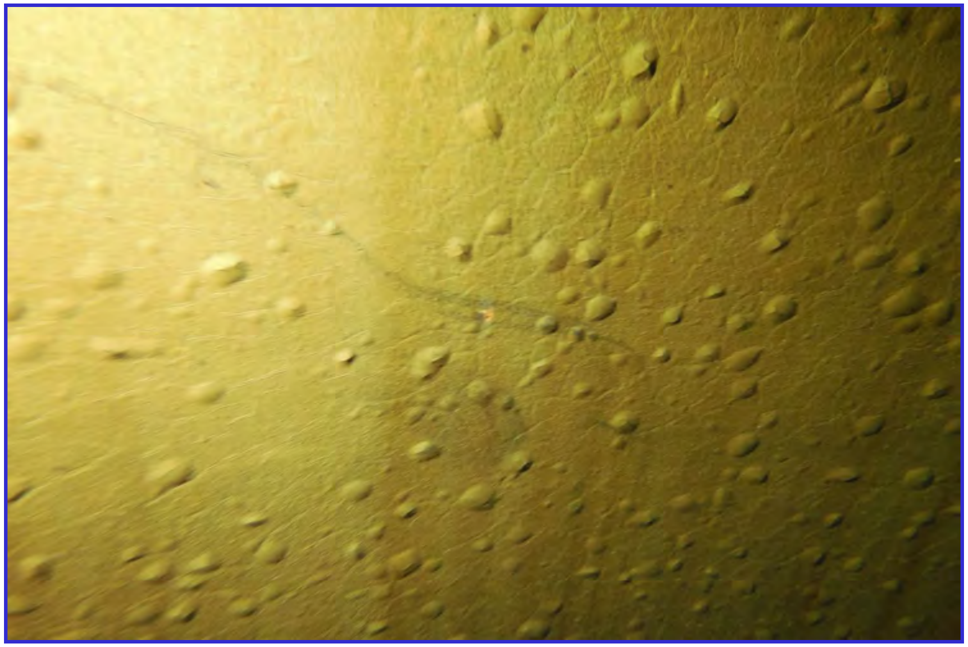


INTERIOR - CPUD - Golden Hills - Maintenance Inspection -057

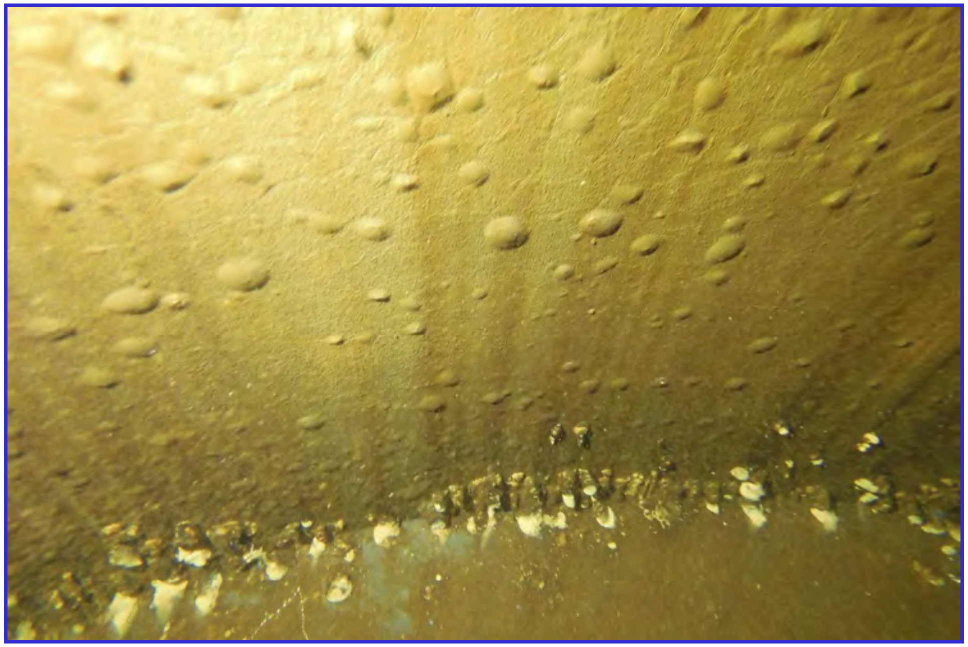


INTERIOR - CPUD - Golden Hills - Maintenance Inspection -058

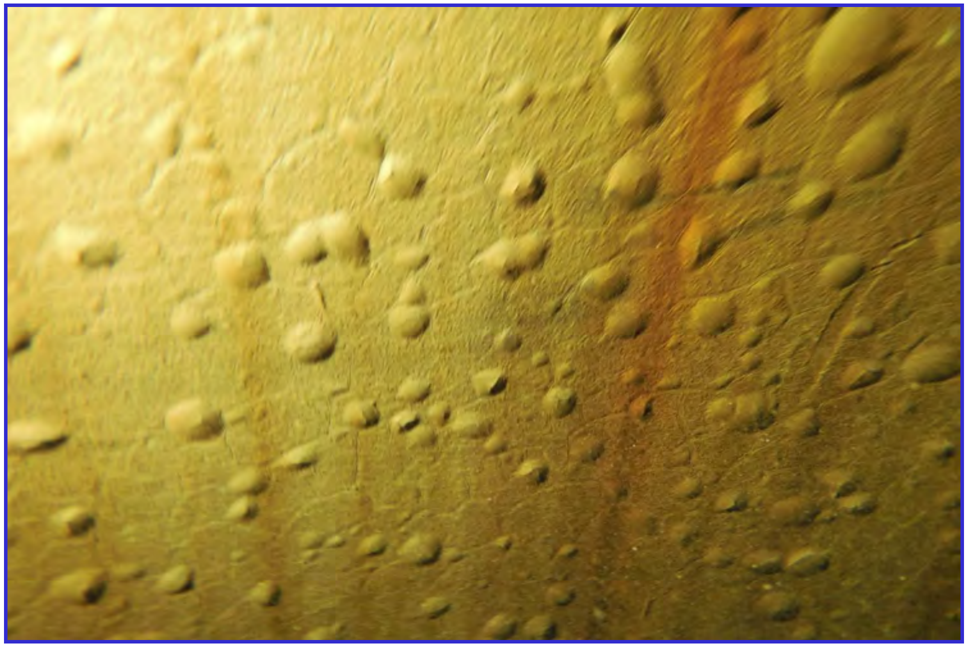
INTERIOR - CPUD - Golden Hills - Maintenance Inspection -059



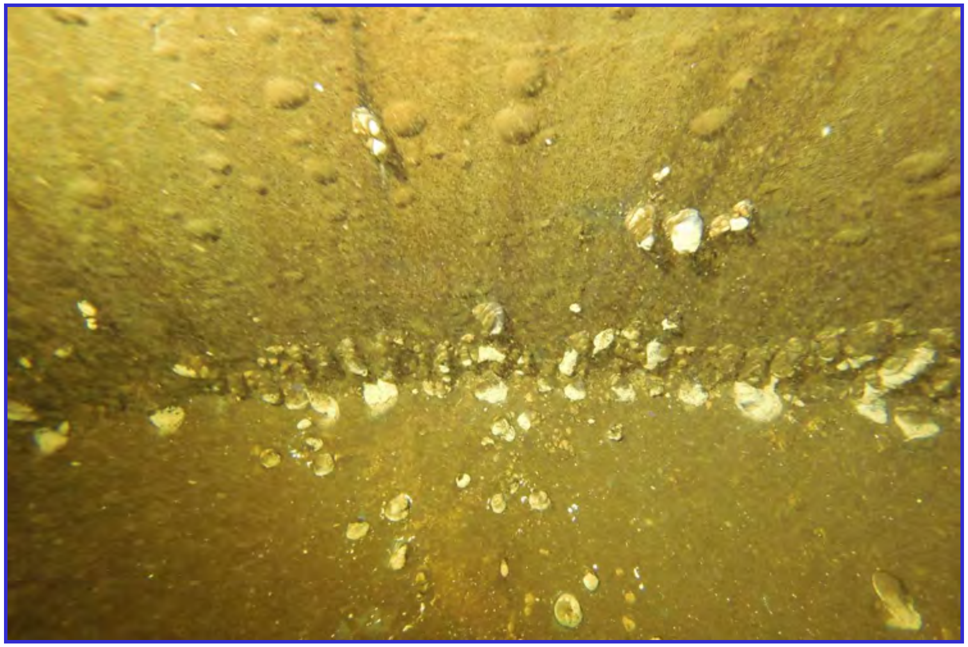
INTERIOR - CPUD - Golden Hills - Maintenance Inspection -060



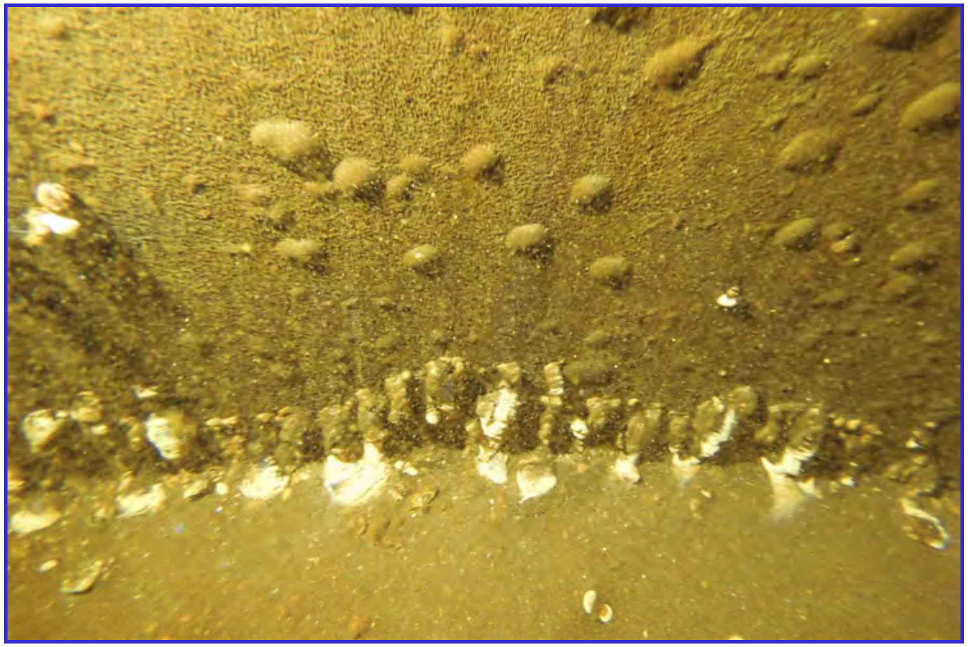
INTERIOR - CPUD - Golden Hills - Maintenance Inspection -061



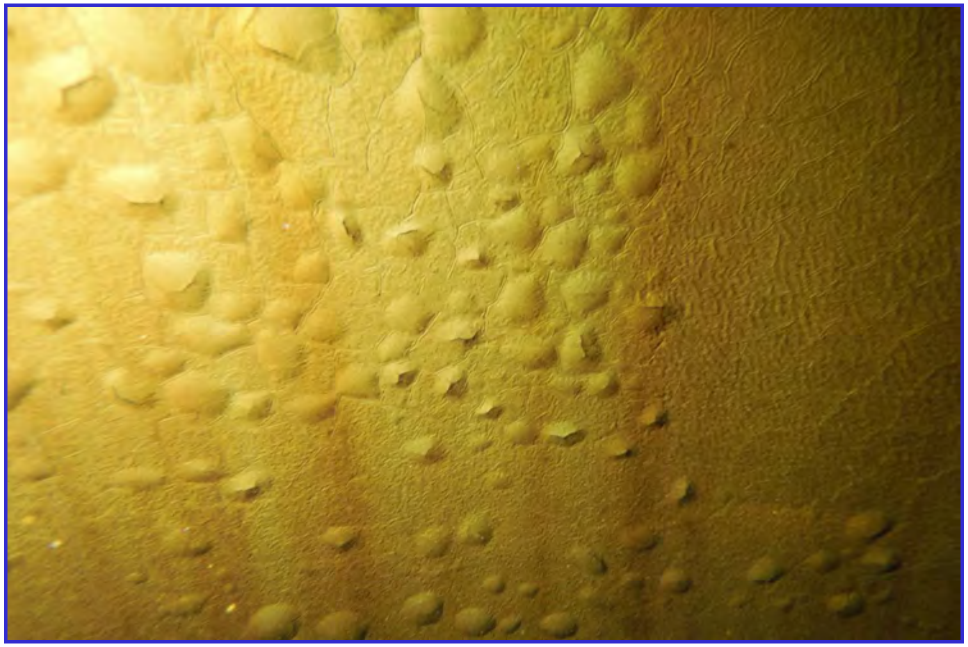
INTERIOR - CPUD - Golden Hills - Maintenance Inspection -062



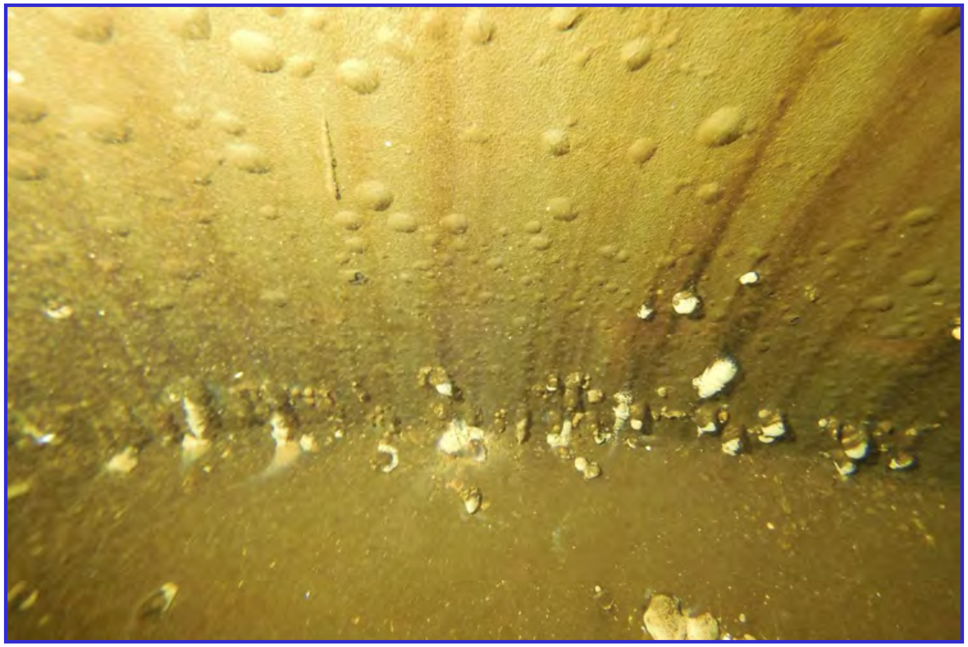
INTERIOR - CPUD - Golden Hills - Maintenance Inspection -063



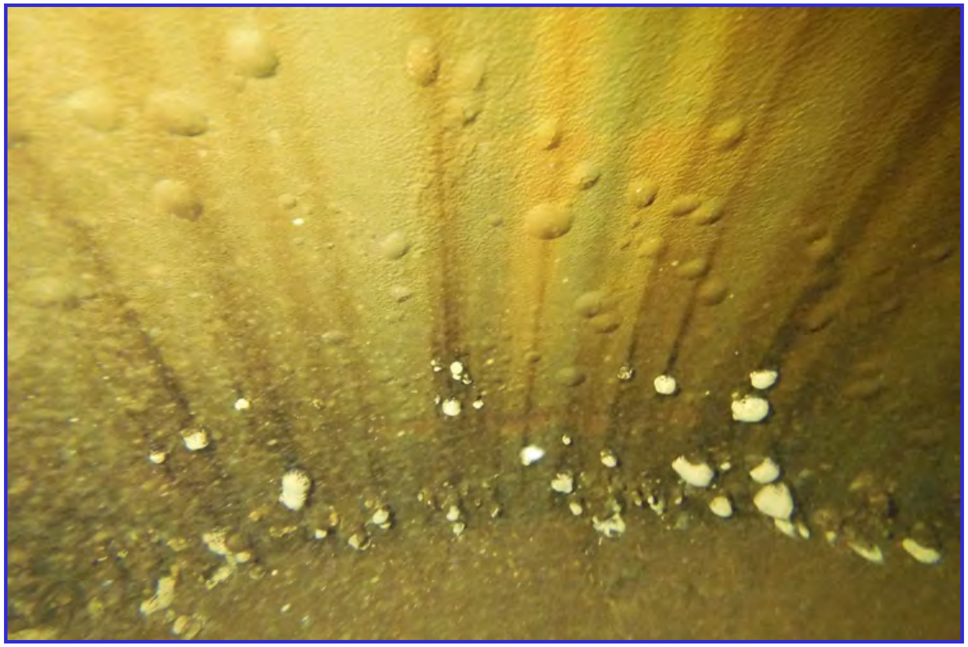
INTERIOR - CPUD - Golden Hills - Maintenance Inspection -064



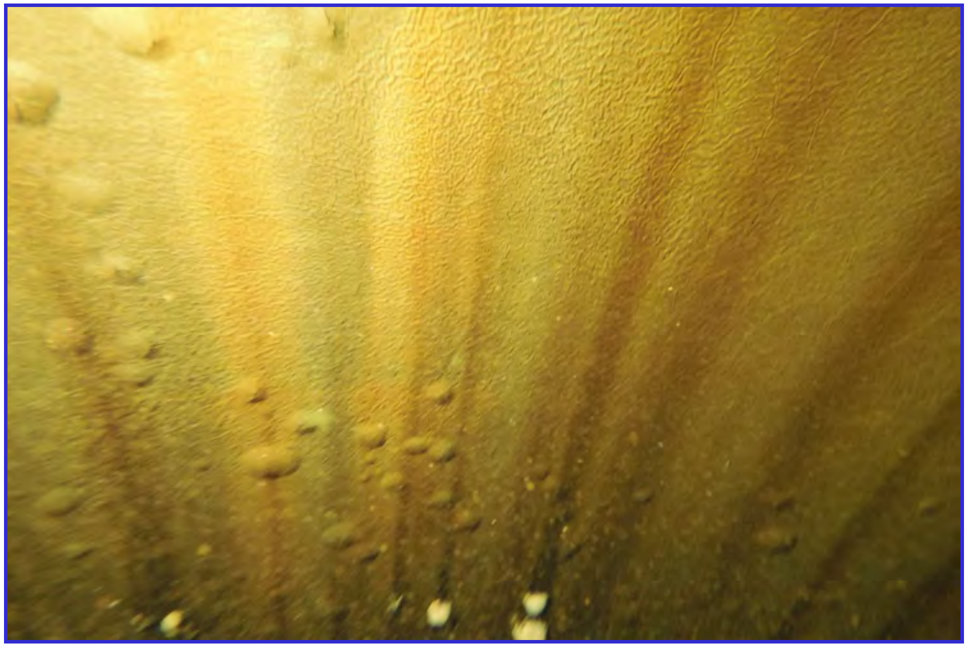
INTERIOR - CPUD - Golden Hills - Maintenance Inspection -065



INTERIOR - CPUD - Golden Hills - Maintenance Inspection -066



INTERIOR - CPUD - Golden Hills - Maintenance Inspection -067



INTERIOR - CPUD - Golden Hills - Maintenance Inspection -068

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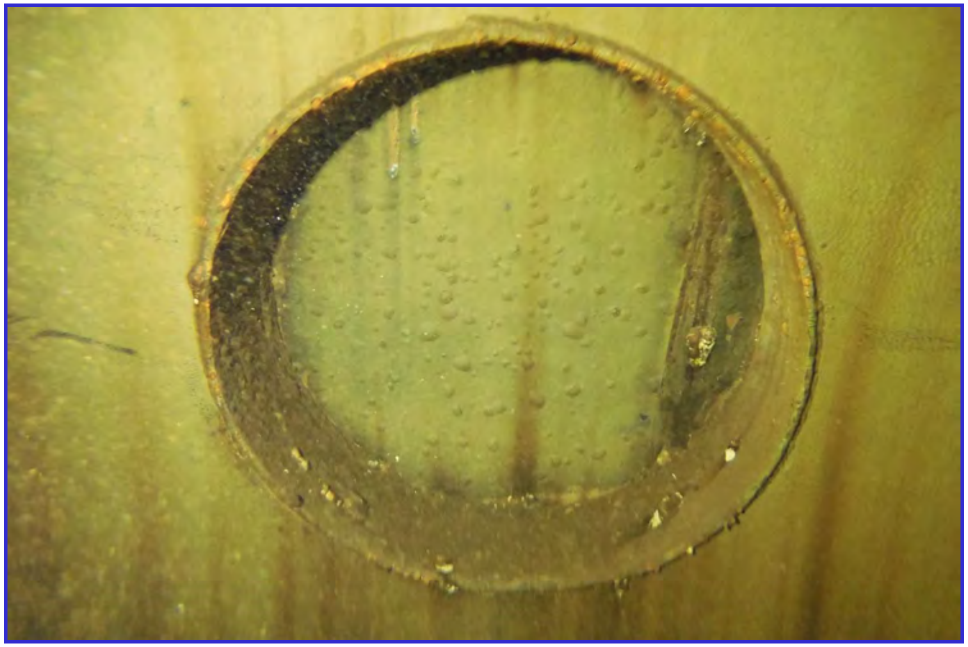
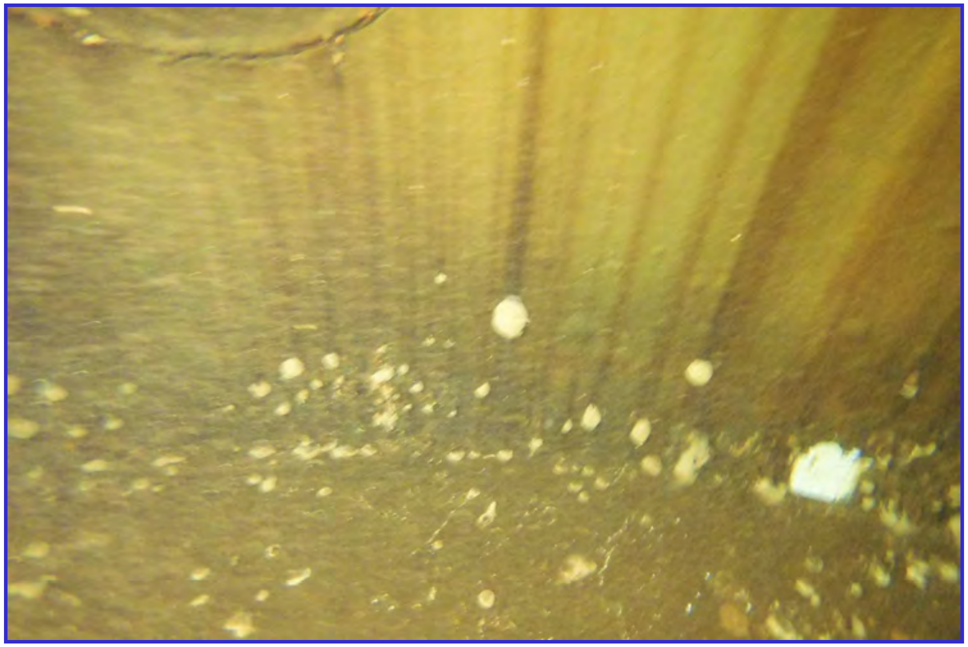


INTERIOR - CPUD - Golden Hills - Maintenance Inspection -070



INTERIOR - CPUD - Golden Hills - Maintenance Inspection -071

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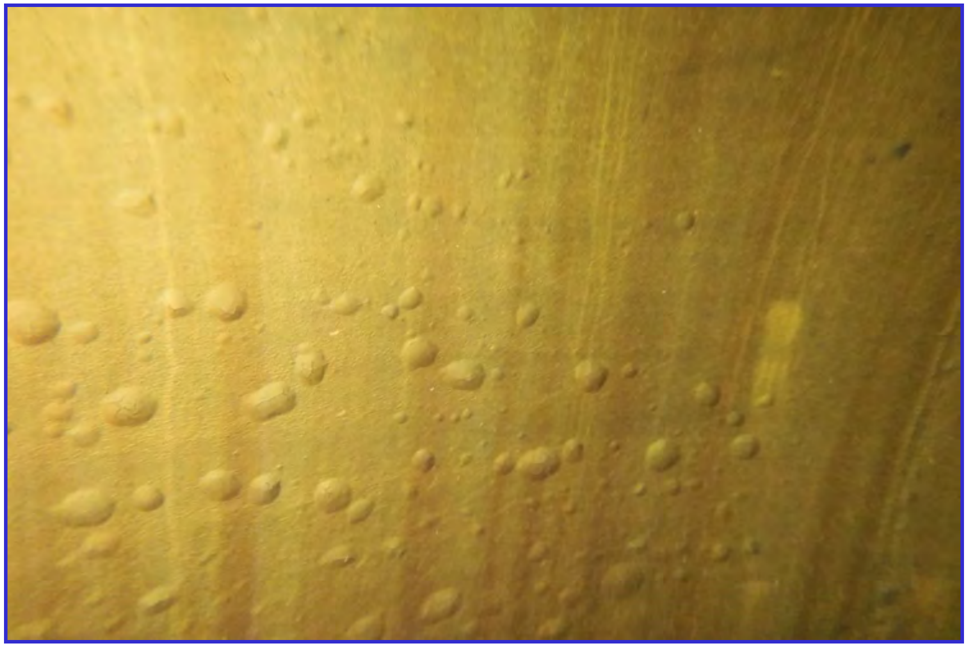
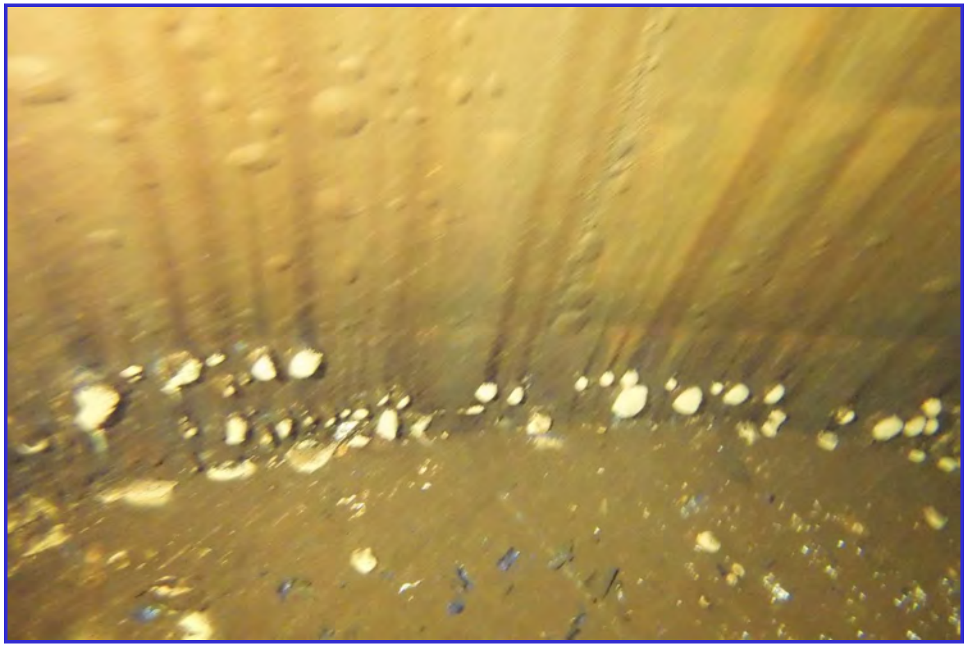


INTERIOR - CPUD - Golden Hills - Maintenance Inspection -073



INTERIOR - CPUD - Golden Hills - Maintenance Inspection -074

INTERIOR - CPUD - Golden Hills - Maintenance Inspection -075

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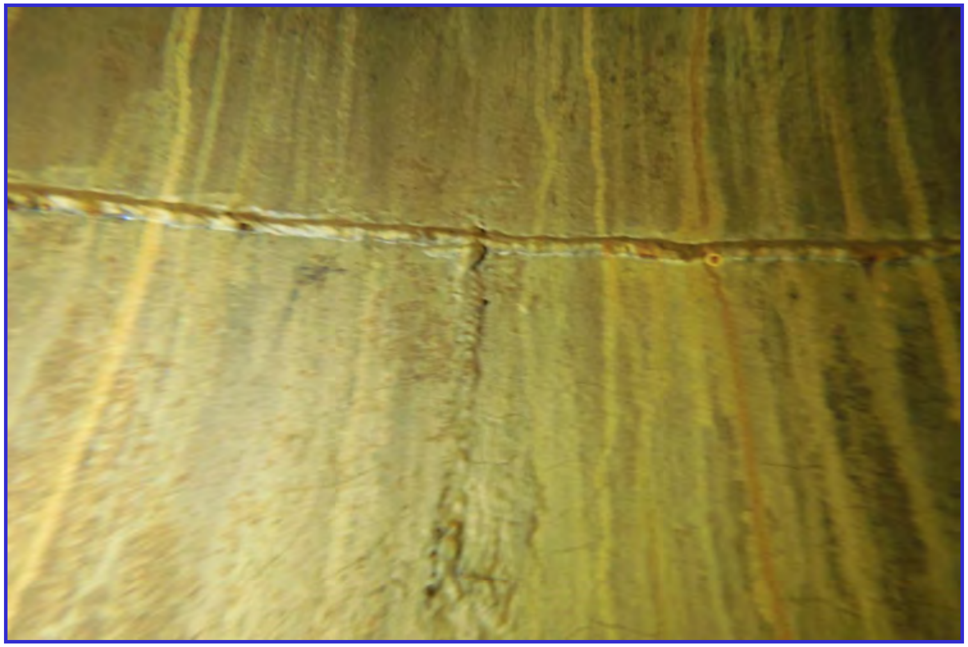
INTERIOR - CPUD - Golden Hills - Maintenance Inspection -078



INTERIOR - CPUD - Golden Hills - Maintenance Inspection -079

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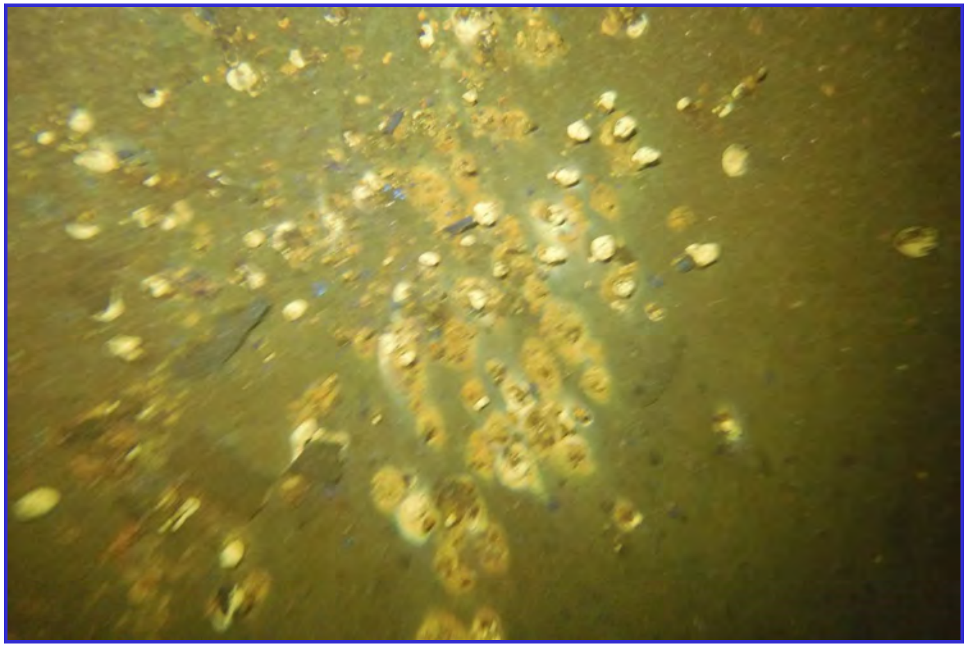
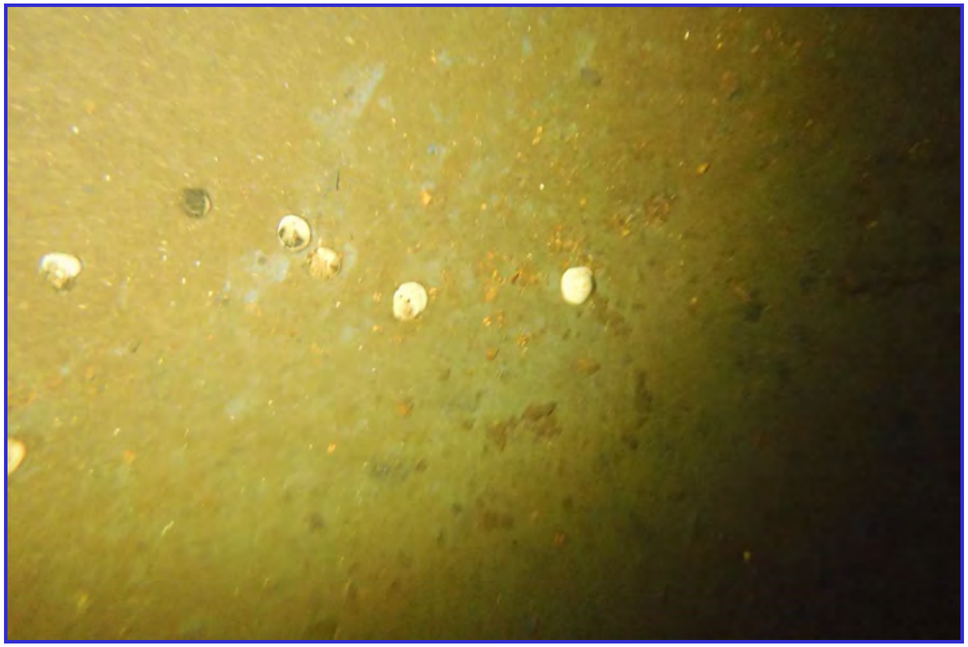


INTERIOR - CPUD - Golden Hills - Maintenance Inspection -081



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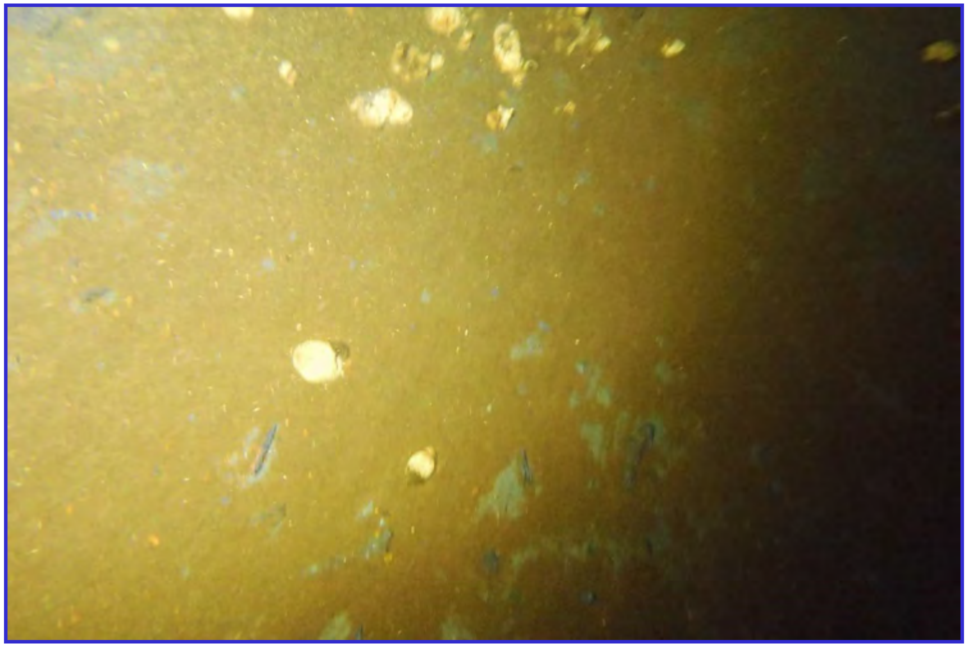

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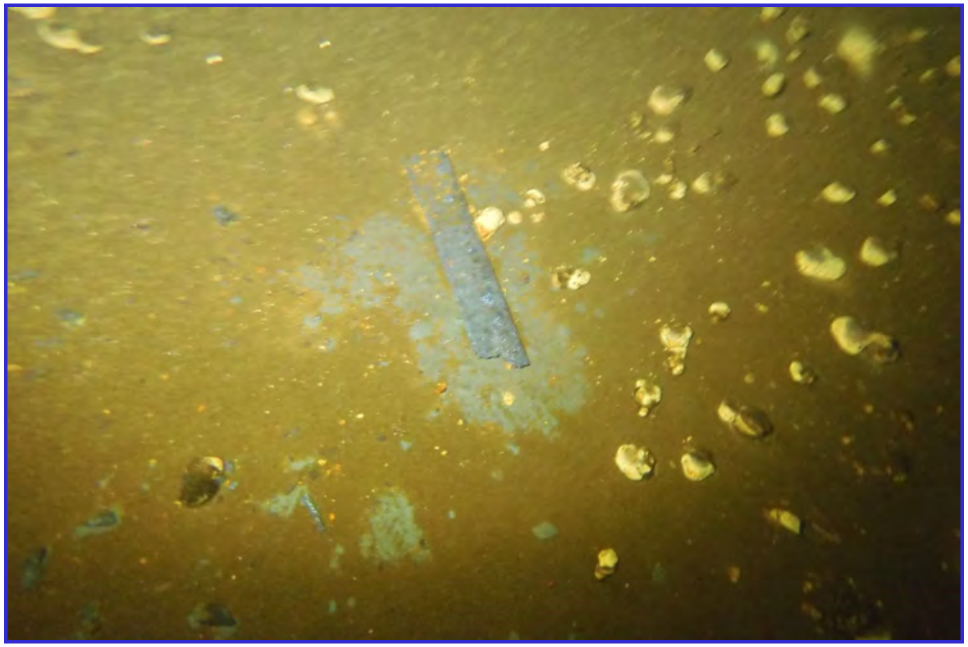

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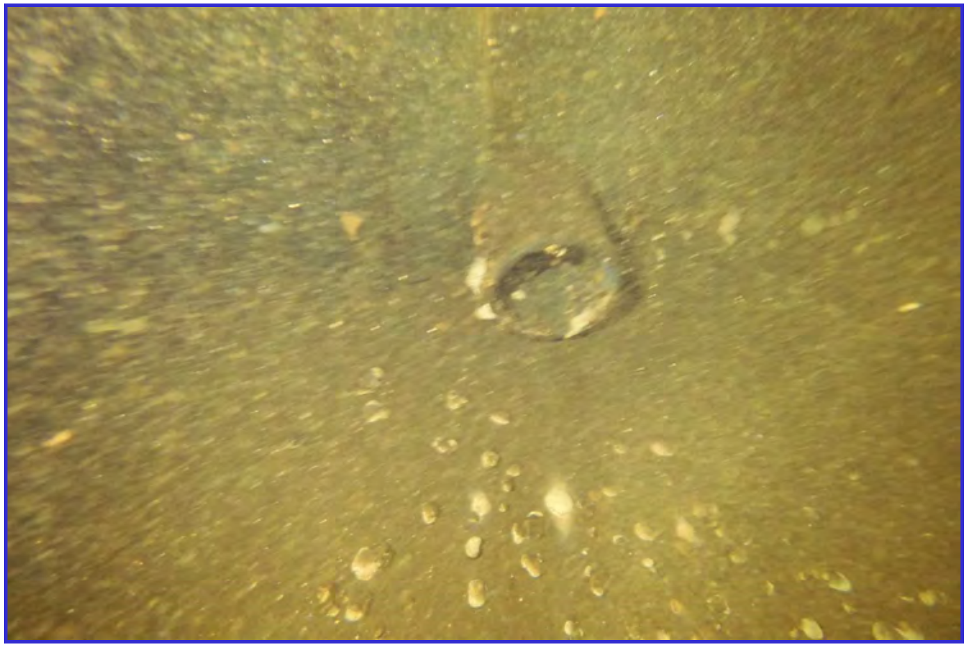

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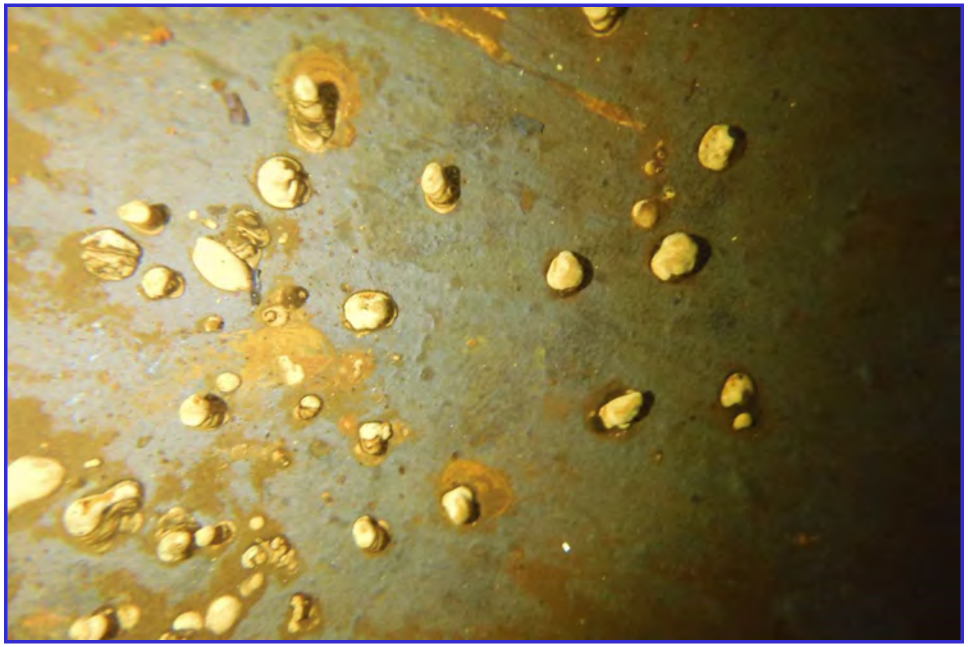

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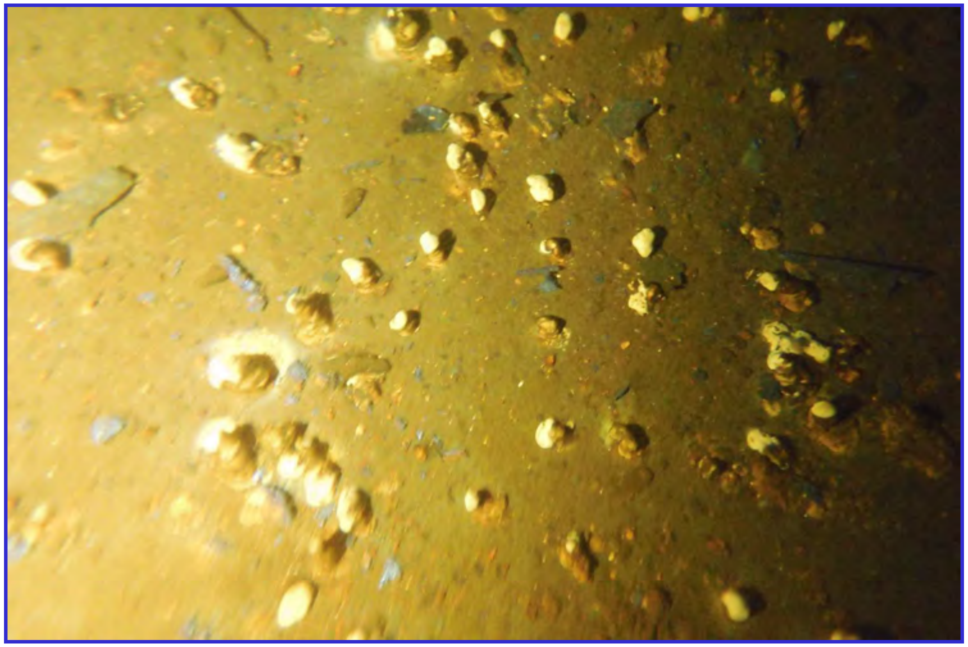
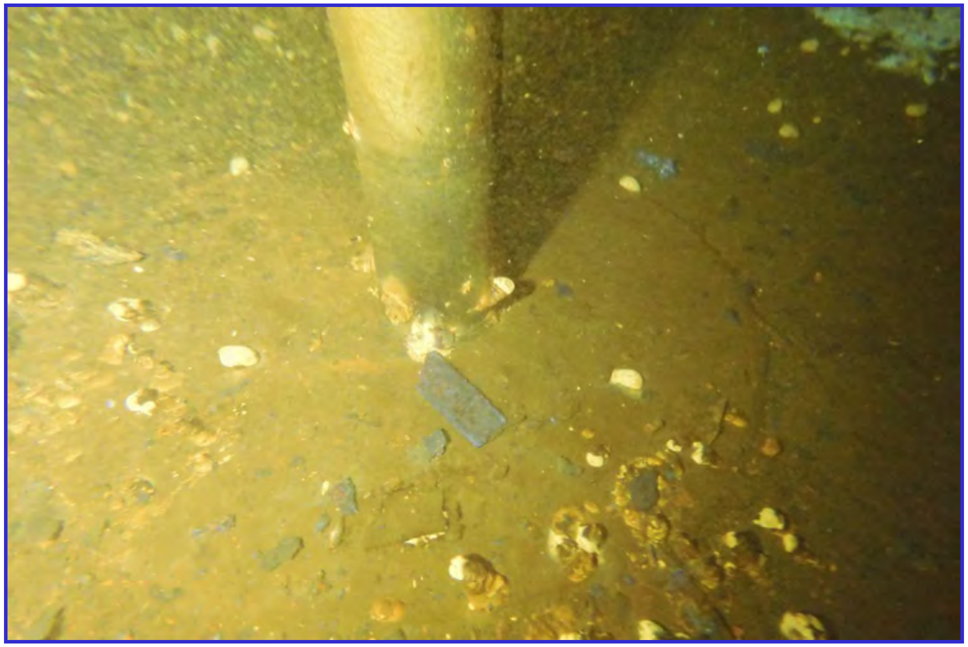
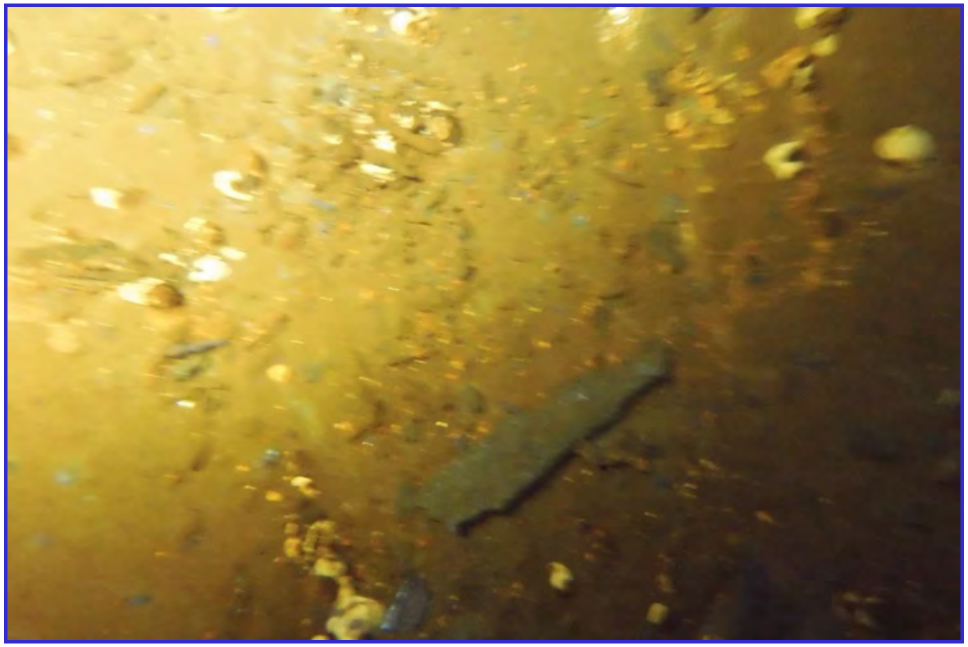


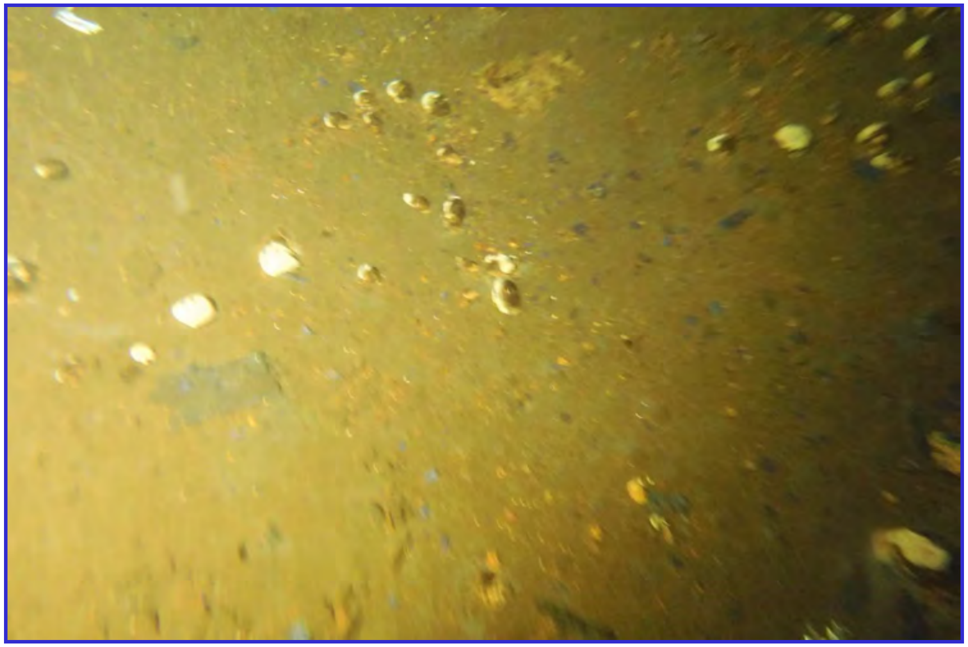
INTERIOR - CPUD - Golden Hills - Maintenance Inspection -087



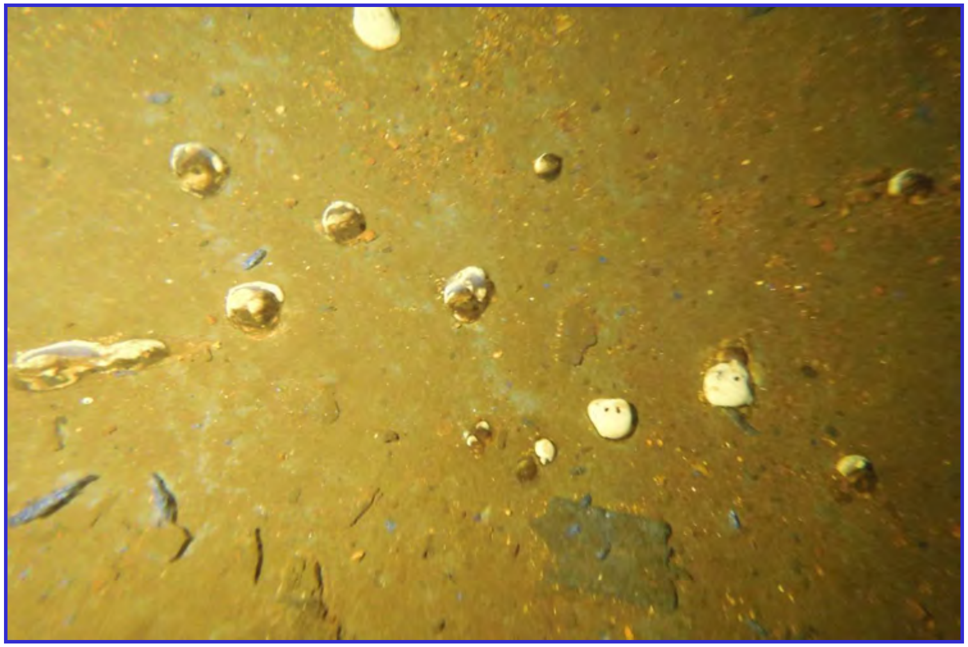
INTERIOR - CPUD - Golden Hills - Maintenance Inspection -088



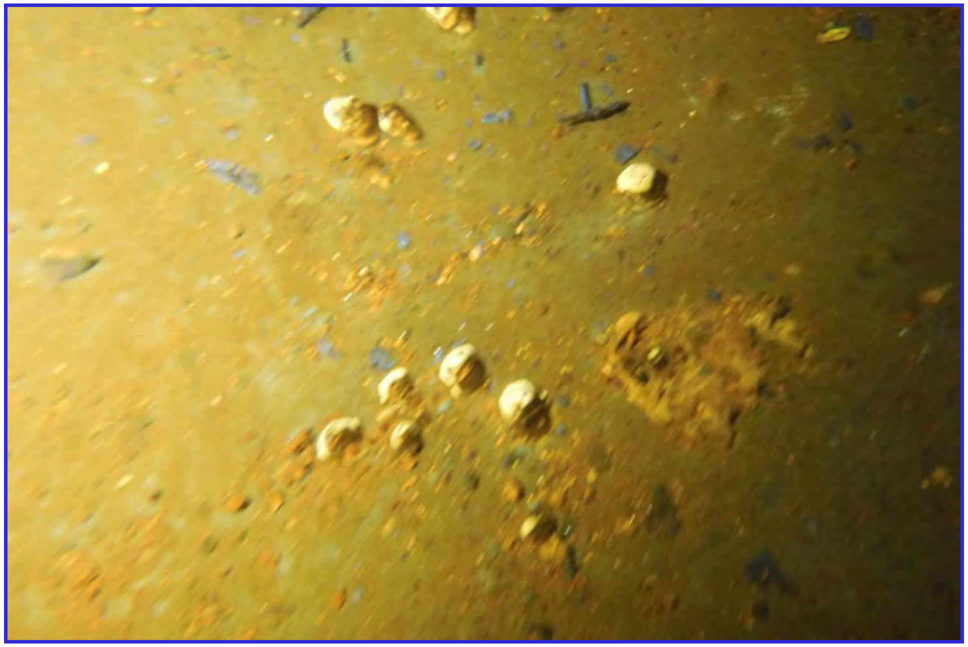
INTERIOR - CPUD - Golden Hills - Maintenance Inspection -089

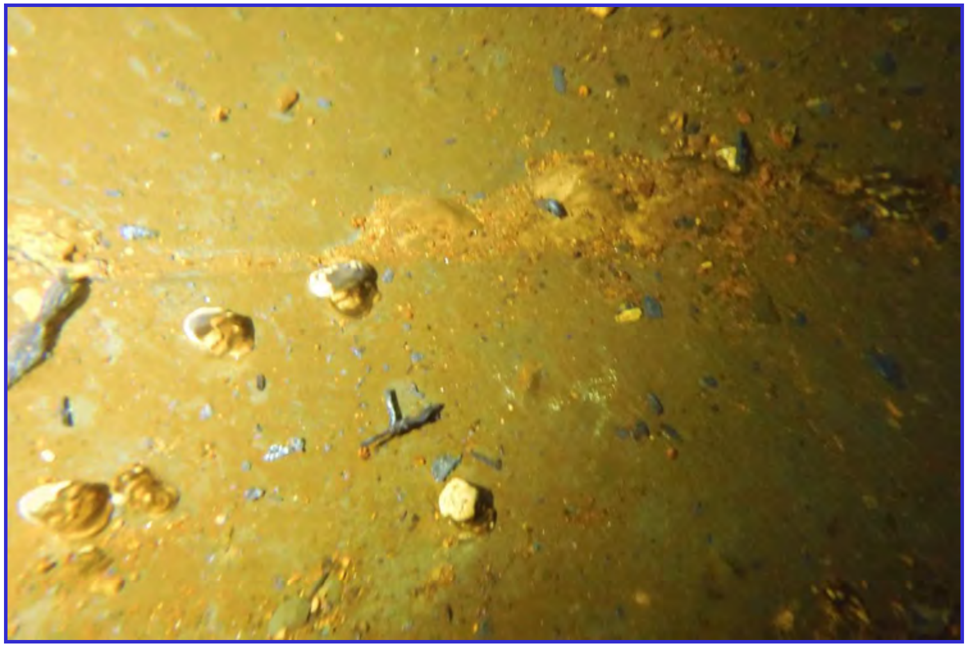


INTERIOR - CPUD - Golden Hills - Maintenance Inspection -090



INTERIOR - CPUD - Golden Hills - Maintenance Inspection -091


INTERIOR - CPUD - Golden Hills - Maintenance Inspection -092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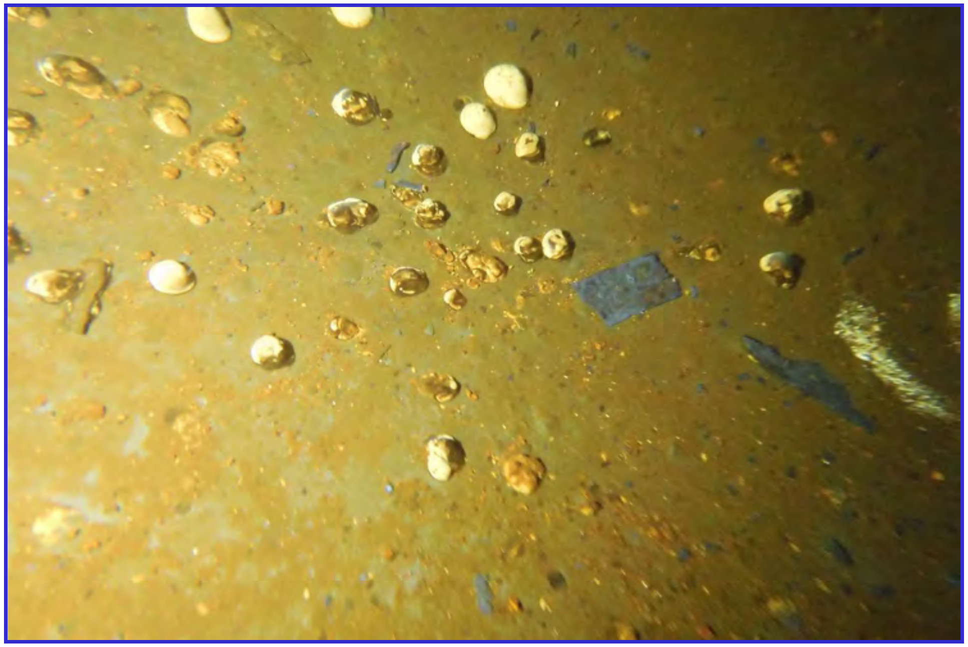
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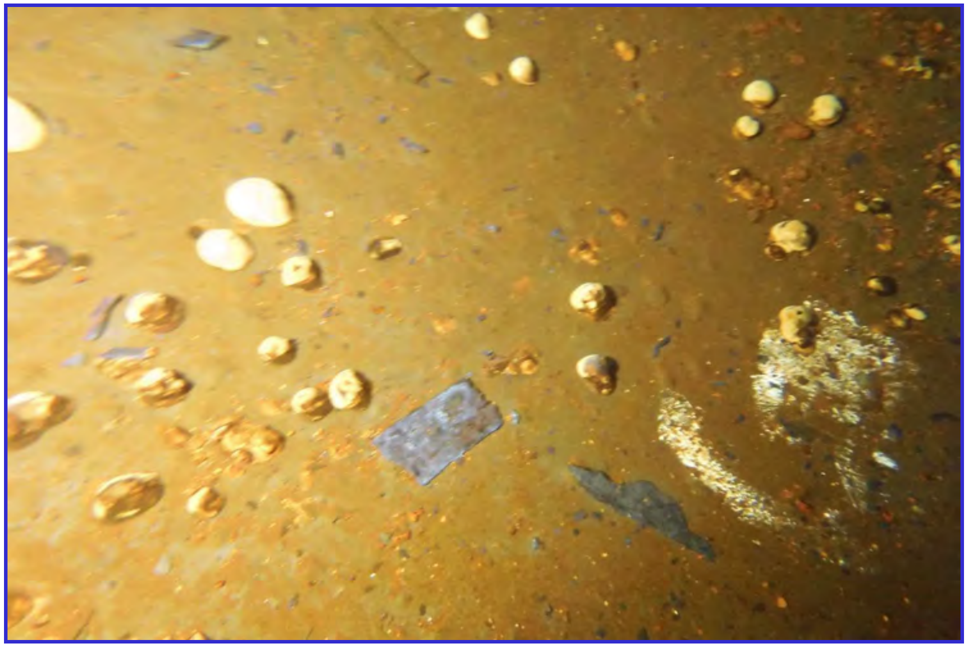
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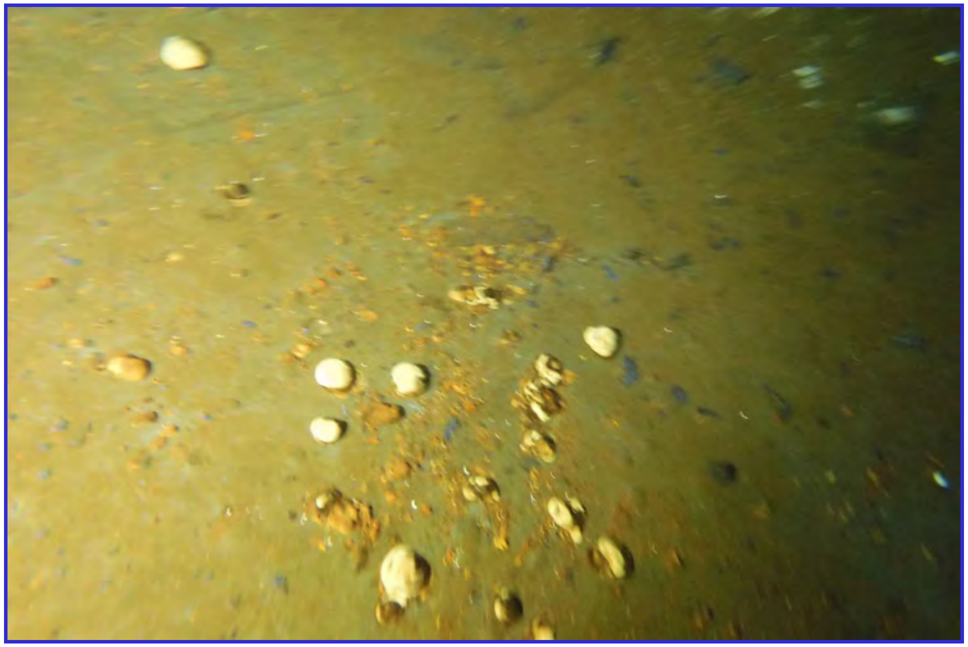
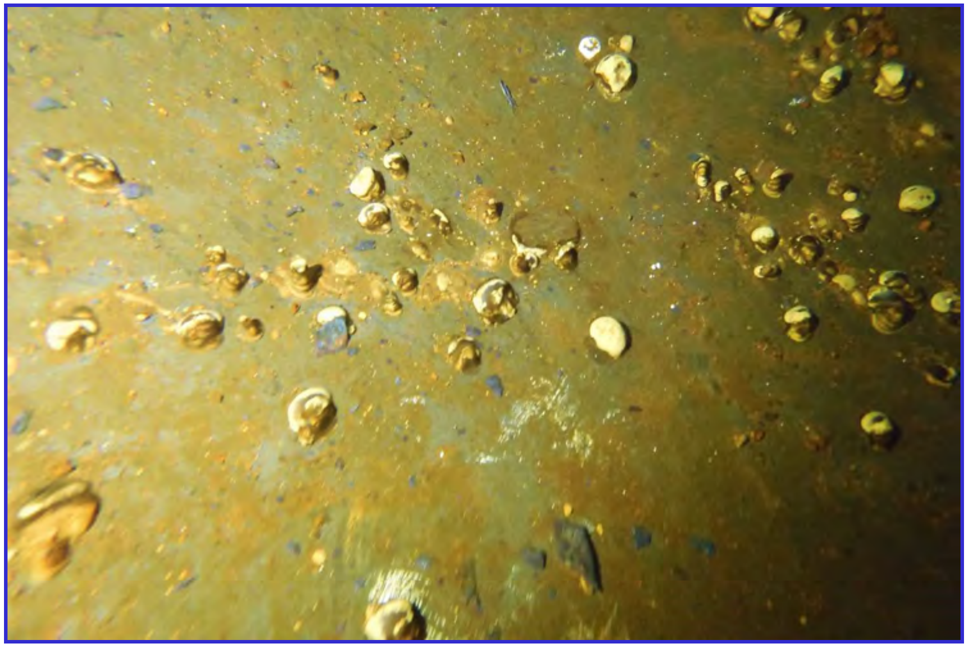
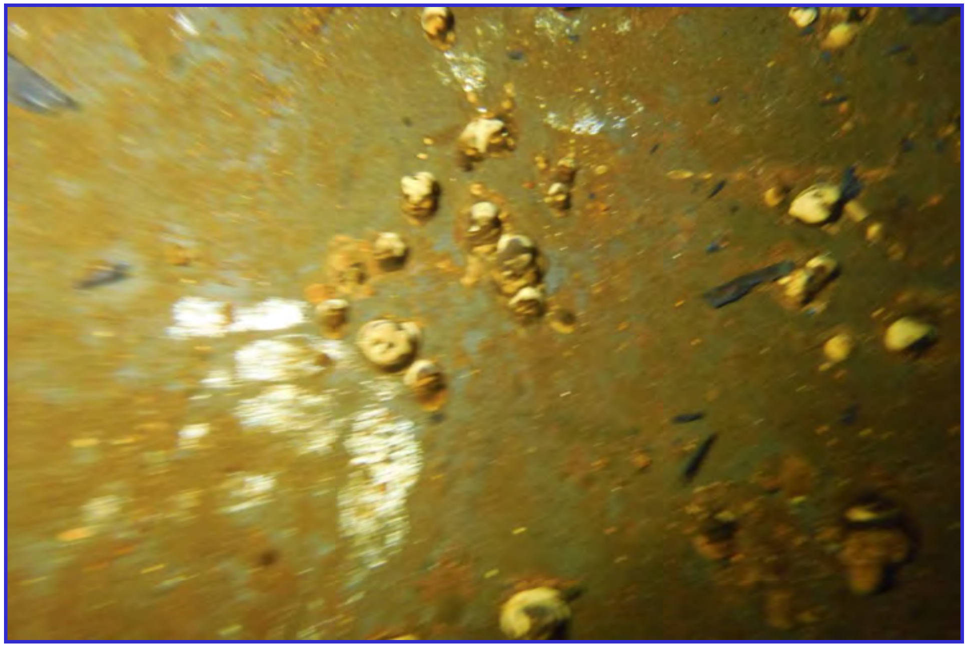


INTERIOR - CPUD - Golden Hills - Maintenance Inspection -096

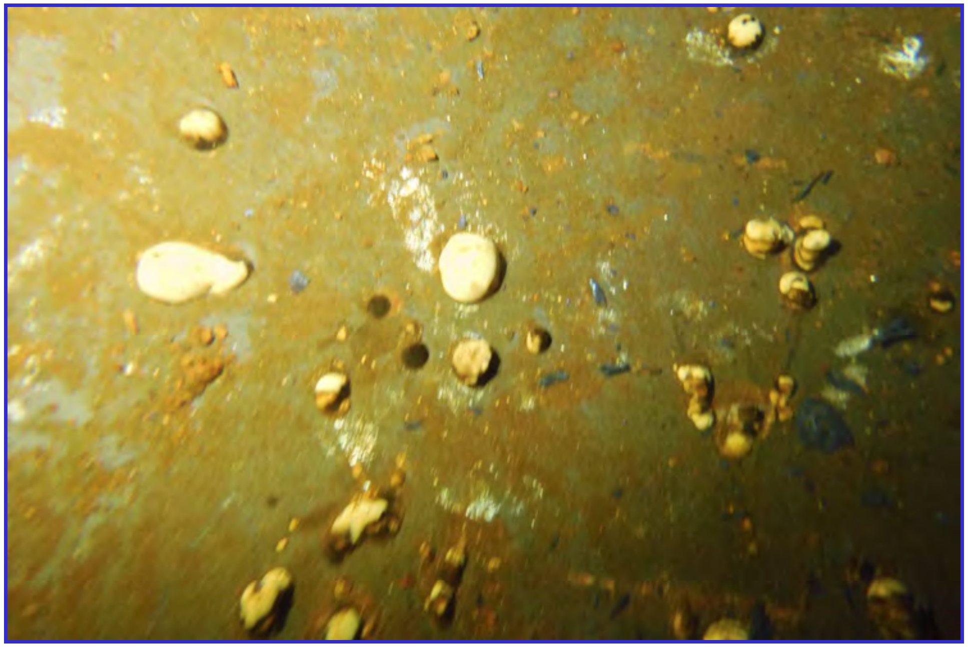
INTERIOR - CPUD - Golden Hills - Maintenance Inspection -097



INTERIOR - CPUD - Golden Hills - Maintenance Inspection -098



INTERIOR - CPUD - Golden Hills - Maintenance Inspection -099

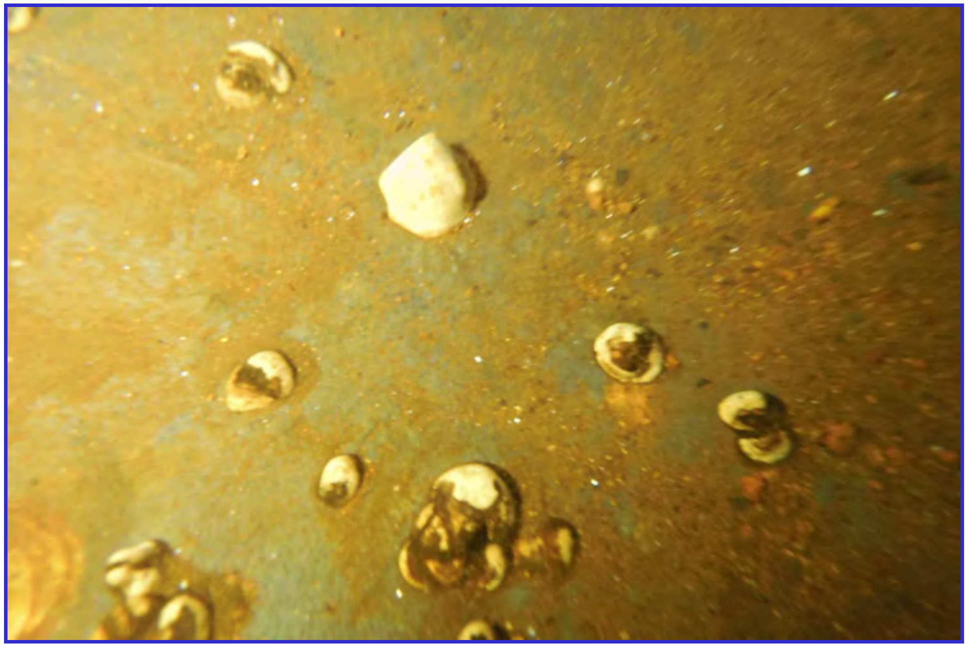


INTERIOR - CPUD - Golden Hills - Maintenance Inspection -100

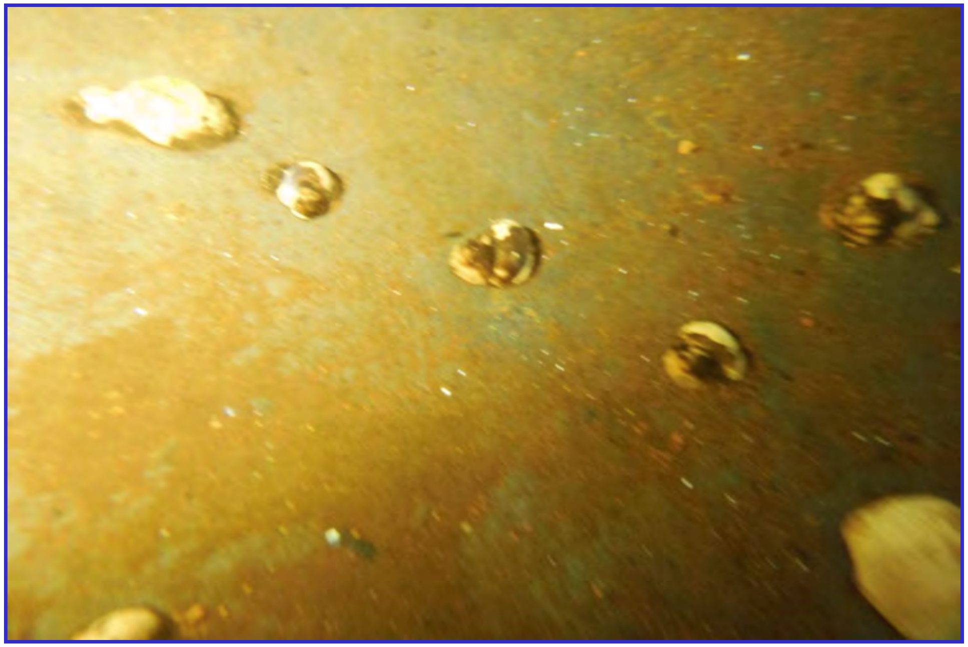
INTERIOR - CPUD - Golden Hills - Maintenance Inspection -101

INTERIOR - CPUD - Golden Hills - Maintenance Inspection -102

INTERIOR - CPUD - Golden Hills - Maintenance Inspection -103



INTERIOR - CPUD - Golden Hills - Maintenance Inspection -104



INTERIOR - CPUD - Golden Hills - Maintenance Inspection -105

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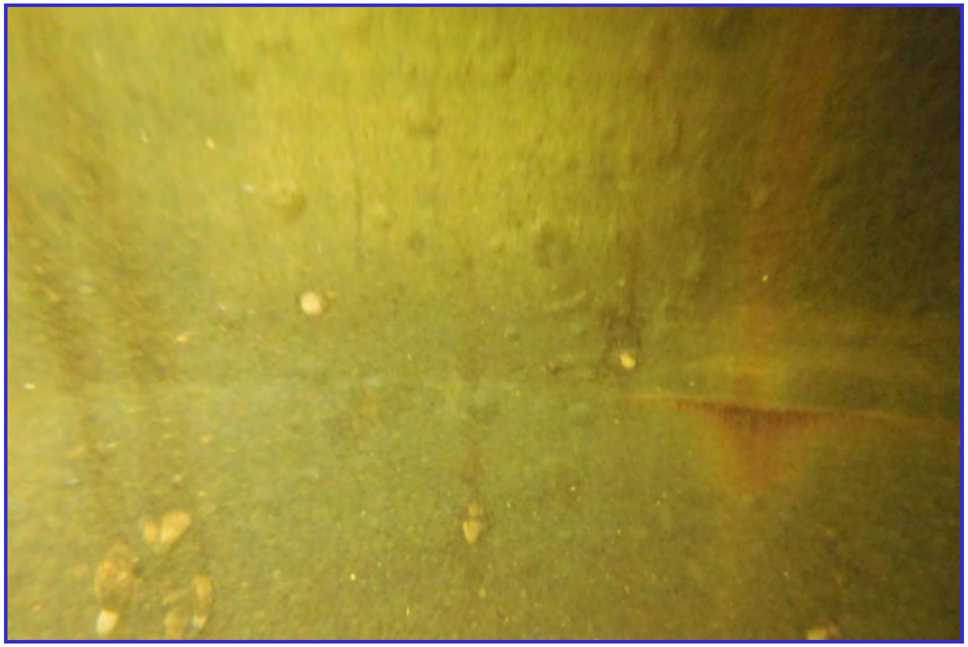
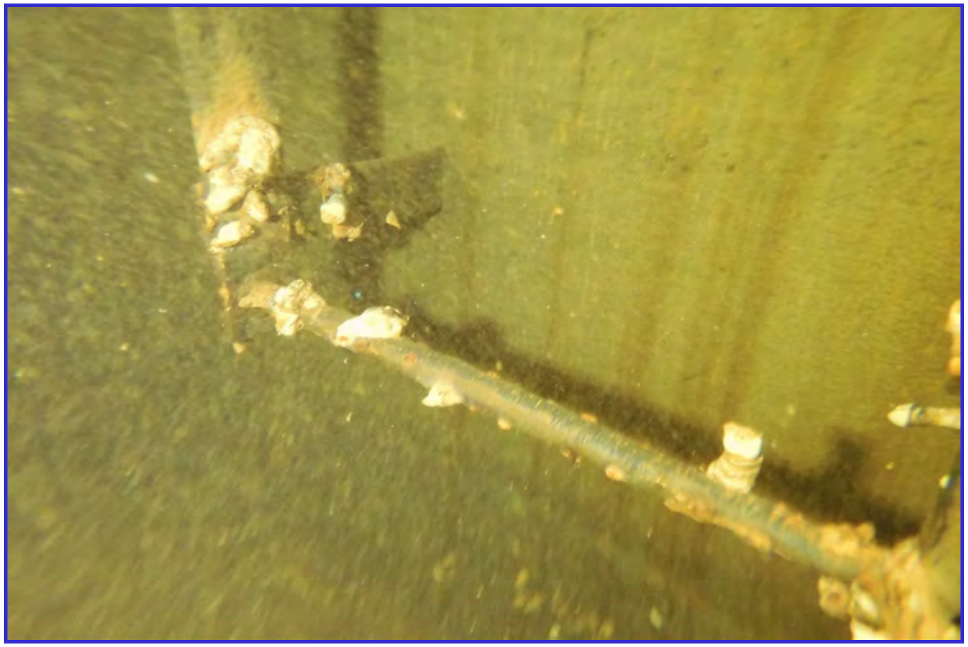
INTERIOR - CPUD - Golden Hills - Maintenance Inspection -107

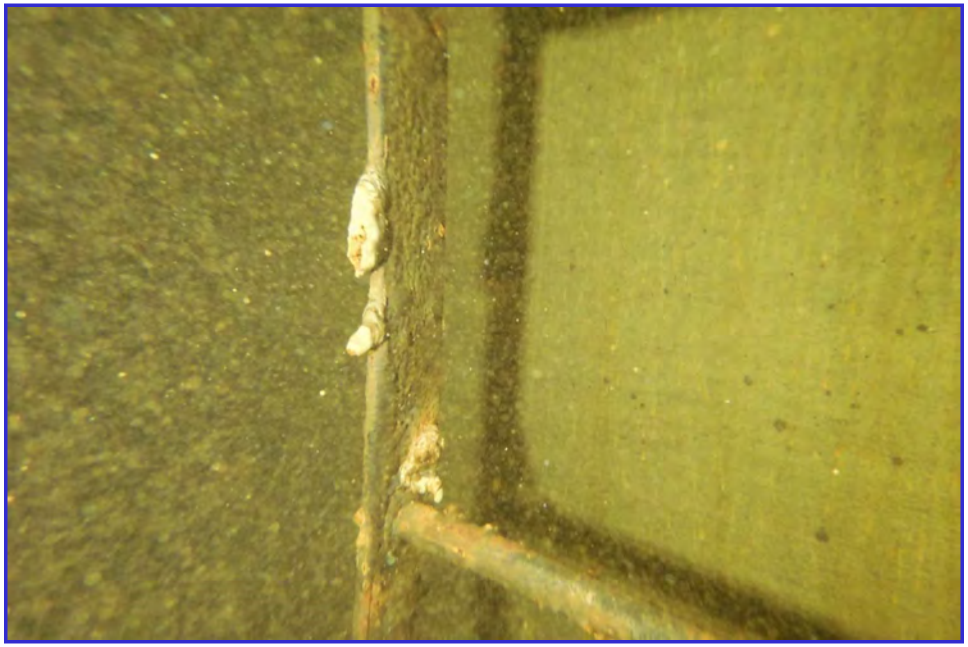


INTERIOR - CPUD - Golden Hills - Maintenance Inspection -108

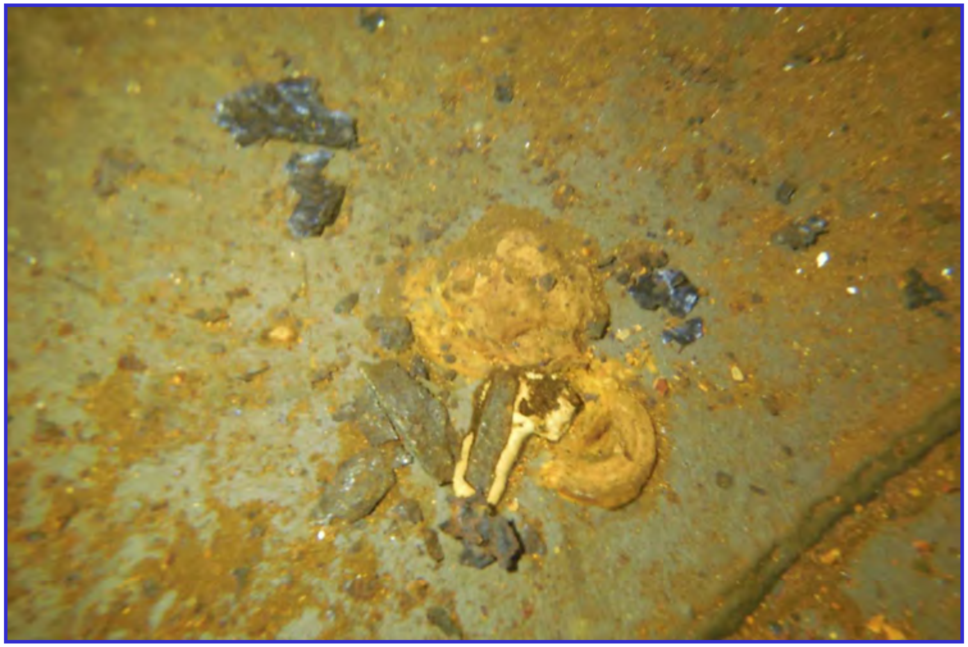
INTERIOR - CPUD - Golden Hills - Maintenance Inspection -109



INTERIOR - CPUD - Golden Hills - Maintenance Inspection -110

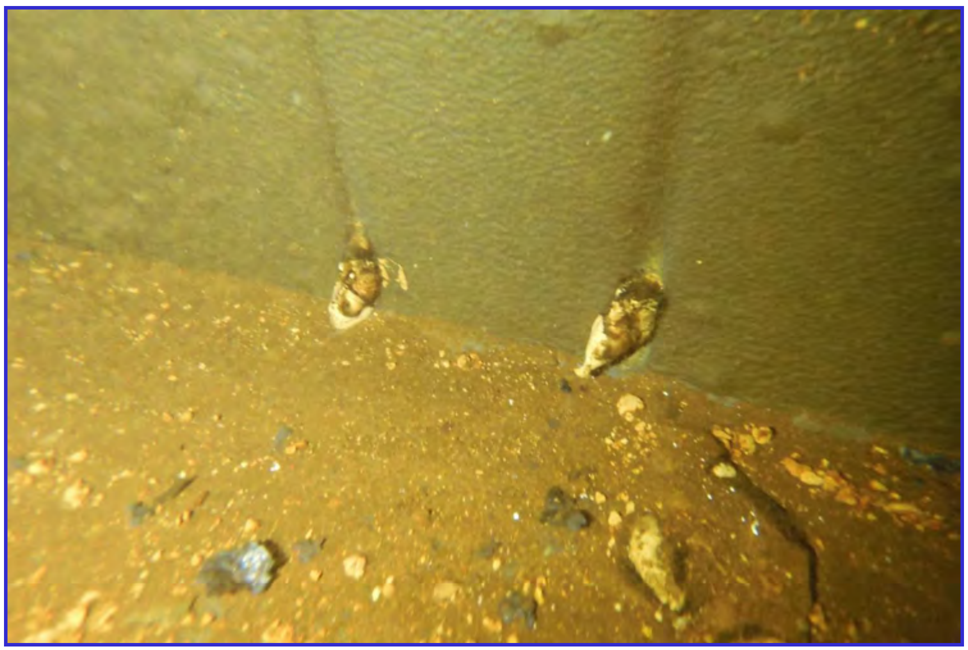


INTERIOR - CPUD - Golden Hills - Maintenance Inspection -111



INTERIOR - CPUD - Golden Hills - Maintenance Inspection -112

INTERIOR - CPUD - Golden Hills - Maintenance Inspection -113



INTERIOR - CPUD - Golden Hills - Maintenance Inspection -114

INTERIOR - CPUD - Golden Hills - Maintenance Inspection -115

INTERIOR - CPUD - Golden Hills - Maintenance Inspection -116

INTERIOR - CPUD - Golden Hills - Maintenance Inspection -117

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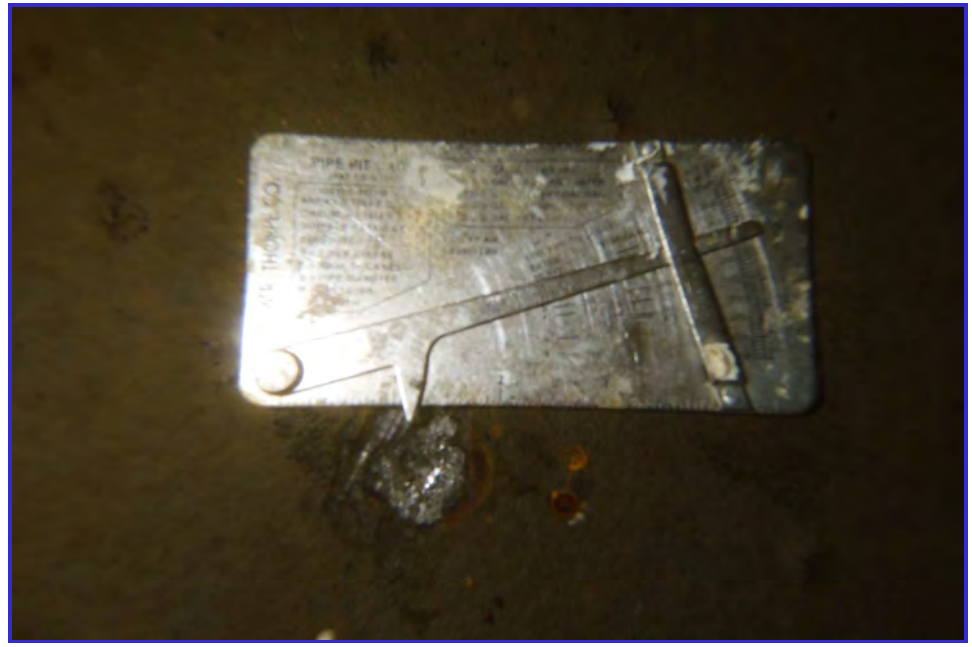
INTERIOR - CPUD - Golden Hills - Maintenance Inspection -119

INTERIOR - CPUD - Golden Hills - Maintenance Inspection -120



INTERIOR - CPUD - Golden Hills - Maintenance Inspection -121

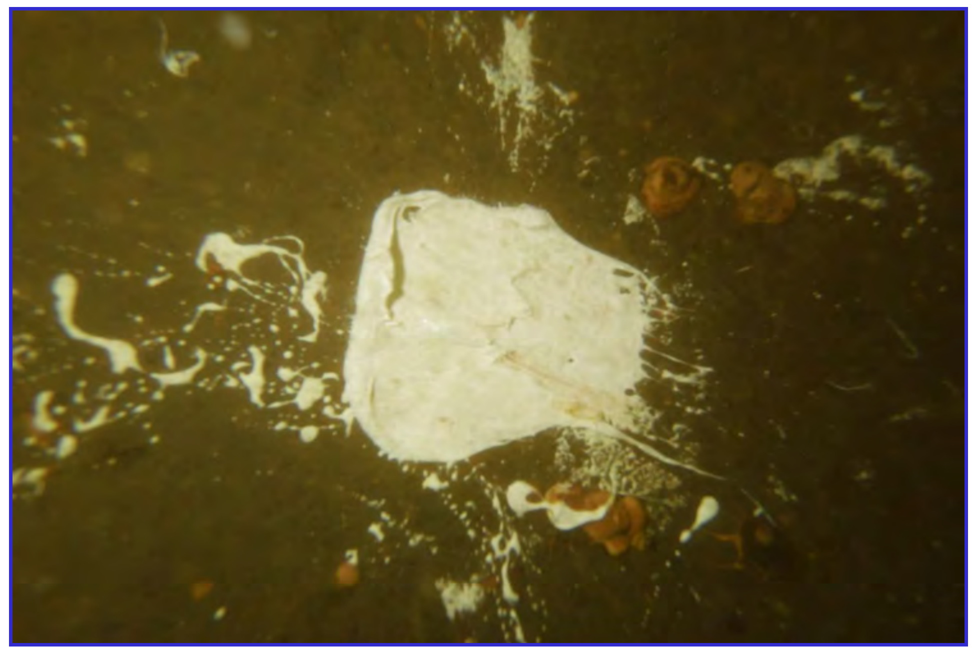
INTERIOR - CPUD - Golden Hills - Maintenance Inspection -122

INTERIOR - CPUD - Golden Hills - Maintenance Inspection -123

INTERIOR - CPUD - Golden Hills - Maintenance Inspection -124

INTERIOR - CPUD - Golden Hills - Maintenance Inspection -125

INTERIOR - CPUD - Golden Hills - Maintenance Inspection -126

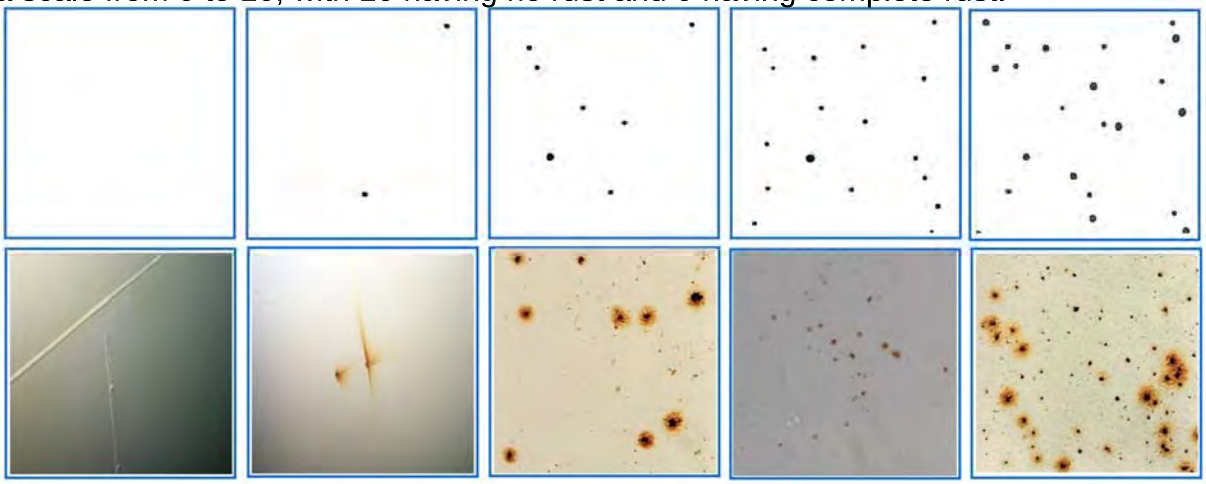


INTERIOR - CPUD - Golden Hills - Maintenance Inspection -127

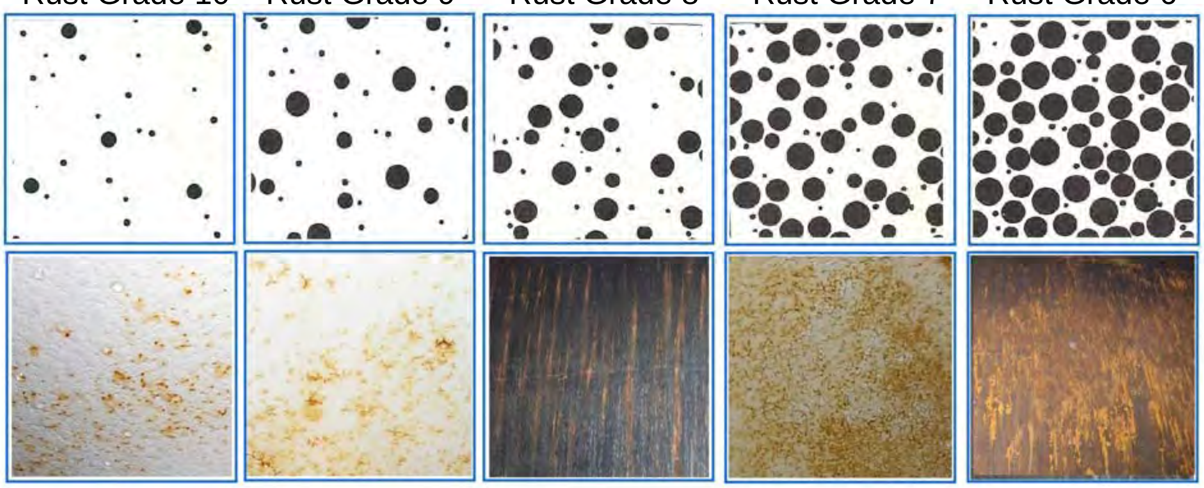
Chart 1 - Condition Rating The table below gives a basic description of the four different categories that CSI Services, Inc. uses to provide a general depiction of the condition of each defined area of a structure. The categories are Poor, Fair, Good, or Excellent. The development of these categories is based on historical knowledge and experience of various paint and lining systems over given periods of time in certain service environments. Basically, the rating is determined based on what should be expected of the paint or lining system at that point in its life cycle. As a result, different determinations are made for maintenance inspection versus warranty inspections. A detailed description of each rating with relative consideration addressed follows:

Rating	General Description of Conditions	
	Maintenance Inspection	**Warranty Inspection**
Poor	This condition is usually prioritized for rework in the short-term. Typically, these surfaces have considerably more coating defects and/or corrosion than what is expected for the age of the system.	This condition identifies an area with wholesale coating defects or corrosion concerns that will typically require significant removal and replacement of the coatings in the area.
Fair	Typically, these surfaces have a level of coating defects and/or corrosion that is slightly worse than what should be expected for the age of the system. This condition is placed on a short-term monitoring schedule.	This condition identifies an area with partial coating defects or corrosion concerns that will require significant rework.
Good	This condition is rated for areas without any considerable coating defects or corrosion. These surfaces are in a condition that is typical for the age of the coating system.	This condition identifies areas with coating defects or corrosion that is typically seen in one-year warranty inspections. Typically, only minor spot repairs are required.
Excellent	This condition is for areas without any considerable coating defects or corrosion. Typically, these surfaces are in a condition that is better than expected for the age of the system.	This condition identified areas that typically are in perfect condition and require no repair work.

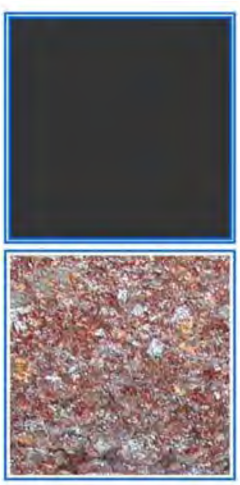
Chart 2 -Rust Grade The black and white figures below depict the standards referenced in ASTM D610 “Standard Test Method for Evaluating Degree of Rusting on Painted Surfaces.” Below each standard is a photographic depiction of each level of corrosion, as used by CSI Services, Inc. The standards depict the percentage of rust on a scale from 0 to 10, with 10 having no rust and 0 having complete rust.



Rust Grade 10 Rust Grade 9 Rust Grade 8 Rust Grade 7 Rust Grade 6



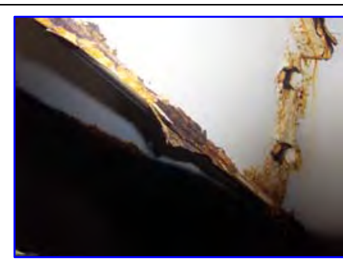
Rust Grade 5 Rust Grade 4 Rust Grade 3 Rust Grade 2 Rust Grade 1



Rust Grade 0

Rust Grade	Description
10	No rusting or less than 0.01% of surface rusted
9	Minute rusting, less than 0.03% of surface rusted
8	Few isolated rust spots, less than 0.1% of surface rusted
7	Less than 0.3% of surface rusted
6	Excessive rust spots, but less than1% of surface rusted
5	Rusting to the extent of 3% of surface rusted
4	Rusting to the extent of 10% of surface rusted
3	Approximately one-sixth of the surface rusted
2	Approximately one-third of the surface rusted
1	Approximately one-half of the surface rusted
0	Approximately 100% of the surface rusted

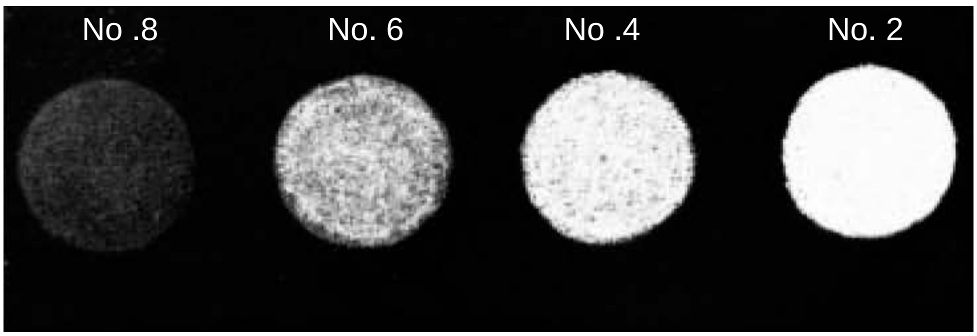
Chart 3 - Corrosion Grade The figure below depicts the photographic standards referenced by CSI Services, Inc. in the determination of the characteristics and stages of corrosion progression. This standard is used to better quantify the level of corrosion once it has progressed to Rust Grades 3, 2, 1, or 0 (see Chart 2). When applicable, CSI classifies an area as one or more of the five different Corrosion Grades. Corrosion Grades 1 through 5 are described below:

Grade	Description	Photo Examples
1	Light Rust - This condition involves relatively light colored rust that does not have any significant metal loss.	 
2	Dark Rust -This condition involves relatively dark colored, thicker rust that is progressing towards the next phase, significant metal loss.	 
3	Pitting - This condition involves isolated or widespread deep spot corrosion (pitting).	
4	Scale - Also known as lamellar or exfoliation corrosion. The edges of the affected area are leaf like and resemble the separated pages of a wetted book.	 
5	Structural Loss - This condition involves metal loss or failure where components will require structural consideration	 

The photos depicted are examples and were not taken on this project.

Chart 4 - Chalking The figure below depicts the photographic standards referenced in ASTM D4214 “Standard Test Method for Evaluating the Degree of Chalking of Exterior Paint Films,” Method D659, Method C. Generally speaking, chalking is the degradation of a paint’s binder leaving behind loose pigments as the binder reacts with the environment, primarily ultraviolet light and oxygen. Evaluating chalking is a means to measure the performance of a coating system and its life cycle projection. It is also important to quantify for consideration of future overcoating options. This test uses these pictorial standards to quantify the amount of chalking present on paint films. The depictions below represent the mount of colored chalk removed onto a cloth during the test. The scale ranges from 2 to 8 with the rating 2 having the most chalk.

Light Colored Paints



Dark Colored Paints

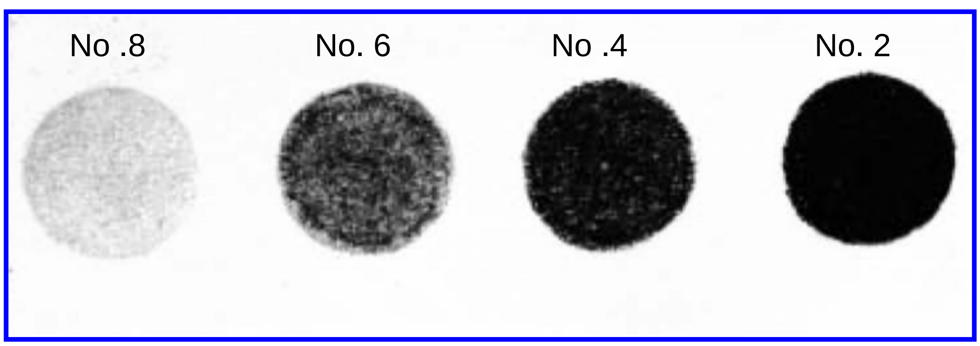
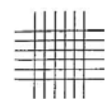
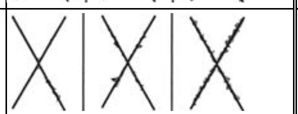
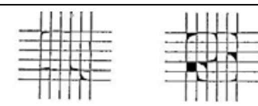
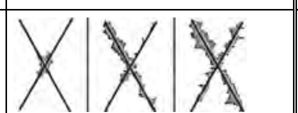
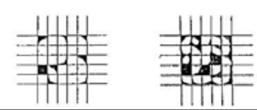
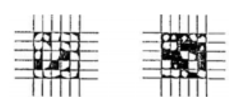
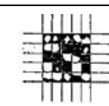
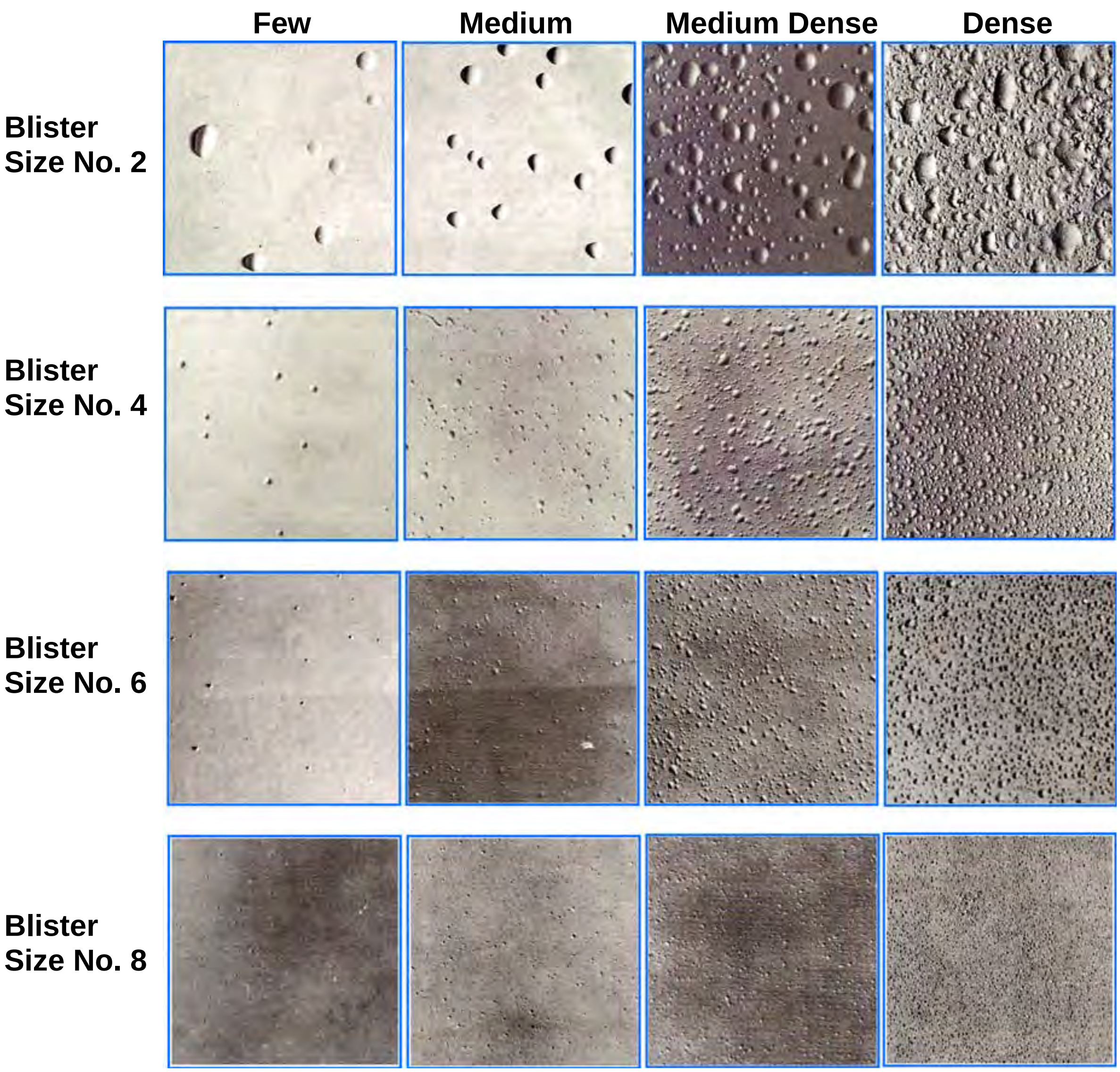


Chart 5 - Adhesion Rating The figures below depict the photographic standards and criteria referenced in ASTM D3359 “Standard Test Method for Evaluating Adhesion by Tape Test” and ASTM D6677 “Standard Test Method for Evaluating Adhesion by Knife.” Both Standards are used to assess the condition of a paint system for life-cycle projections. It is also used to evaluate an existing paint system’s ability to withstand the added stress that any overcoating strategies can create. Depending upon the thickness of the paint system, ASTM D3359 has two different test methods. The rating criteria for both standards follow:

ASTM D3359					
Method A			Method B		
Rating	**Observation**	**Surface of X-cut from which flaking/peeling has occurred**	**Rating**	**Percent Area Removed**	**Surface of cross-cut area from which flaking has occurred for six parallel cuts and adhesion range by percent**
5A	No peeling or removal	None	5B	0% none	
4A	Trace peeling or removal along incisions or their intersection		4B	Less than 5%	
3A	Jagged Removal along incisions up to 1/16” on either side		3B	5 – 15%	
2A	Jagged removal along most of incisions up to 1/8” on either side		2B	15 – 35%	
1A	Removal from most of the area of the X under the tape		1B	35-65%	
0A	Removal beyond the area of the X		0B	Greater than 65%	

ASTM D6677	
Rating	Description
10	Fragments no larger than $\frac{1}{32}$” x $\frac{1}{32}$” can be removed with difficulty
8	Chips up to $\frac{1}{8}$” x $\frac{1}{8}$” can be removed with difficulty
6	Chips up to $\frac{1}{4}$” x $\frac{1}{4}$” can be removed with slight difficulty
4	Chips larger than $\frac{1}{4}$” x $\frac{1}{4}$” can be removed with slight pressure
2	Once coating removal is initiated by knife, it can be peeled at least $\frac{1}{4}$”
0	Coating can be peeled easily to length greater than $\frac{1}{4}$”

Chart 6 – Blistering Rating The figure below depicts the photographic standards referenced in ASTM D714 “Standard Test Method for Evaluating Degree of Blistering of Paints”. This test uses these pictorial standards to quantify both the size and density of blisters that may develop in linings. Although the standard uses a blister size scale of 0 to 10 this chart uses the most common sizes of blisters found in the field. The standard does not use a reference for the size of each of the blisters depicted. CSI used this scale as a means for further quantification by qualifying the largest blister depicted as being 1 inch in width (Blister Size No. 2) and the smallest blister being 1/32 of an inch in width (Blister Size No. 8).



P. O. Box 801357
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Providing Quality Technical Services to the Coating Industry

November 19, 2023 ***Via Email:*** asmith@pbieng.com

Ashley Smith, PE
Peterson Brustad Inc.
80 Blue Ravine Road, Suite 280
Folsom, CA 95630

Office: 916.608.2212
Cell: 530.200.6309

Subject: **Final Report - Maintenance Inspection**

Re: **CPUD – Mokelumne Hill Reservoir**

Dear Ashley:

Please find attached the final report for the evaluation that was completed on the above referenced tank. Also attached is our invoice.

Thank you for your business and please let me know if you have any questions or comments about our findings. I can always be reached by cell at 951.609.6991 or by e-mail at rgordon@csiservices.biz.

Sincerely,
CSI Services, Inc.

N. Randy Gordon

N. Randy Gordon, PCS
Technical Services Manager

CSI SERVICES

P. O. Box 801357, Santa Clarita, CA 91380 877.274.2422

Final Report
Maintenance Inspection
Mokelumne Hill Reservoir
Calaveras Public Utility District

Prepared for:
Ashley Smith, PE
Peterson Brustad Inc.
80 Blue Ravine Road, Suite 280
Folsom, CA 95630

Prepared by:
CSI Services, Inc.

N. Randy Gordon, PCS
Technical Services Manager

PROTECTIVE COATING SPECIALIST
N. RANDY GORDON
No. 2018-621-011
Exp. 12-31-26
PCS
STATE OF CALIFORNIA

November 19, 2023

Hawaiian Office: P.O. Box 671, Aiea, HI 96701
Northern California Office: P.O. Box 371, Sonoma, CA 95476
Coating Specialists and Inspection Services, Inc.
Consulting Evaluations Tank Diving Inspection

Table of Contents

Attachments

- Field Notes
- Exterior Photos
- Interior Photos
- CSI Chart 1 – General Description of Conditions
- CSI Chart 2 – Rust Grade Criteria
- CSI Chart 3 – Corrosion Grade Criteria
- CSI Chart 4 – Coating Chalking Criteria
- CSI Chart 5 – Coating Adhesion Criteria
- CSI Chart 6 – Coating Blistering Criteria

Introduction

Peterson Brustad Inc. authorized CSI Services, Inc. (CSI) to conduct a maintenance inspection on the Calaveras Public Utility District, Mokelumne Hill Reservoir located at 4866 Lyle Court, Mokelumne Hill, CA. This report documents the findings of the inspection and services performed.

Any recommendations have been made in accordance with the applicable requirements of American Water Works Association's Standard (AWWA) D102 "Coating Steel Water Storage Tanks," AWWA Standard M42 "Steel Water Storage Tanks," and CSI's experience with evaluating over a thousand water storage facilities. A photo summary and narrated video are also included to document the condition of the tank.

The field-work was completed on August 9, 2023 by a team primarily comprised of Anthony Jackson, Steven Metcalf and Steven Metcalf Jr. The exterior shell observations were made mostly from grade level, while the exterior of the roof was examined close-up. The interior inspection was carried out with the tank's water level at approximately 21 feet using special underwater diving equipment and techniques. Steve Metcalf was the site supervisor and Anthony Jackson was the lead diver. Mr. Randy Gordon, Technical Services Manager, reviewed the results of the field data and prepared recommendations for maintenance work. Mr. Gordon has over 30 years of experience through the evaluation of thousands of storage tanks and other structures. He is certified as an SSPC Protective Coating Specialist (PCS) and NACE/SSPC Level 3 Coating Inspector.

Summary

The estimated 40+ year old coating systems on the tank are in overall poor condition with widespread and pervasive corrosion. The exterior paint system is severely weathered but has satisfactory adhesion. The exterior paint is believed to be the original system applied and very likely has high concentrations of heavy metals (e.g. lead, chromium, etc.) that will require special precautions to protect the workers and environment when it is disturbed.

The lining in the tank is in an overall unsatisfactory condition with widespread rust including undercutting, pitting and exfoliation. Blistering of the lining below the MWL is pervasive and widespread. The majority of the corrosion is in the upper part of the tank and includes the beginning of structural loss. The most advanced corrosion spots below the CWL were patched during this inspection using an NSF certified underwater curing epoxy. The existing lining conditions dictate that the existing exterior paint and interior lining systems should be removed and replaced within the next 2 to 3 years to prevent further metal loss.

Background

The Mokelumne Hill Reservoir is a welded steel on grade structure where the year of construction is unknown as the nameplate is weathered and unreadable but estimated to be a 1980's era structure. The tank is approximately 80 feet in diameter by 40 feet high providing a nominal capacity of 1,500,000 gallons.

The tank shell has five courses that are connected to a knuckle radiused roof with rafters, girders and one center column. The tank has one roof vent, one roof hatch, and two shell manways. There is one interior ladder and one exterior ladder. The exterior ladder has fall protection and a vandal deterrent. The tank is not seismically anchored to its concrete ringwall foundation. There is no internal or external cathodic protection (CP) system associated with this tank. The tank has a water level sensor, rigid piping connections, and the overflow is external.

It is believed that the interior linings are the original coatings applied. The interior steel surfaces, including the roof and roof support members are coated with an epoxy system. The exterior roof, shell, and appurtenances are painted with what appears to be an alkyd system. The internal roof lap seams are not caulked.

Field Evaluation

The purpose of this survey was to assess the condition of the existing coatings and recommend maintenance coating work, where needed. The evaluation mainly involved visual observations, but also involved various testing procedures. Photographs and video were taken to document the field inspections, and a photo summary and narrated video is included within this report.

For survey purposes, the tank has been segmented into defined areas: exterior roof, exterior shell, interior roof, interior shell, and interior floor. The various appurtenances within each of these areas have also been evaluated. A rating system has been developed to quantify the condition of these various tank areas. Each of the rating criteria is found in the Attachments (Charts 1 through 6).

The condition of the coating systems was rated as being poor, fair, good, or excellent (Chart 1). The extent of any rust defects identified within each of the areas was generally determined using the guidelines set forth in ASTM D610 "Standard Test Method for Evaluating the Degree of Rusting of Painted Steel Surfaces" (Chart 2). Where applicable, the characteristic or stage of corrosion was determined in accordance with CSI Corrosion Grade criteria (Chart 3). The degree of paint chalking was determined in accordance with ASTM D4214 “Standard Test Method for Evaluating the Degree of Chalking of Exterior Paint Films,” Test Method D659, Method C (Chart 4). Coating adhesion was assessed in accordance with ASTM D3359 “Standard Test Method for Evaluating Adhesion by Tape Test, modified Method A and/or a modified version of ASTM D6677 “Standard Test Method for Evaluating Adhesion by Knife” (Chart 5). The modified version of ASTM D6677 was used in areas where destructive testing was not found to be practical. Any blistering that may have been present was rated in accordance with ASTM D714 “Standard Test Method for Evaluating the Degree of Blistering in Paints” (Chart 6), and the paint dry film thickness was measured with a Positector 6000FN3 Type II gage in accordance with the applicable guidelines set forth SSPC PA2. The visual observations and data collected from the various areas of the tank are found in the charts below:

Exterior

Close-up visual examination of the coating was limited to the first (lowest) shell course, upper shell areas adjacent to the ladder, and the roof. The exterior paint on the heavily weathered roof is in poor condition and the shell was in fair condition, both with moderate chalking (ASTM D4214, No. 6). Dark rust (CSI Corrosion Grade 2) was present in areas that had been mechanically damaged from operations or vandalism and areas where paint was peeling. The amount of rust on the roof was less than one-sixth of the overall surface area (ASTM D610, 3). Areas where paint was found to be cracking were rated a 2 in accordance with ASTM D661. The paint thickness was found to range from 7.0 to 10.0 mils, and the paint was estimated to exhibit satisfactory adhesion (ASTM D6677, 4A). Some of the specific data collected follows:

Exterior Paint	Overall Condition	Fair										
Paint Defects	Roof Quadrant				Shell Quadrant				Tank Support			
	Exterior		Poor		Exterior		Fair		Exterior		Fair	
	S	W	N	E	S	W	N	E	S	W	N	E
Rust spots (ASTM D610)	3	3	3	3	8	8	8	8	8	8	8	8
Corrosion Grade	2	2	2	2	2	2	2	2	2	2	2	2
Rusting at crevices												
Spot peeling												
Delamination												
Cracking (ASTM D661)												
Checking (ASTM D660)												
Chemical staining												
Chalking	6	6	6	6	6	6	6	6	6	6	6	6

Interior

The roof area is defined as those surfaces above the highest water level (HWL). Close-up visual examinations were made to all areas below the waterline and all other areas were assessed from the water level. The coating on the underside of the roof plates and roof support structure is in poor condition with corrosion common to the edges of the support member flanges and roof plates (CSI Corrosion Grade 2). Spot peeling and cracking was observed throughout (CSI Corrosion Grade 2). The total amount of corrosion on the roof was rated to be approximately one sixth of the total surface area (ASTM D610, 3), and there was a moderate amount of rust staining present at the faying surfaces of the roof structure.

The shell surfaces are covered with a dark sediment, but spot checking revealed the lining on the shell was found to be in poor condition with areas of dark rust (CSI Corrosion Grade 2), especially below the high-water level segment of the shell. The total amount of corrosion on the shell was rated to be excessive but less than 1 percent of the total surface area (ASTM D610, 6) with some minor pitting observed. Fields of intact and broken, medium dense blisters were observed (ASTM 714, 2-few).

The floor had sediment upon it, but spot checking revealed an epoxy system that was estimated to be in poor condition, (ASTM D610, 6) with fields of small, medium-dense blisters (ASTM 714, 2-few). Some pitting uncovered at the floor was patched during the inspection and the prior patches were observed to be performing properly.

The data collected from the underwater inspection follows:

Interior Paint					Above Water Condition		Poor		Below Water Condition		Poor	
Paint Defects/Overall Grade	Roof Quadrant				Shell Quadrant				Floor Quadrant			
	Interior		Poor		Interior		Poor		Interior		Poor	
	S	W	N	E	S	W	N	E	S	W	N	E
Rust spots (ASTM D610)	3	3	3	3	6	6	6	6	6	6	6	6
Rust areas (ASTM D610)												
Corrosion Grade	2	2	2	2	2	2	2	2	2	2	2	2
Rust staining												
Rusting at crevices												
Spot peeling	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Delamination												
Cracking (ASTM D661)	2	2	2	2	2	2	2	2	2	2	2	2
Blistering (ASTM 714) Size/Densit					2/Few	2/Few	2/Few	2/Few	2/Few	2/Few	2/Few	2/Few
Pitting (Estimated Amount)												
Pitting (Estimated Deepest Mils)												

Dive Inspection Video

Click on link or cut and paste the external link: https://youtu.be/UShHmflrSaY

Discussion

The paint system on the exterior was found to be relatively thin and in poor condition on the roof and fair condition at the shell. All surfaces have isolated spot rust and areas of peeling, and the paint system was found to have significantly weathered from chalking. It was also noted that the underside of the center vent has heavy corrosion up to and including some metal loss.

Chalking is the term for the powdery characteristic of an aged coating that may also have a faded finish. Chalking is a result of the natural breakdown of a paint system's binder when it is exposed to sunlight. The binder (or resin) degrades in ultraviolet light, which leaves behind the unbound pigment or chalk. Aside from a faded appearance, chalking can result in corrosion as the film weathers (thins) away through cycles of wind and rain. As the paint endures years of direct sunlight, it begins to weather away, which results in the paint no longer providing enough barrier protection from corrosion. On this basis, it is recommended that a plan for recoating the tank with an industrial paint should be completed.

Generally speaking, there are four possible approaches to maintenance coating work. The coatings can be either completely removed and replaced (repainted), spot repaired, spot repaired and overcoated, or simply overcoated. In evaluating the condition of a coating to determine the best approach there are a number of different factors to consider. The first set of factors includes the determination of the coating's ability to withstand the added stress of an additional coat(s). Attributes impacting this decision

include film thickness and adhesion. If a film is too thick or has poor adhesion, the tension from the curing stresses and/or the weight of the additional paint can cause the existing system to disbond. The second set of factors to consider when determining what maintenance coating approach to take is the amount of surface area requiring repair, the overall difficulty in providing access to the structure, and whether the coating system contains heavy metals. The final factor is the condition of the substrate.

When considering whether a spot repair approach is a viable option, a good rule of thumb is that up to 10 percent of the surface area requiring repair is the point at which making spot repairs with overcoat becomes a diminishing return. With 10 percent rusting, overcoating may be an option if the adhesion is better than fair. If there is more than 10 percent rusting and the substrate is free of mill scale, overcoating may be considered an option if the adhesion is satisfactory. Once the amount of surface area exceeds this range, the cost of cleaning and coating the individual rust spots approaches (or exceeds) the total cost of removal and replacement.

On this basis, it is recommended that the tank exterior paint system be spot repaired and overcoated within the next 4 to 6 years before any significant metal loss develops.

At interior surfaces, the tank lining system was found to have widespread dark corrosion above the highest water level (HWL) with lamellar and/or exfoliation corrosion common to knuckle bracing edges and structural loss at the rafters connected to the dollar plate. A significant amount of corrosion was found below HWL with pitting and medium dense patches of broken and unbroken blisters.

Exfoliation corrosion is a form of intergranular corrosion which involves selective attack of a metal at or adjacent to grain boundaries. In this process, corrosion products force metal to move away from the body of the material, giving rise to a layered, laminar appearance. Exfoliation corrosion is also known as layer corrosion or lamellar corrosion.

Since all of the blisters were underwater and below the common water level, it is presumed that the blisters are a result of osmotic forces. Osmotic blistering is typically caused when coatings that are to be placed into immersion service are applied too thick, overcoated too soon, under colder weather conditions, and/or over contaminated surfaces. One form of osmotic blistering is solvent entrapment. Solvents are added to coatings to act as a vehicle during application. When coatings are applied too thick the coating solvents that were designed to be released during application are locked in-place when the catalyzed coating reaches a full chemical cure. Additionally, if coatings are applied under cold or cooler conditions, the solvents have a difficult time escaping from the film before it gets hard. Blisters that result from solvent entrapment tend to be localized to the coolest and lowest areas of a tank. Solvent vapors are typically heavier than air, and the lowest portion of a tank tends to become saturated with these gases

without proper ventilation at the time of application. Coated over contamination creates a source for osmotic forces. This contamination attracts fluid that creates pressures that exceed the film's ability to bond, creating blisters.

Isolated corrosion pits can develop within a coating system that may have only a few small breaks that were not corrected through periodic maintenance repairs. If the remaining, adjacent coating has excellent adhesion, it will inhibit undercutting corrosion. As a result, the corrosion forces will have a tendency to concentrate on the exposed bare metal, which results in pitting. Pitting can be critical in some instances. The maximum corrosion rate for steel in fresh water is typically no more than 30 mils per year (MPY). As a result, the pitting can develop into a perforation if not repaired. If a thru-hole develops within a tank bottom, the isolated issue can develop into a much larger corrosion problem. Corrosion requires oxygen to advance, and the underside of the tank bottoms are considered a dead-air space. As a result, the bottom of tank floors are typically not coated. A perforation or thru-hole with even a small trickle of water will reintroduce oxygen into the environment creating active corrosion that is difficult to identify until the steel floor plate requires replacement.

Industrial paint systems such as those applied to industrial facilities (i.e. piping, structural steel, storage tanks) typically have a life expectancy of 25 to 35 years before any spot maintenance coating repairs are required. The now failed interior lining system is estimated to be 40+ years old and has surpassed its expectations. The characteristics of the coating defects indicate that the lining failed many years ago.

A common tank design in the past was to run tank piping up through the tank bottom. This design can help prevent piping from obstructing outside areas of the tank but can be problematic during a seismic event. During an earthquake, there is the potential for the tank bottom to move at a different rate than the below grade piping. Past seismic events have resulted in piping connections being sheared or cracked, which resulted in a loss of water capacity during times when it was most needed during the emergency. Moving tank piping to the shell to include flexible connections for inlet/outlets is a better design when considering this issue.

Recommendations

The following activities are recommended for remedial work:

Exterior

Within the next four to six years, spot repair and overcoat the exterior coating. This work should include the following:

1) This work should include cleaning all surfaces in accordance with SSPC’s Surface Preparation Standard No. 15, “Commercial Power Tool Cleaning” followed by 4-6 mils of an industrial epoxy primer and 3-5 mils of a polyurethane finish coat.

2) Test the paint system for heavy metals to determine if any special actions are required to protect workers and the environment during paint disturbance.

Interior

Within the next 2 to 3 years, remove and replace the interior lining. This work should include the following:

3) Remove and replace the lining system at all interior surfaces. This work should include cleaning all surfaces in accordance with SSPC's Surface Preparation Standard No. 10 "Near-White Metal Blast Cleaning" (SSPC-SP10) followed by three 4 to 6 mil coats of an NSF Certified epoxy lining.

4) Caulk all crevices in the tank such as roof lap seams.

5) Anticipate the need for minor structural repairs (welding, grinding, etc.)

6) Consider retrofitting the tank piping to include flexible couplings and the relocation of tank bottom connections to the lower shell.

P.O. Box 801357, Santa Clarita, CA 91380
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Fax: 661.755.7628
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Page	1	of	1
Date	08/09/23	Wednesday	
CSI Job No.	223084		
Completed By	Metcalf		

Field Water Tank Dive Inspection Report

Tank Name:	Mokelumne Hill	Dive Supervisor:	Steven Metcalf
Tank Owner/Client:	CPUD	Dive Leader:	Anthony Jackson
Client Contact:	Ashley Smith	Dive Tender	Steven Metclaf Jr.

Scope Maintenance Inspection

Site Information

Item	Description
Cross Street	Sport Hill Rd
Tank Location	9490 Sport Hill Rd
GPS Coordinates	38.29617 -120.69440
Nearest Structures	None
Surrounding Site	Gravel

Item		Notes
Perimeter Fencing	Yes	No Comments
Site secured on arrival	Yes	No Comments
Overhead Power Lines	No	None
Antenna on Tank	No	None
Roof Accessible	Yes	No Comments

Interior Structural Characteristics

Item	Data	
Roof Structure	Rafters and Center Column	
Column Design	Pipe	
Upper Center Column	Dollar Plate	
Column Base Design	Free Plate with Clips	
Connections	Bolted	
Overflow Design	Funnel and Pipe Floor Exit	
Inlet Interior Design	Floor Stub	
Lining Type/Original	Epoxy	Yes

Item	Data			
Outlet Design	Floor Stub			
No. Interior Ladder	Yes	One		
CP System/Type	No	None		
Water Depth	21			
Water Agitator	No	None		
Barrier Walls	No			
No. of Columns	One Column			
Caulking	Roof	No	Columns	No

Exterior Structural Characteristics

Item	Data	
Capacity (gallons)	1,500,000	
Diameter (feet)	80	
Height (feet)	40	
Erection Year	Unknown	
Contract No.	Unknown	
Tank Type	Welded Steel	
Tank Profile	on grade	
Tank Geometry	Cylinder	
Number of Courses	Five	
Height of Each Course	8 Ft	
Roof Design	Pitched Roof with Nuckle	
No. Shell Manways	Two Shell Manways	
Type of Manways	Round	
Manway Cover Design	Bolted Circle	
Diameter of Manways	20 in	
No. Roof Hatches/Location	One	Near Edge
Hatch Design	Square Shoe Box	
Size of Roof Hatch	24 in	
No. Roof Vents/Location	One	Center
Roof Vent Design	Round Hood	
Construction Co.	Unknown	

Item	Data	
Center Roof Vent Size	24 in	
Roof Vent Sealed	Yes	Satisfactory
Roof Rail System	Yes	No Comments
Roof Rail Satisfactory	Yes	No Comments
Rail Location	Top of Ladder	
No. & Type Roof Access	One	Ladder
Exterior Vandal Deterrent	Yes	
Ext Ladder Satisfactory	One	Yes
Ext Ladder Fall Prevent	Yes	
Roof Tie-Off Present	Yes	
Tank Piping	Floor Inlet and Outlet	
Inlet Diameter	12 in	
Outlet Diameter	12 in	
Flexible Pipe Coupling	In Ground	
Overflow Pipe Diameter	12 in	
Overflow Exterior Design	12 in	
Drain Location	Floor	
Tank Foundation	Concrete Ring Wall	
Water Level Indicator	Yes	
Tank Type	Potable	
Lining Type/Original	Polyurethane	No

Miscellaneous Notes

EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection

EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -001

EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -002

EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -003

EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -004

EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -005

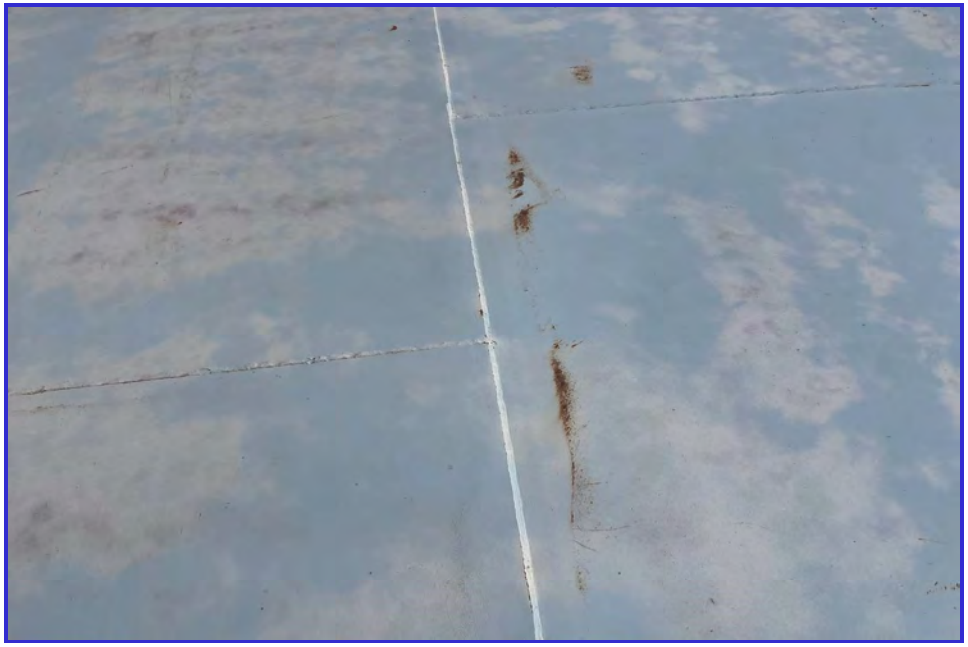
EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -006

EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -007

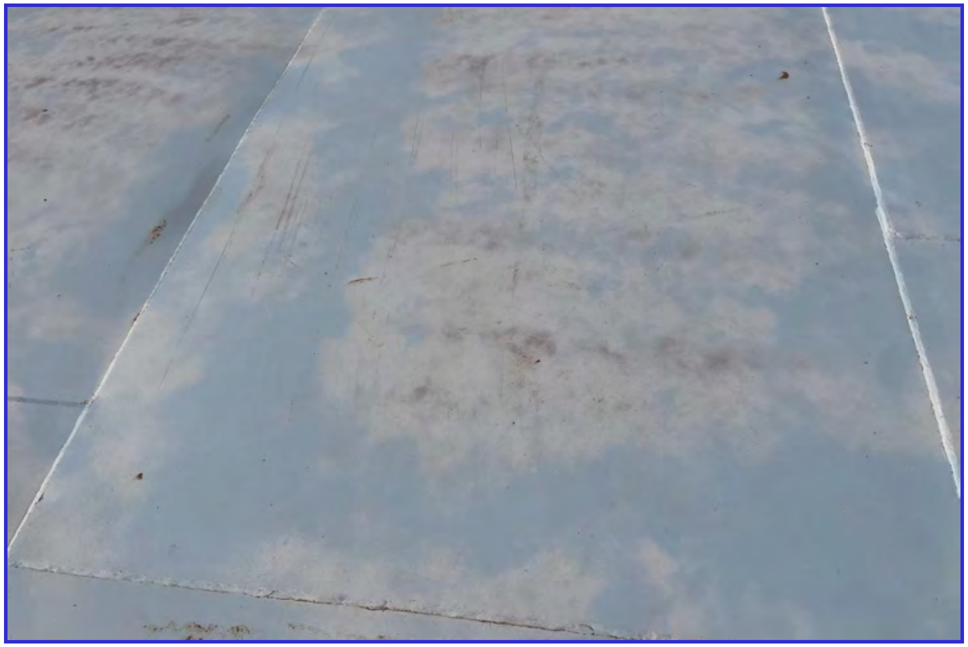
EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -008

EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -009

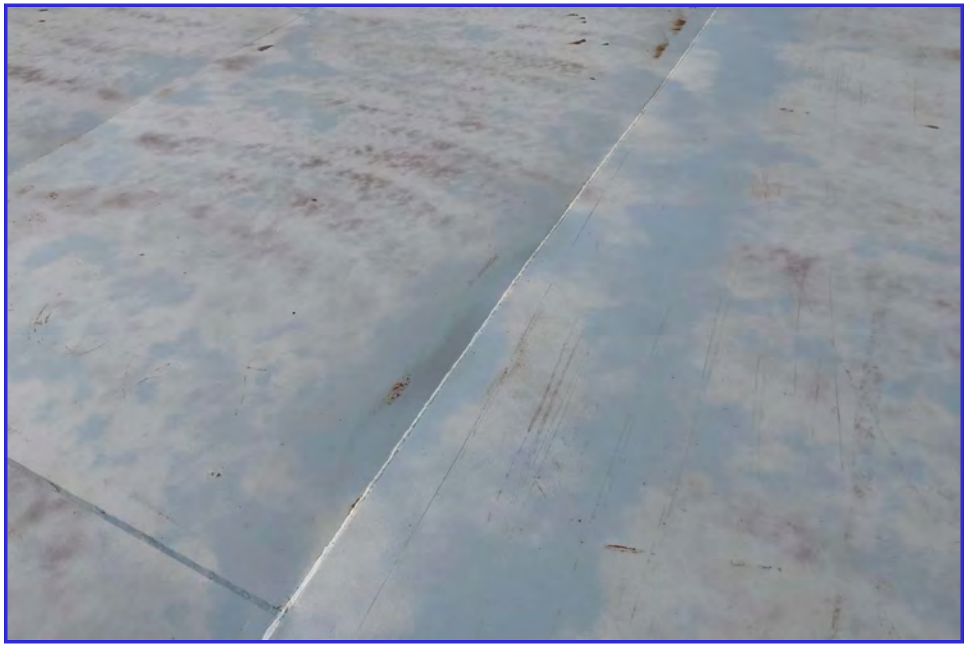
EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -010



EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -011



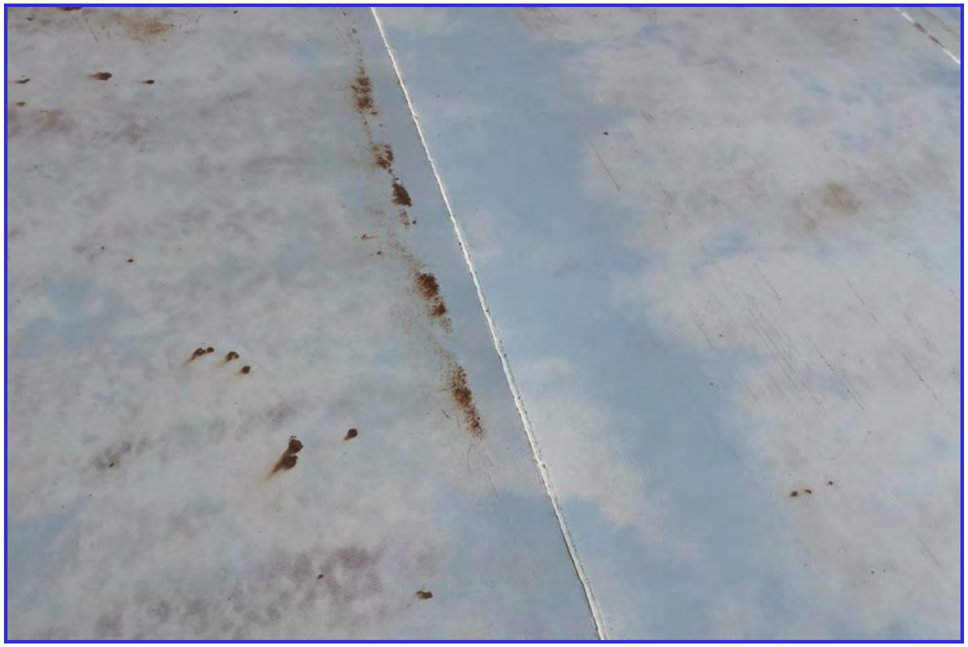
EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -012



EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -013

EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -014

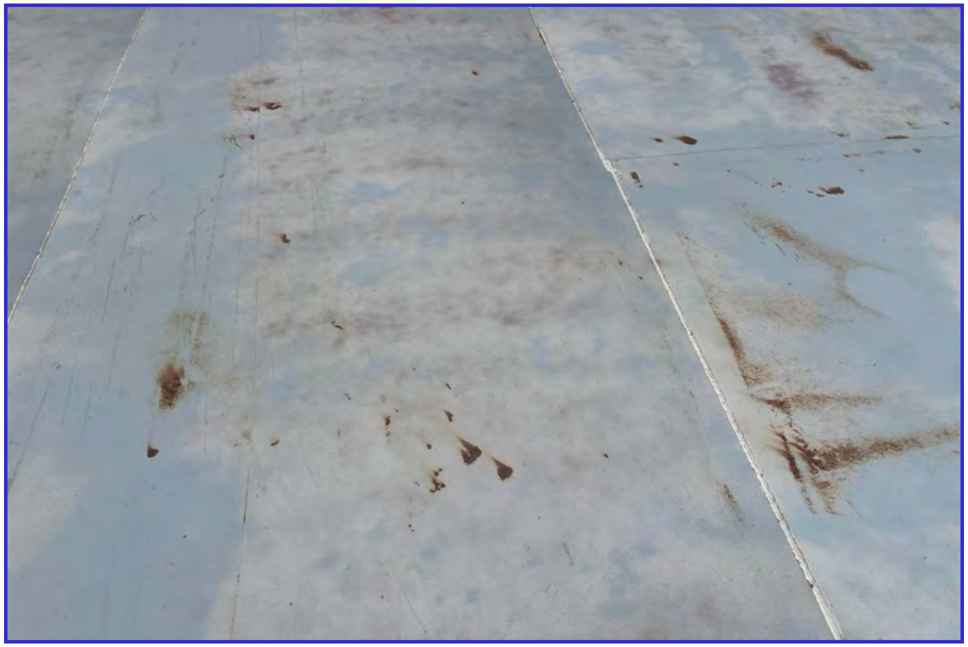
EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -015



EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -016

EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -017

EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -018



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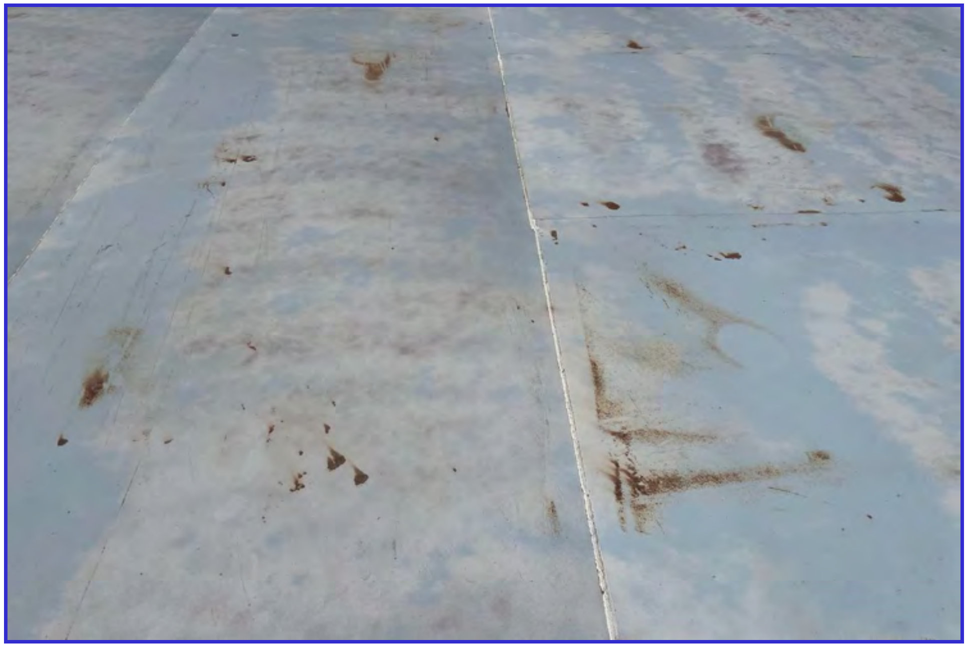
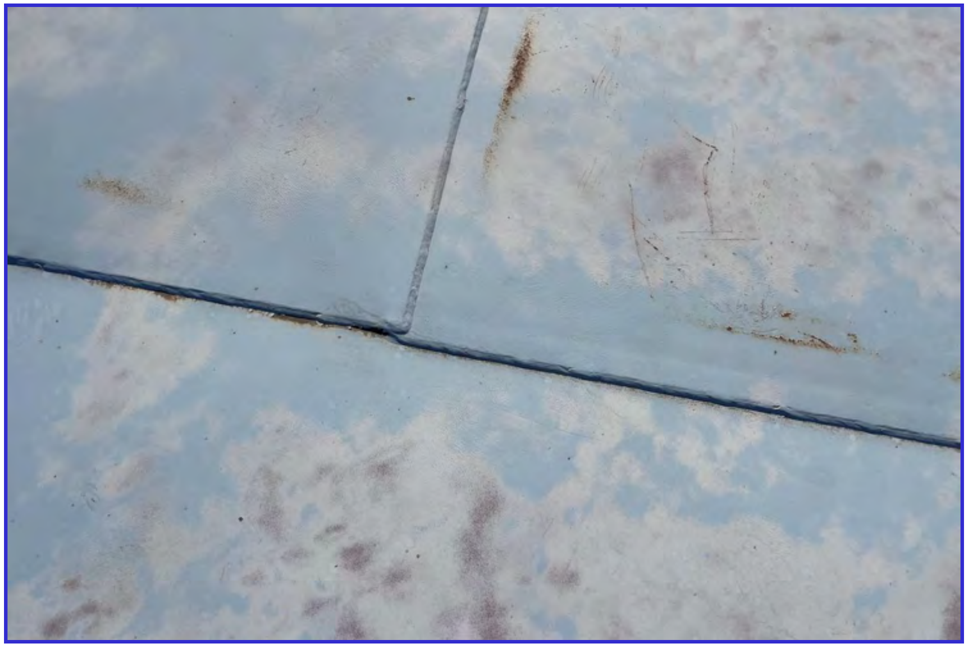


EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -020

EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -021

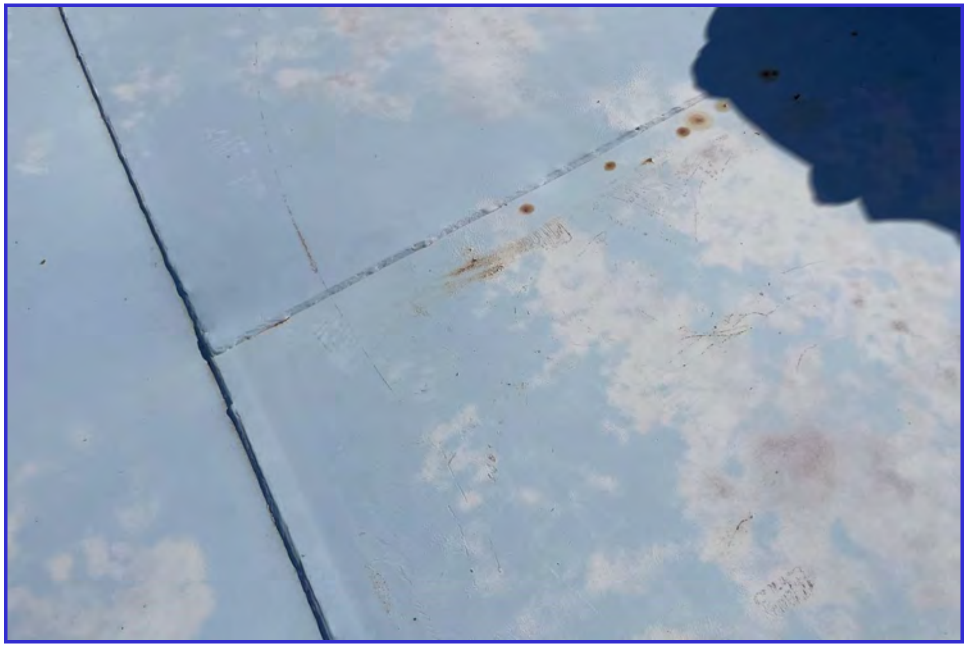
EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -022



EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -023

EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -024

EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -025

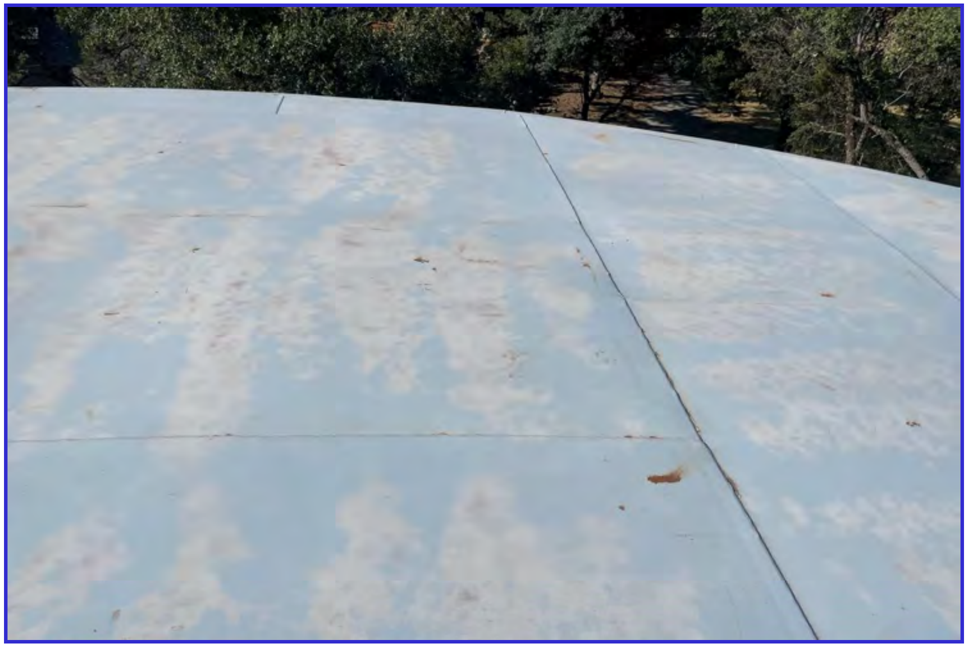


EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -026

EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -027

EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -028

EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -029



EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -030

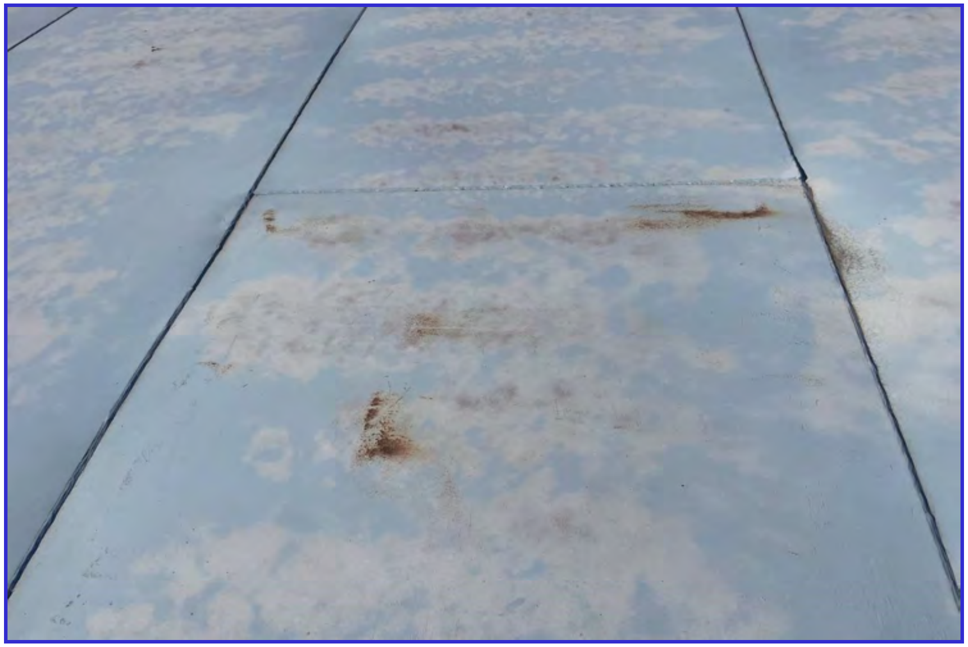
EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -031

EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -032

EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -033

EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -034

EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -035



EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -036

EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -037

EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -038

EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -039

EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -040

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EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -045

EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -046

EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -047

EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -048

EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -049

EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -050

EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -051

EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -052

EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -053

EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -054

EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -055

EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -056

EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -057

EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -058

EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -059

EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -060

EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -061

EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -062

EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -063

EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -064

EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -065

EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -066

EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -067

EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -068

EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -069

EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -070

EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -071

EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -072

EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -073

EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -074

EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -075

EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -076

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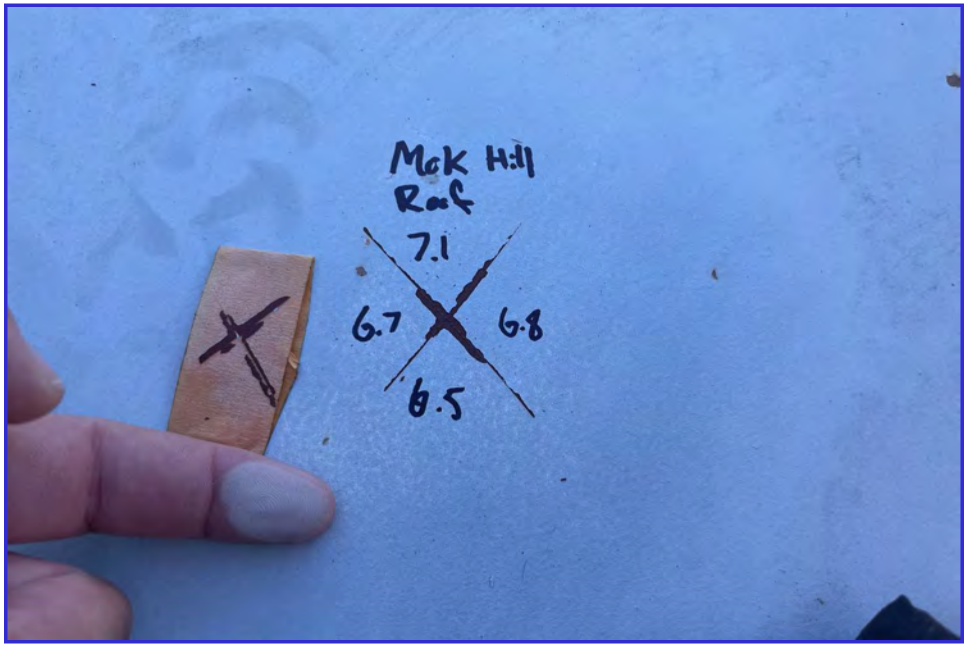
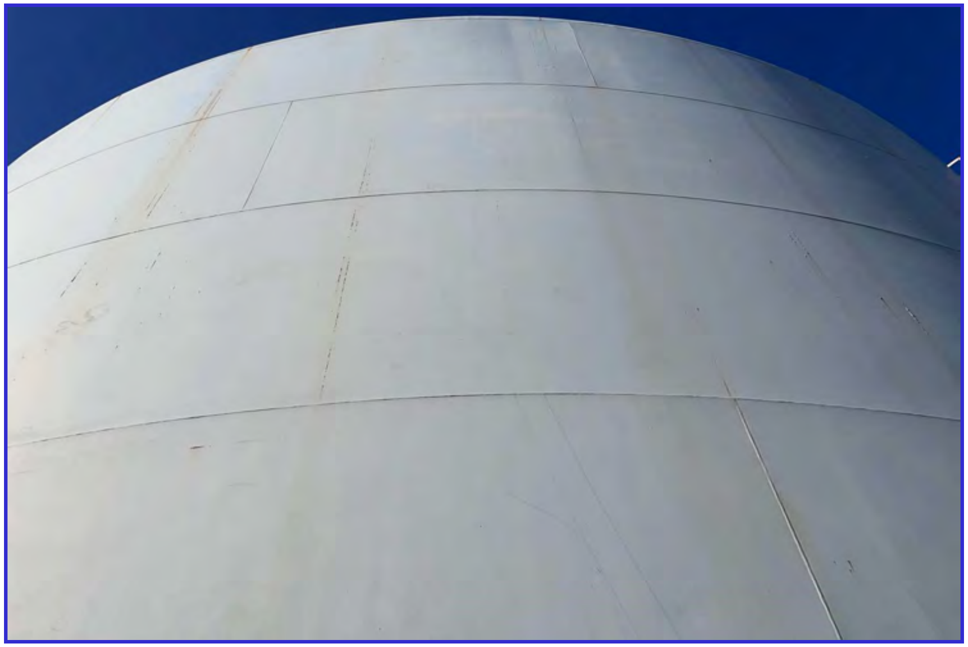


EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -079

EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -080

EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -081

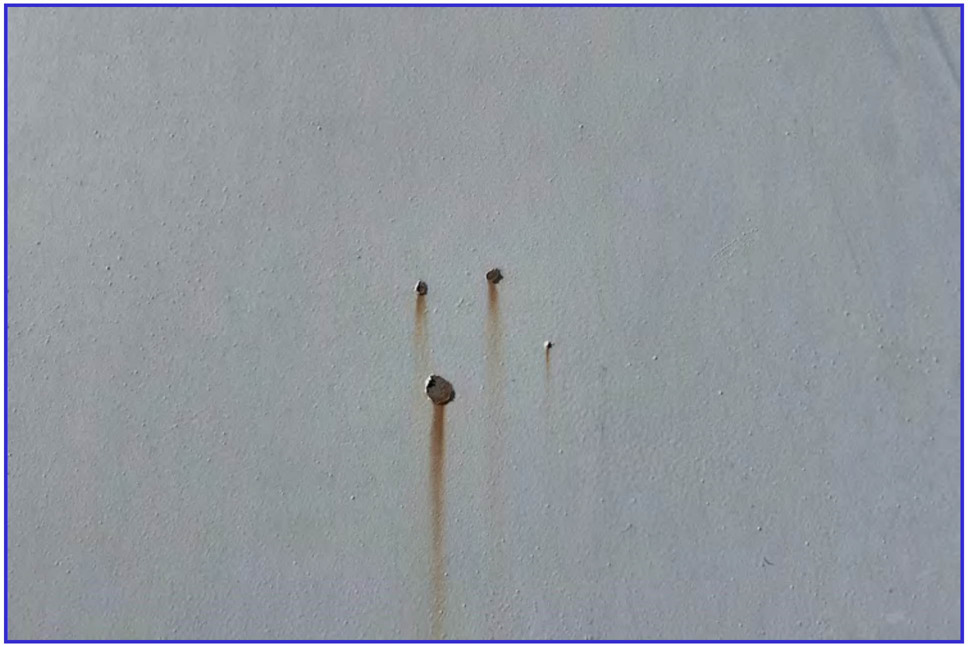
EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -082



EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -083

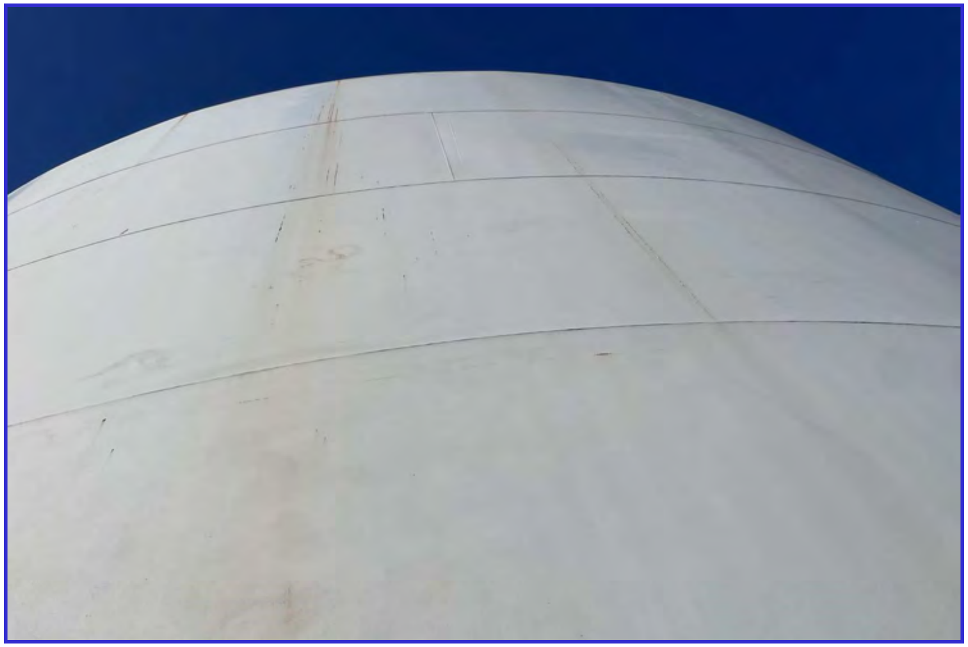
EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -084

EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -085



EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -086

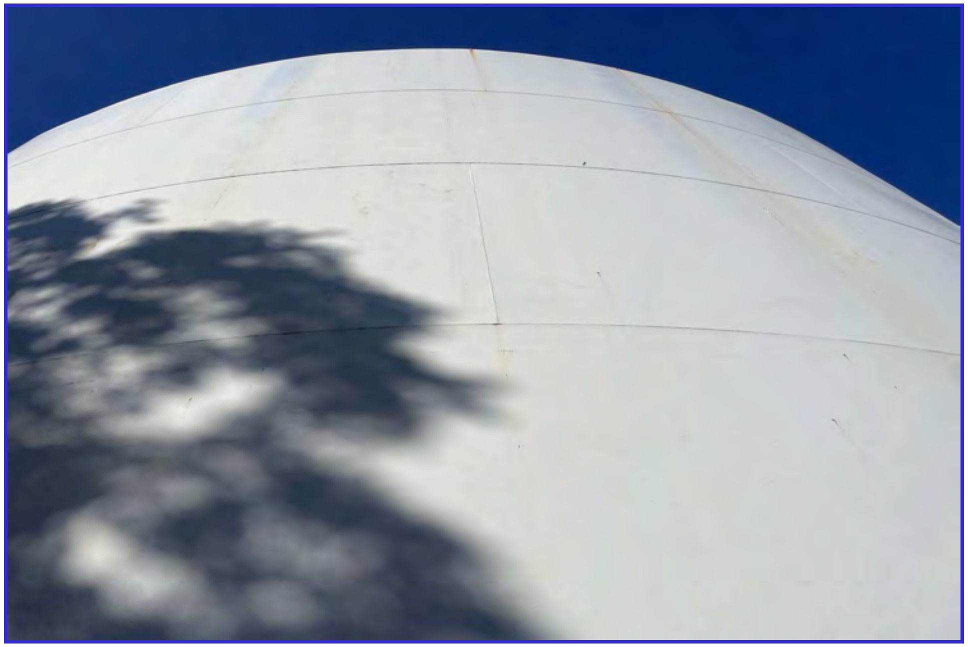
EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -087



EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -088

EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -089

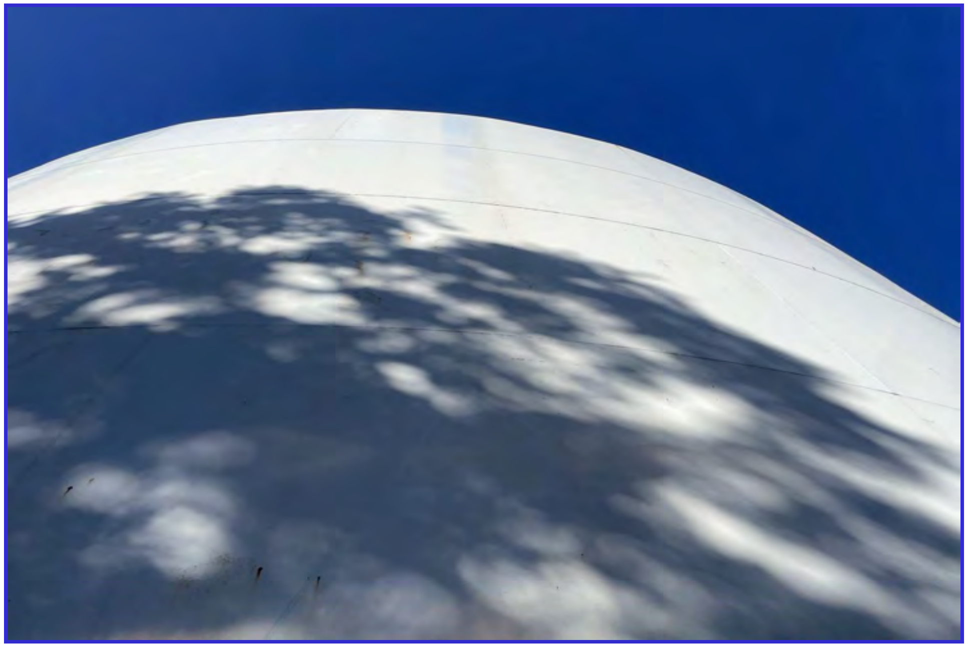
EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -090



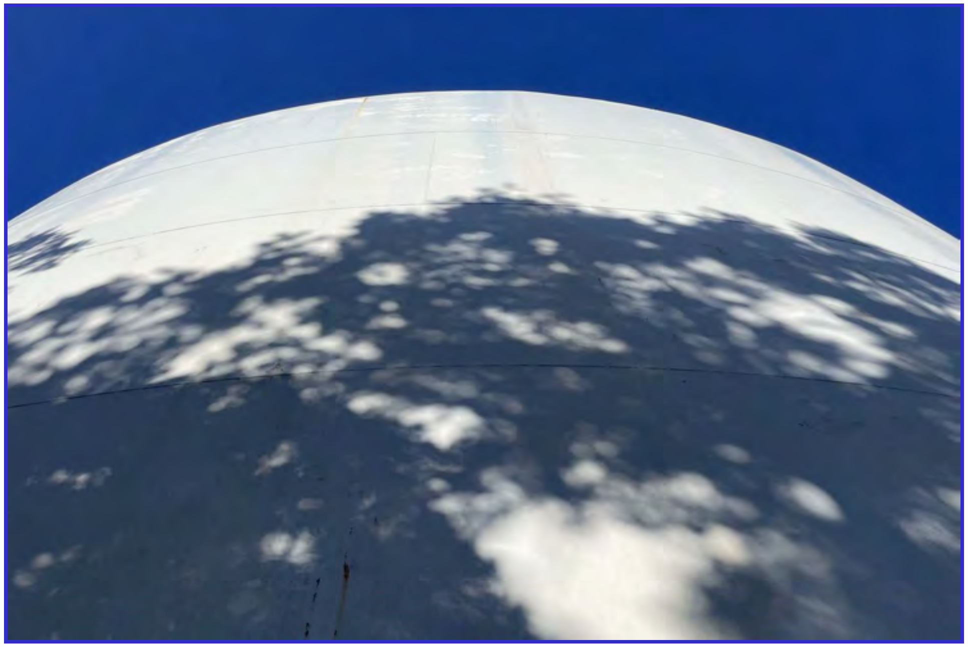
EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -091

EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -092

EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -093



EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -094



EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -095

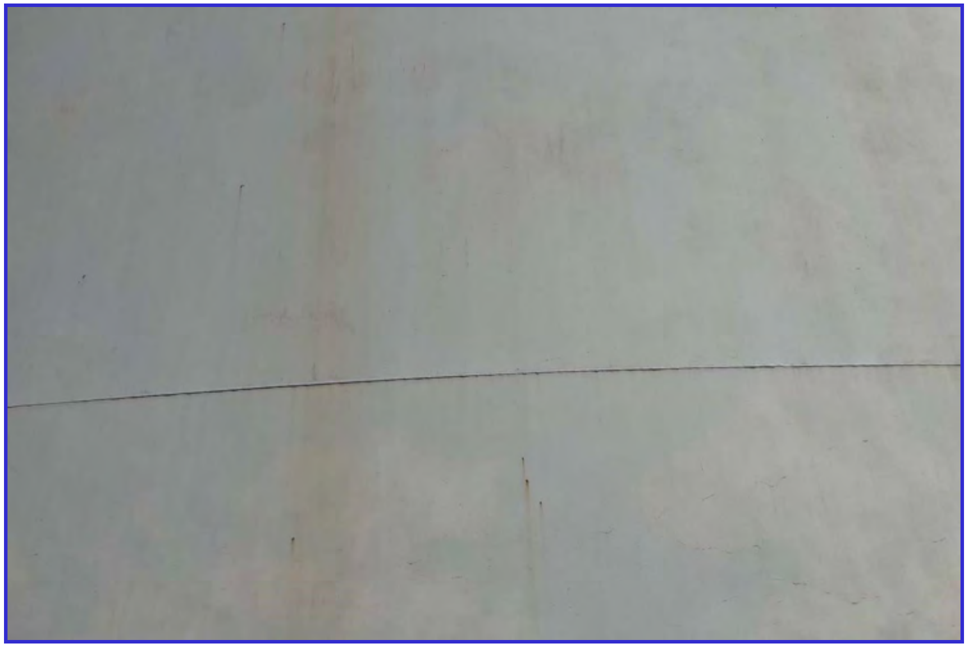
EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -096

EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -097

EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -098

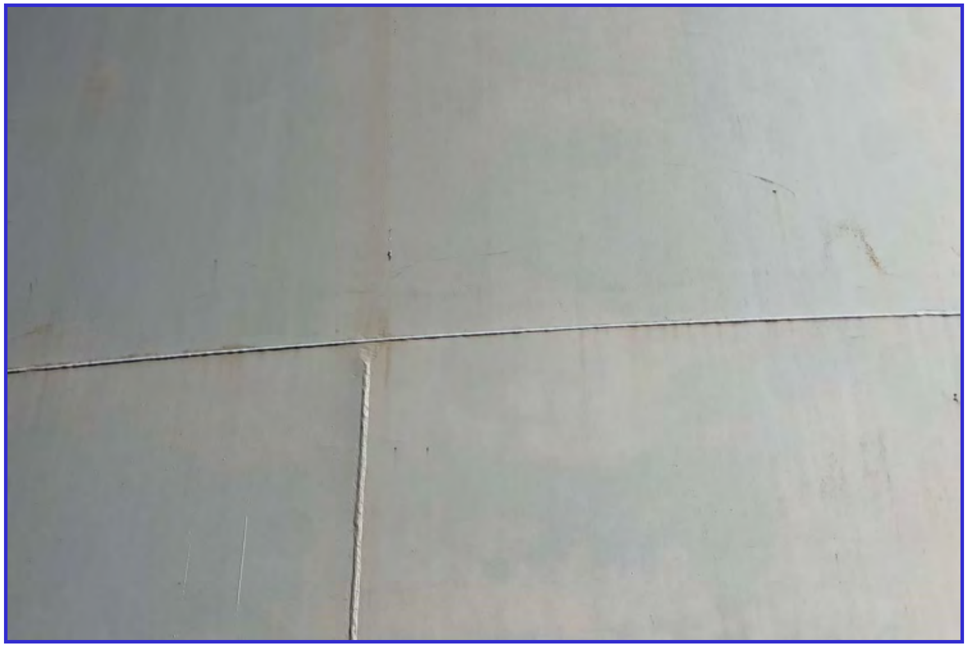
EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -099

EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -100



EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -101

EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -102

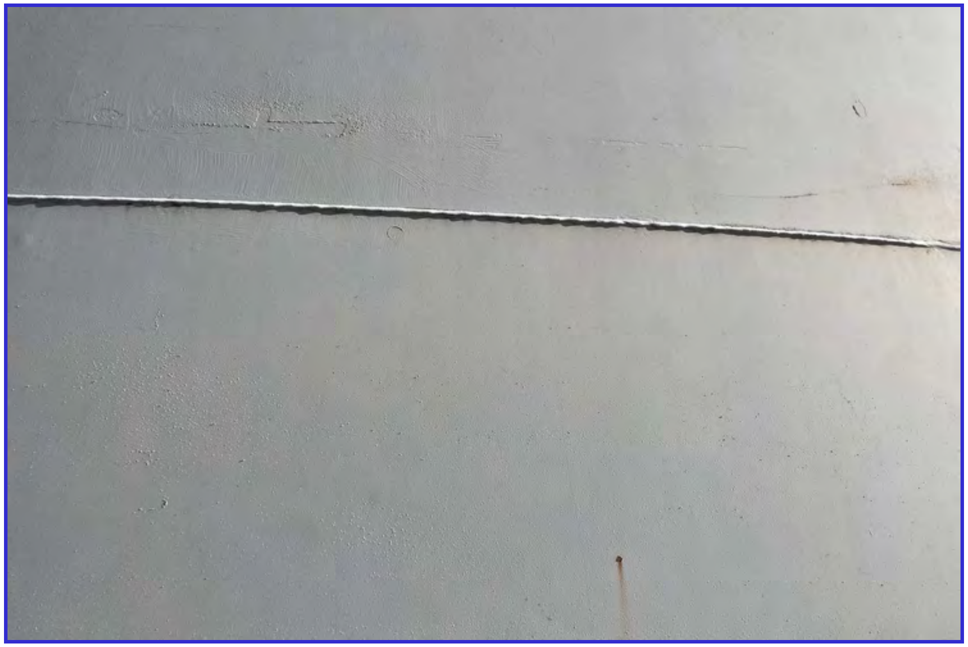


EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -103

EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -104

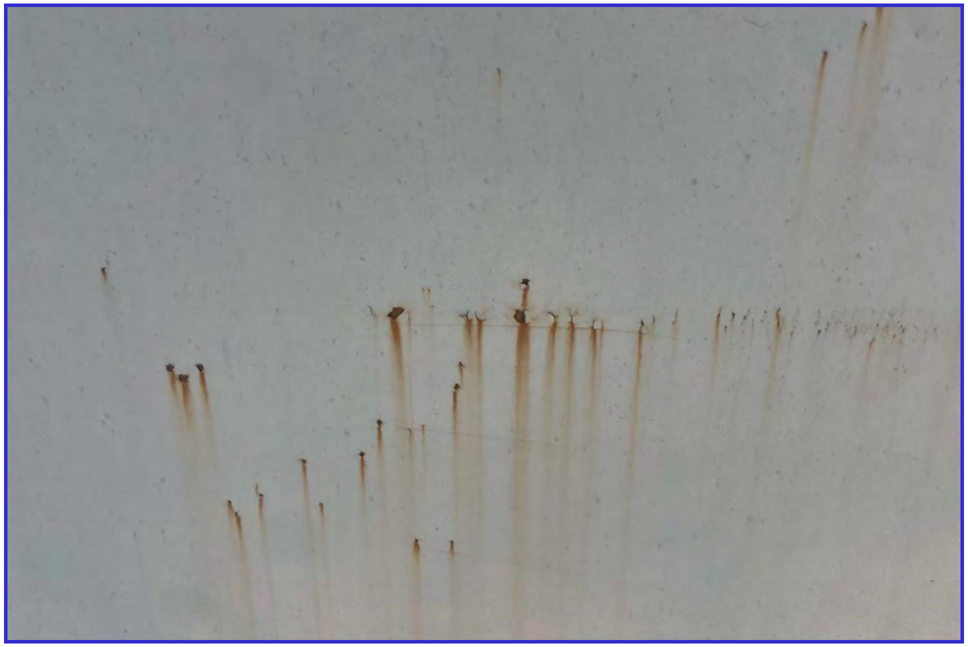
EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -105

EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -106



EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -107

EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -108



EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -109

EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -110

EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -111

EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -112

EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -113

EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -114

EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -115


EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -116


EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -117


EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -118


EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -119


EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -120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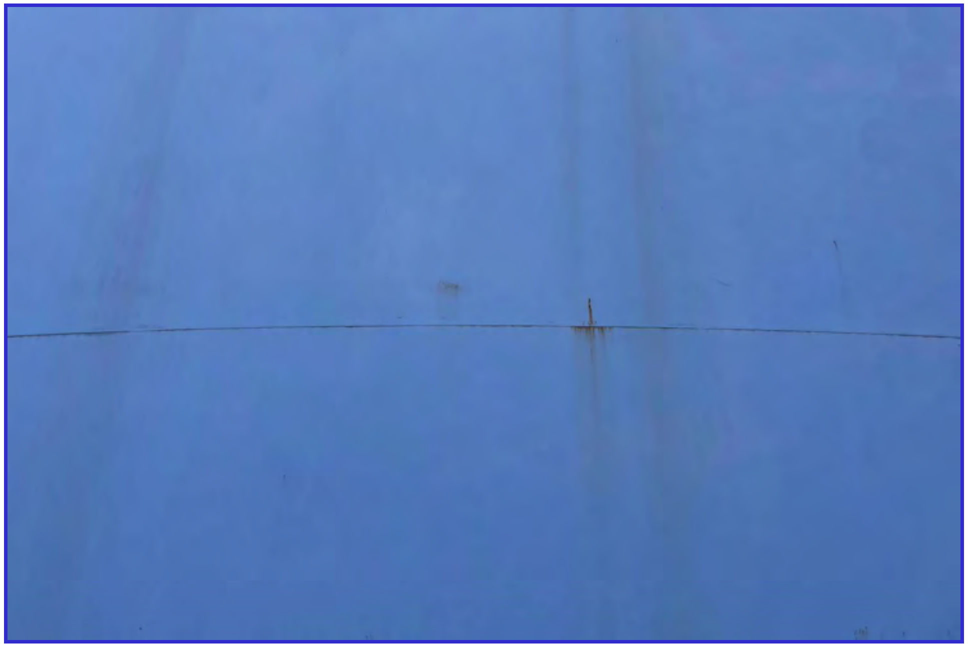
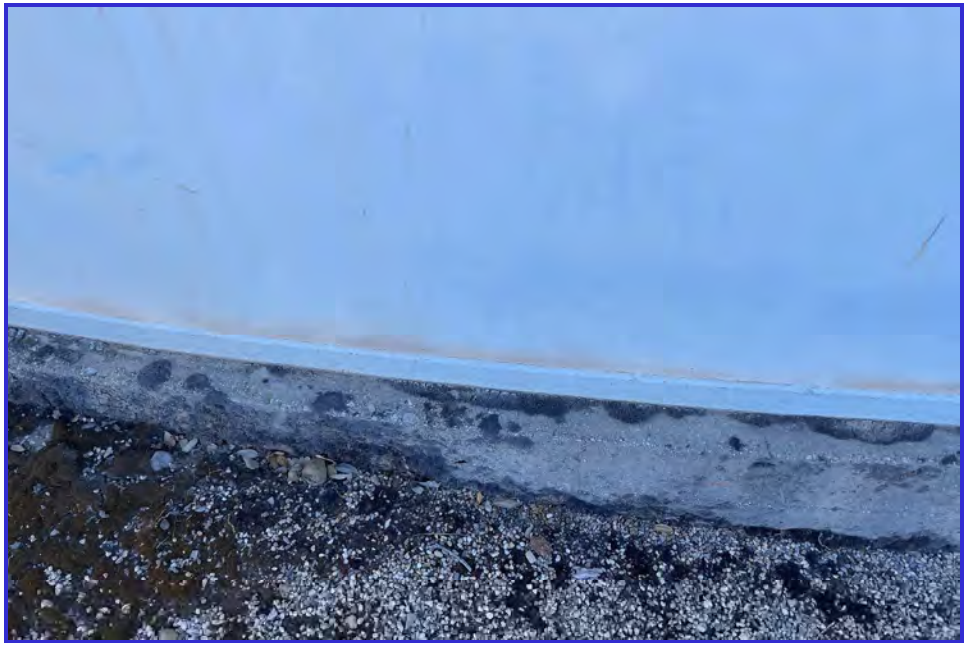
EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -122


EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -123

EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -124

EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -125



EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -126

EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -127

EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -128

EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -129

EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -130

EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -131

EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -132

EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -133

EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -134

EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -135

EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -136

EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -137

EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -138

EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -139

EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -140

EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -141

EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -142

EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -143

EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -144

EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -145

EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -146

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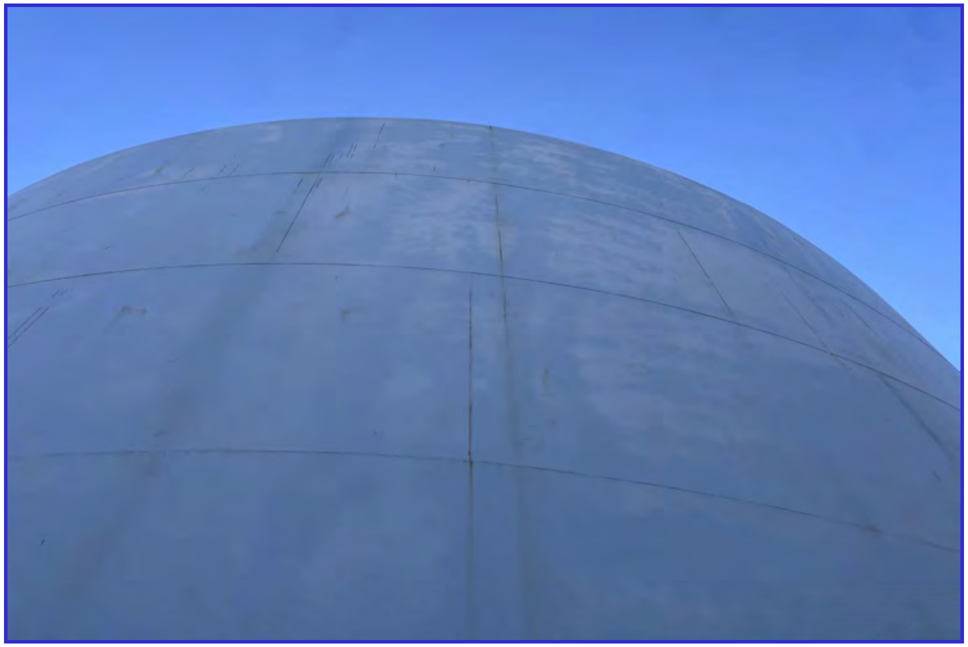
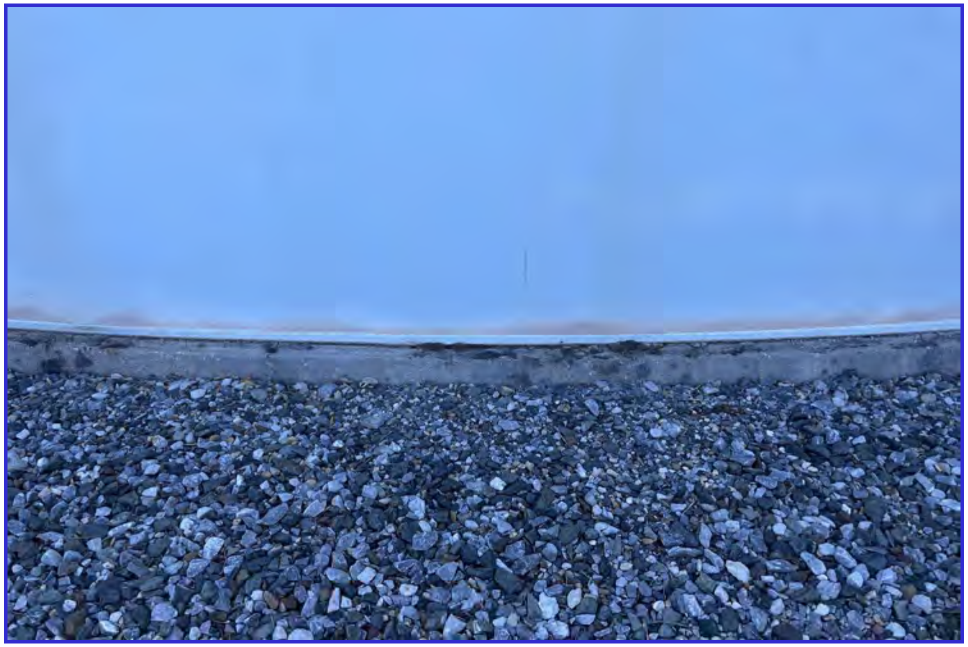
EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -148



EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -149

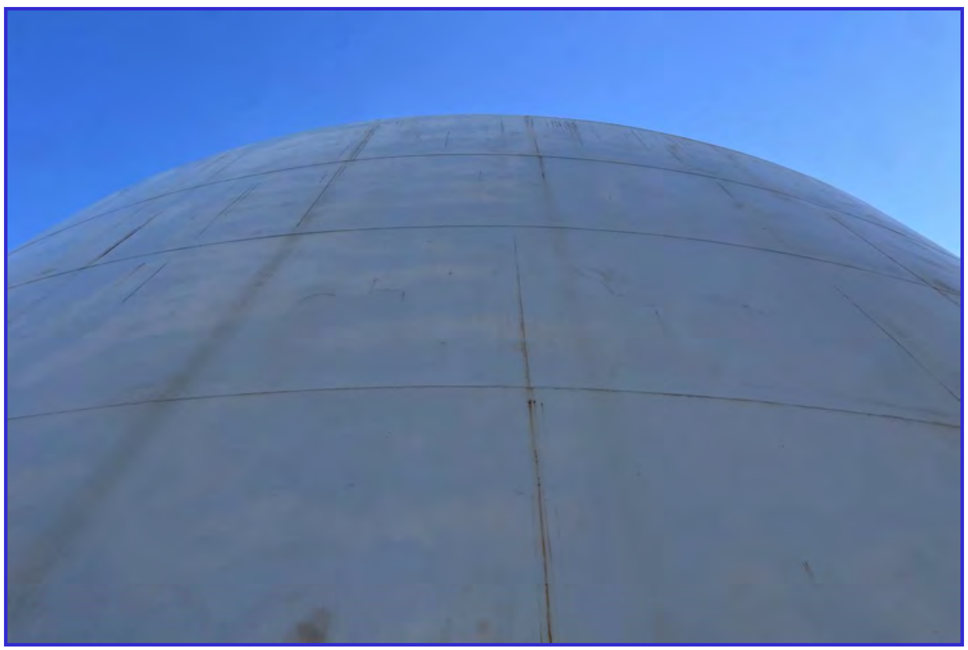


EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -150

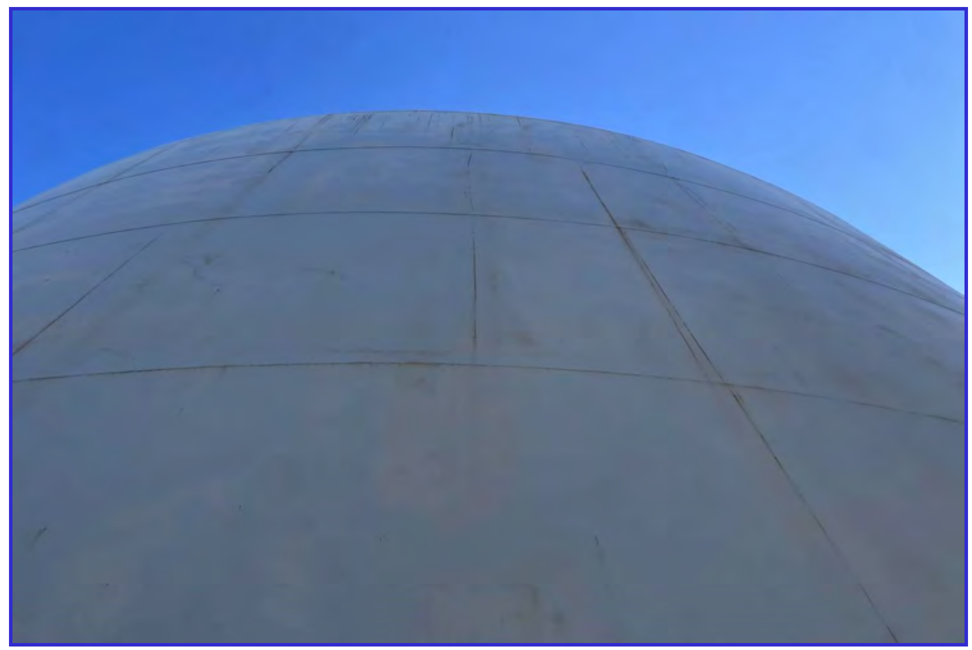
EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -151

EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -152

EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -153



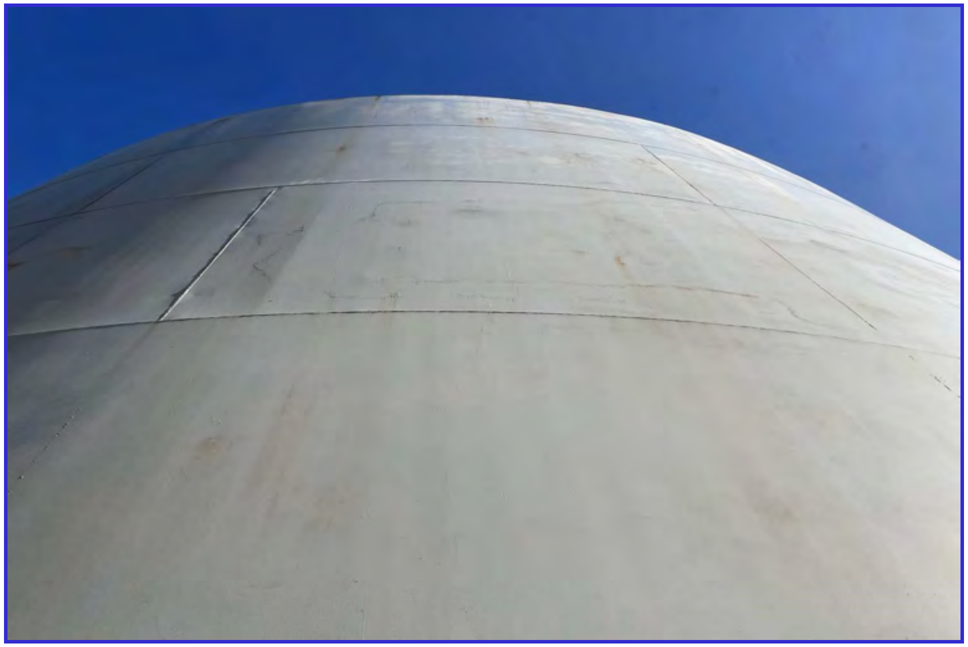
EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -154



EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -155

EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -156

EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -157

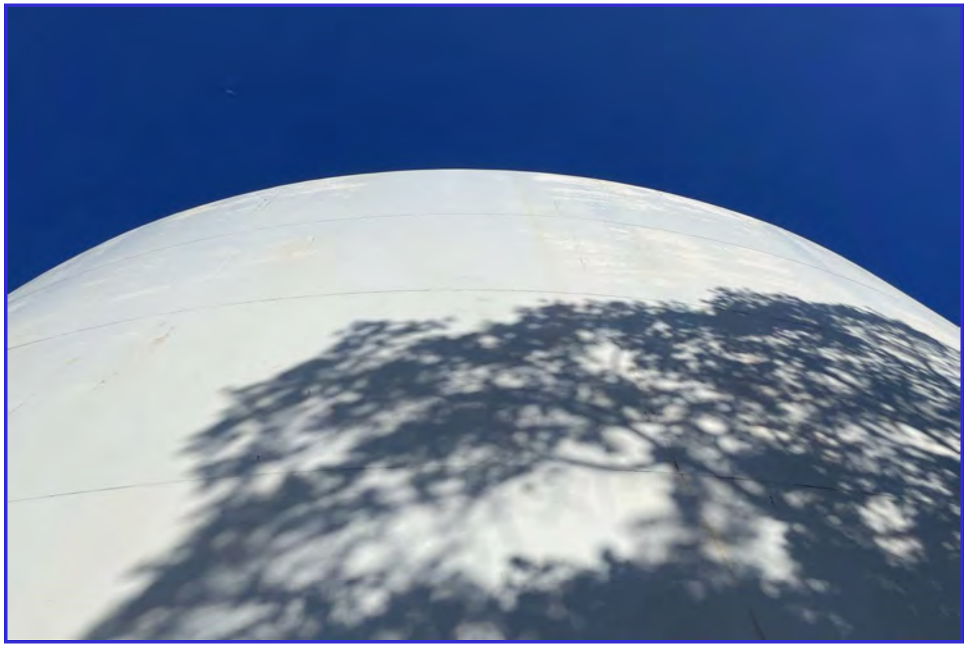


EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -158

EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -159

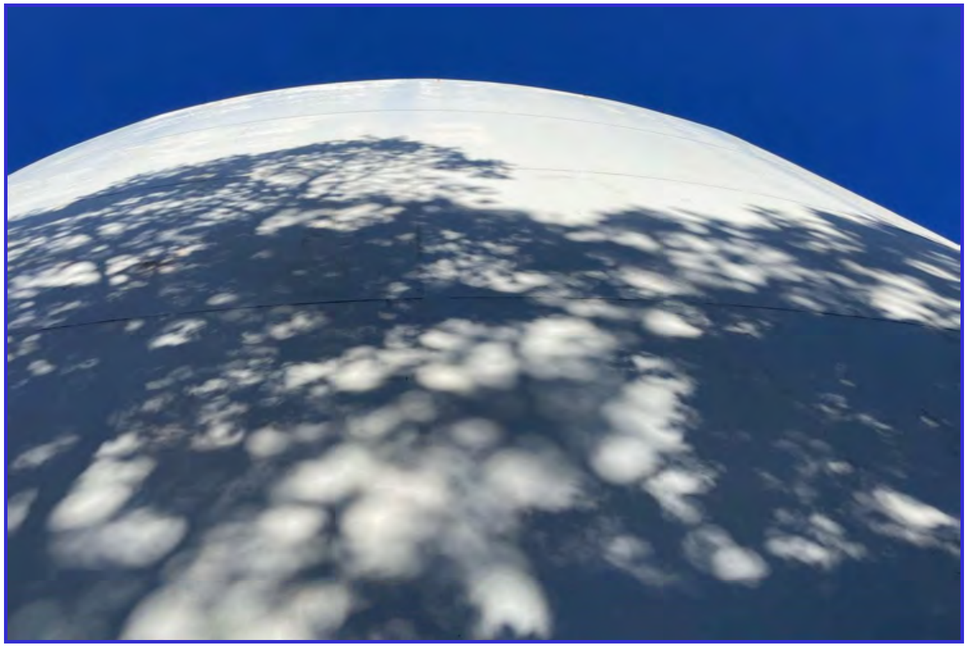
EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -160

EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -161



EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -162

EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -163



EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -164

EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -165

EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -166

EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -167

EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -168

EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -169

EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -170

EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -171

EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -172

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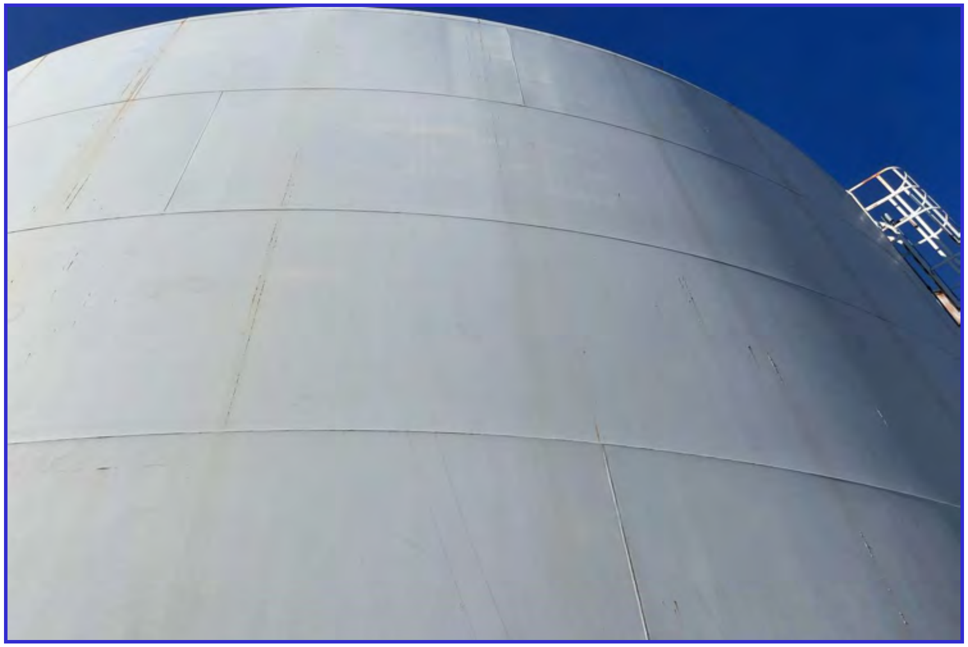
EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -174

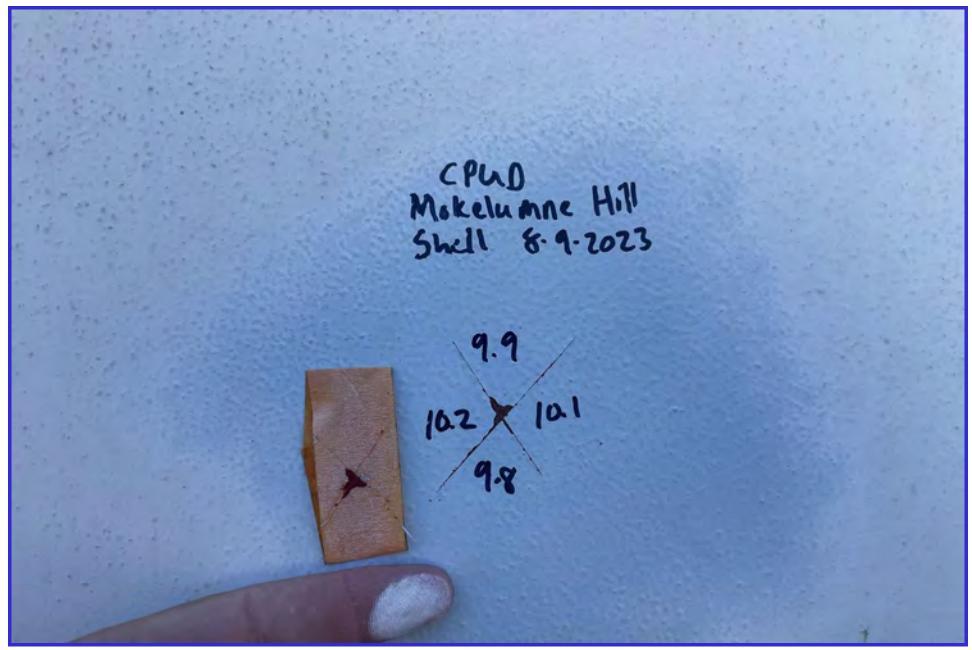


EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -175

EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -176

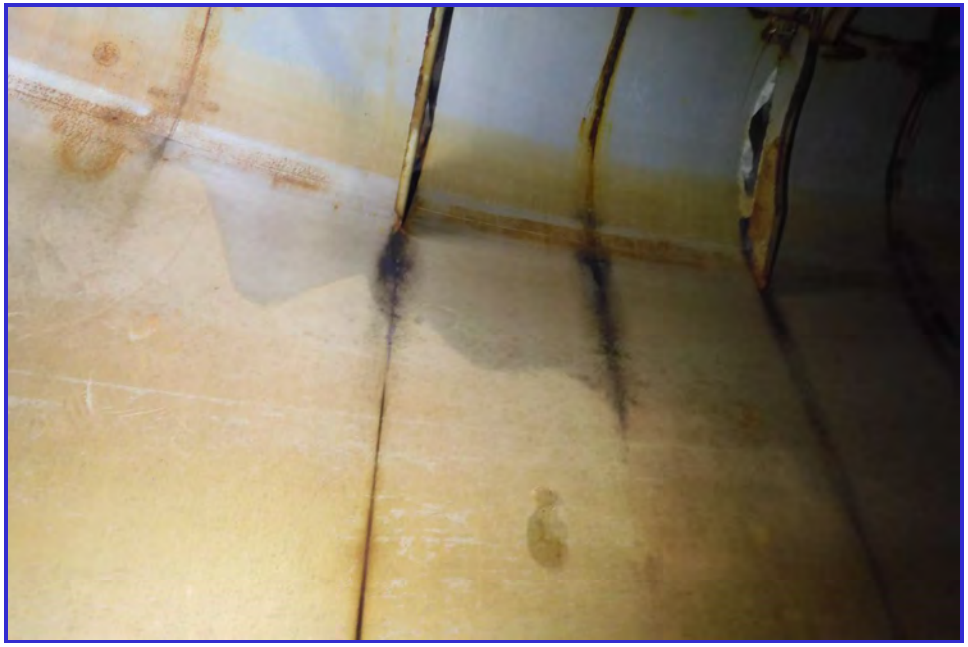
EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -177

EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -178

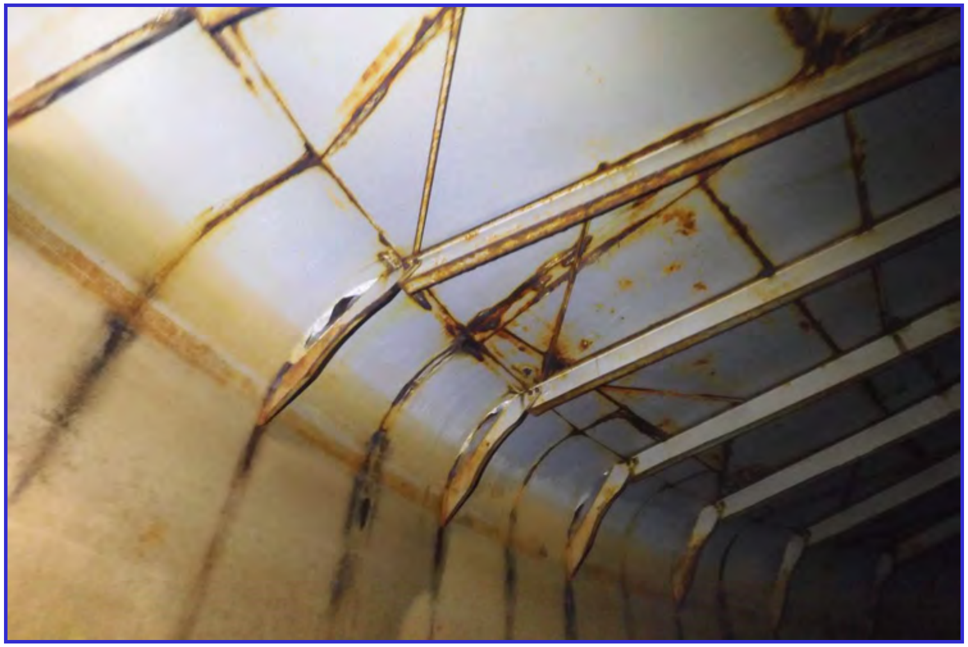


EXTERIOR - CPUD - Mokelumne Reservoir - Maintenance Inspection -179

INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection



INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -001



INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -002

INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -003

INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -004

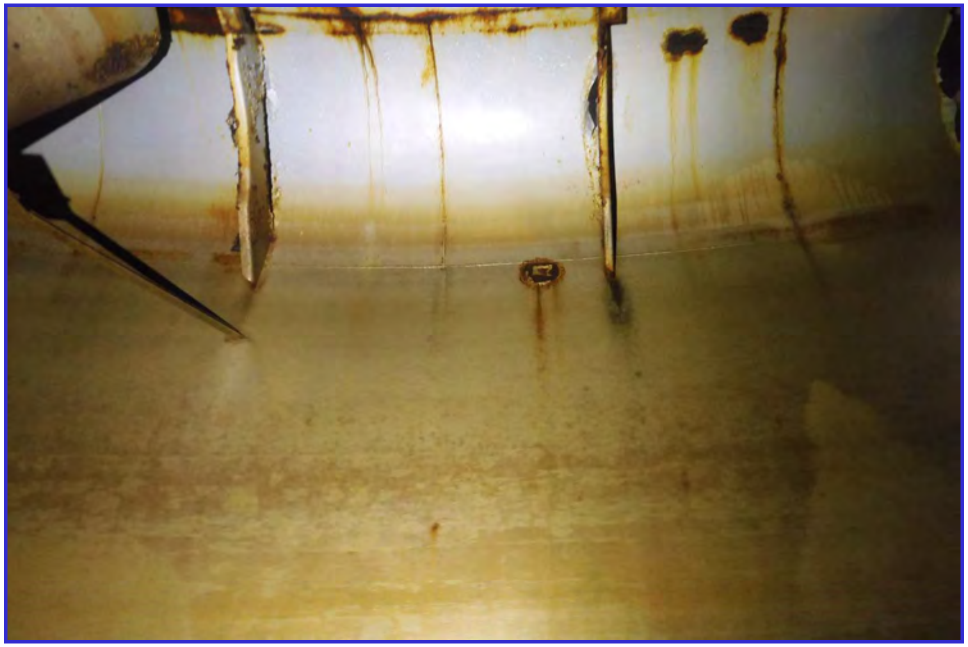
INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -005

INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -006

INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -007

INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -008

INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -009

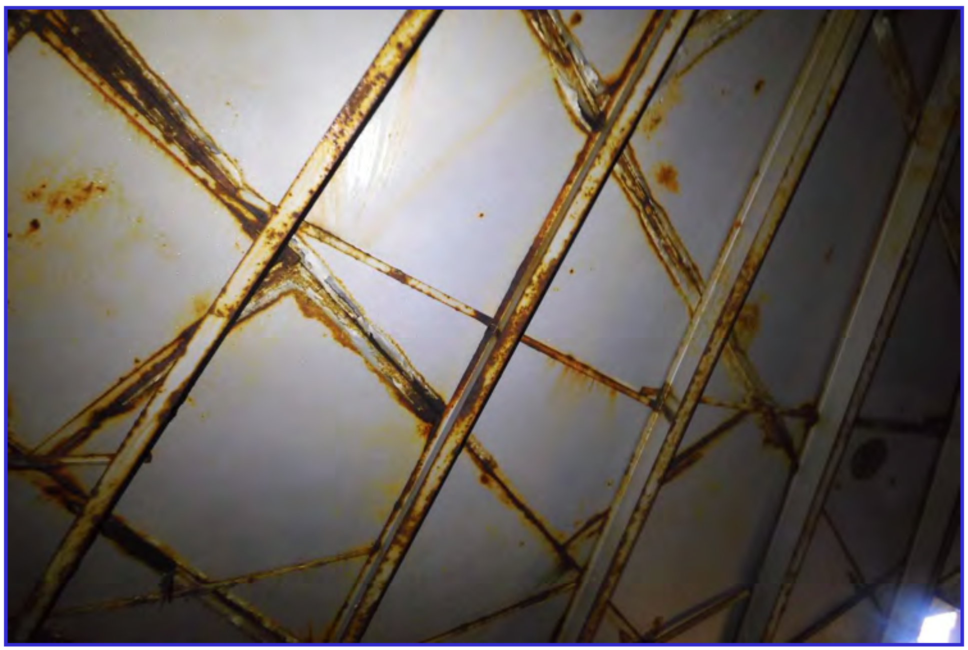


INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -010

INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -011

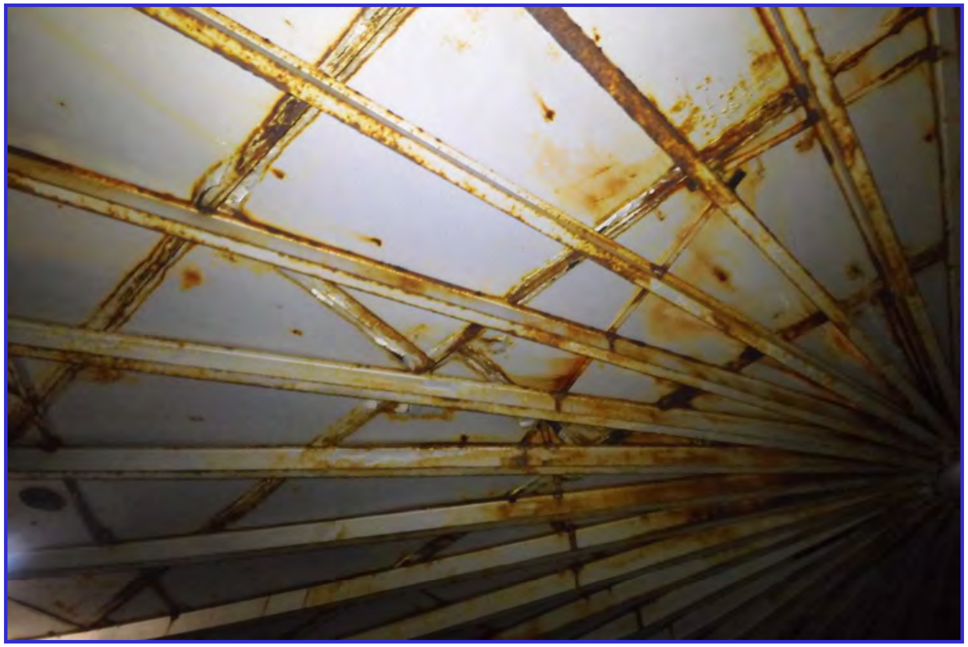
INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -012

INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -013



INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -014

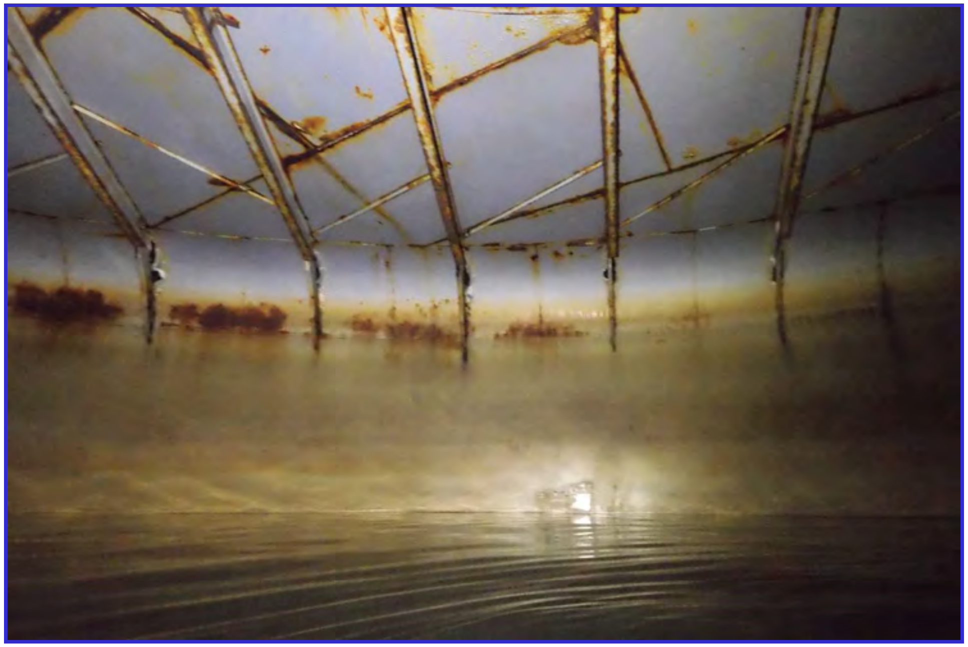
INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -015



INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -016

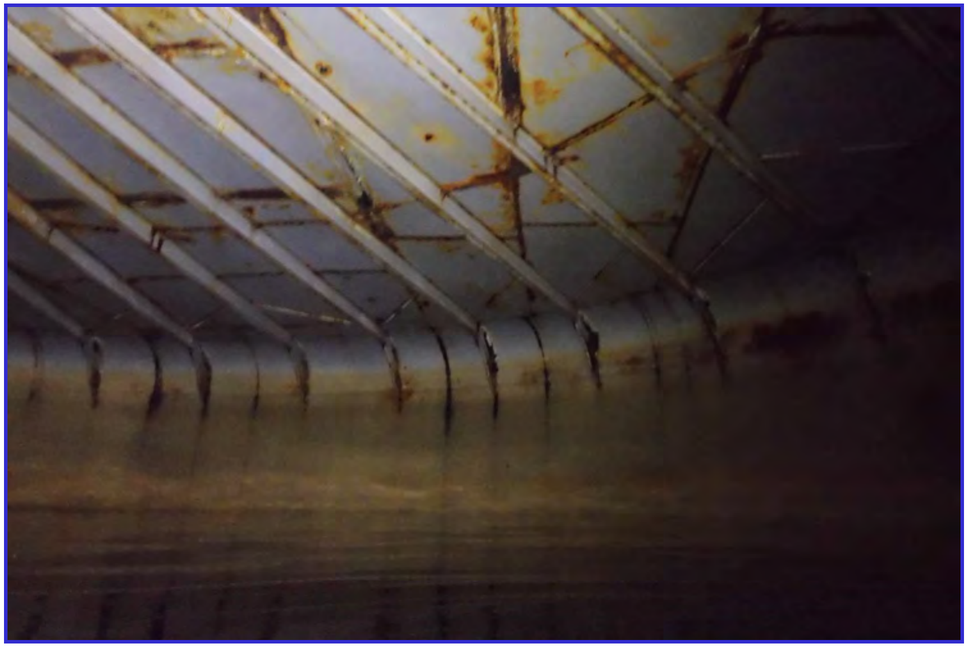
INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -017

INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -018

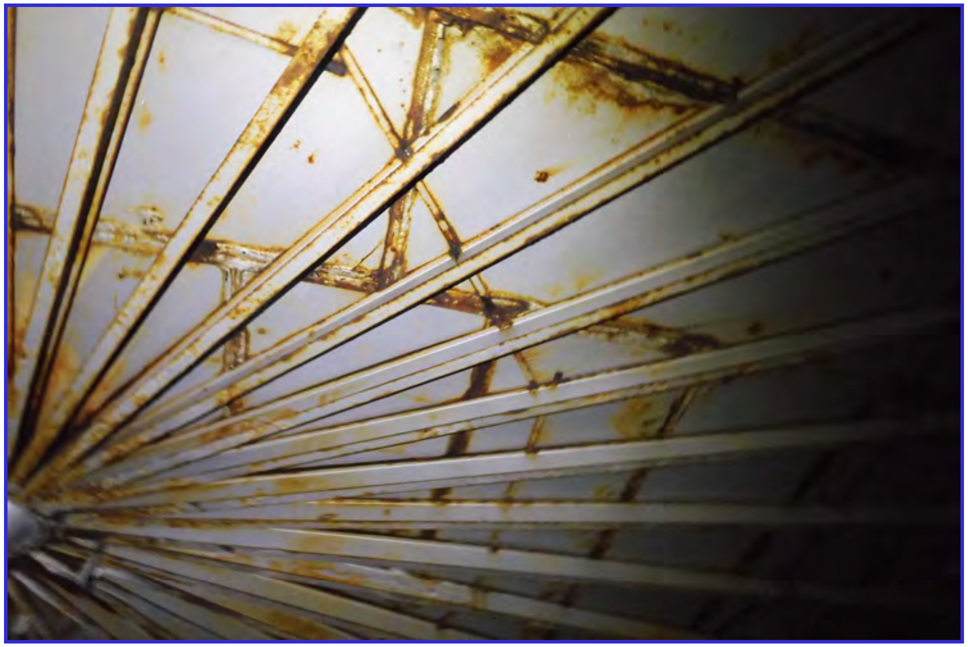


INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -019

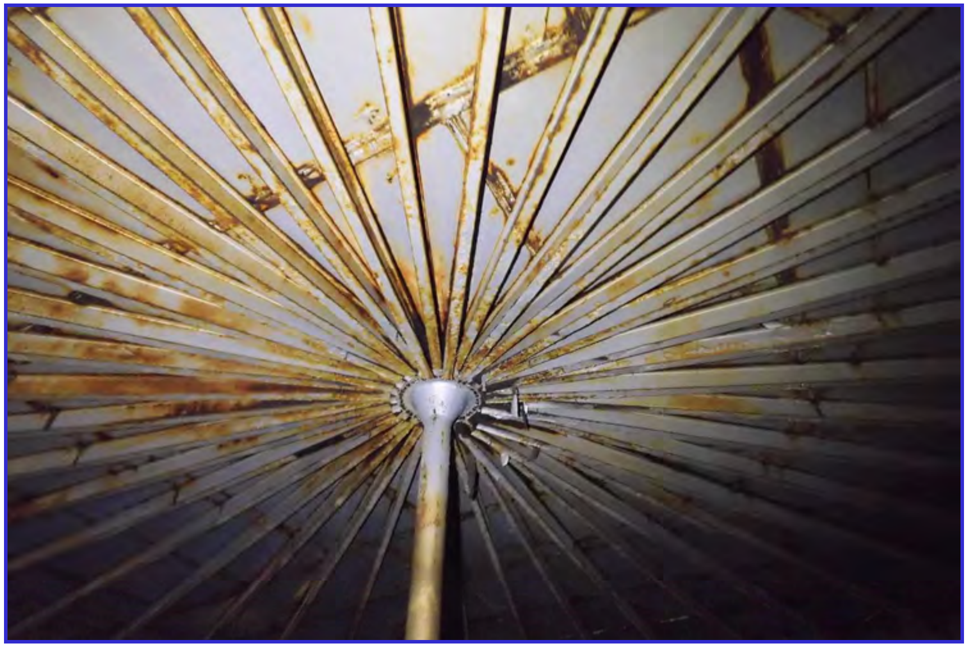
INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -020



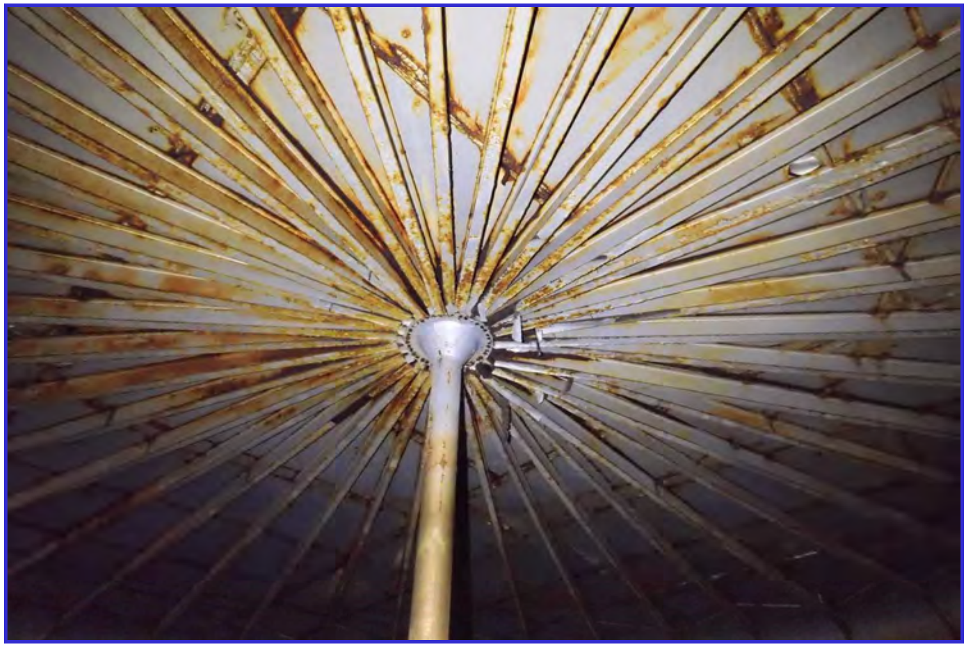
INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -021



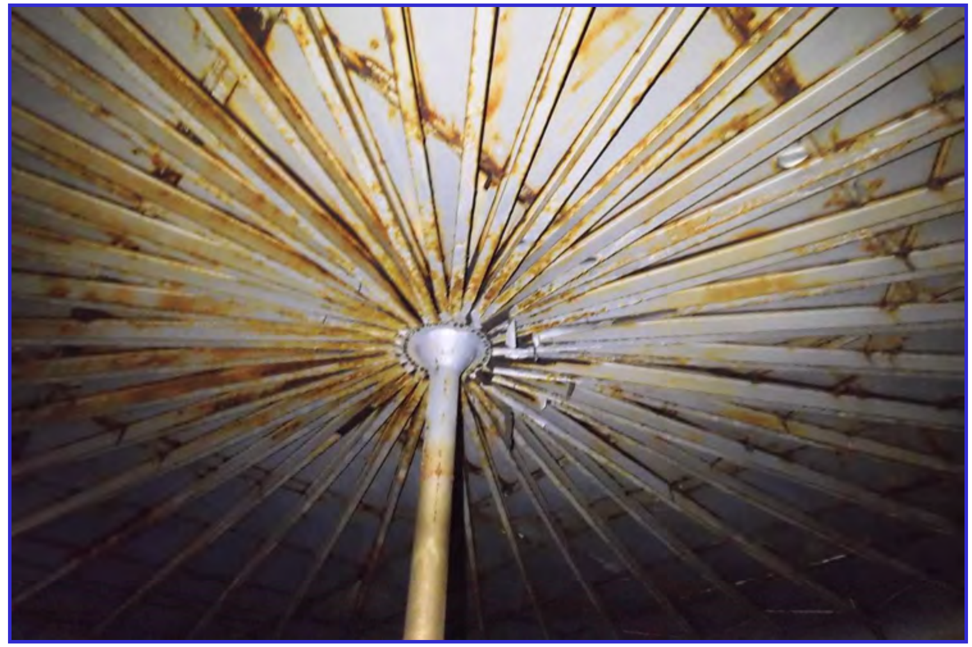
INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -022



INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -023

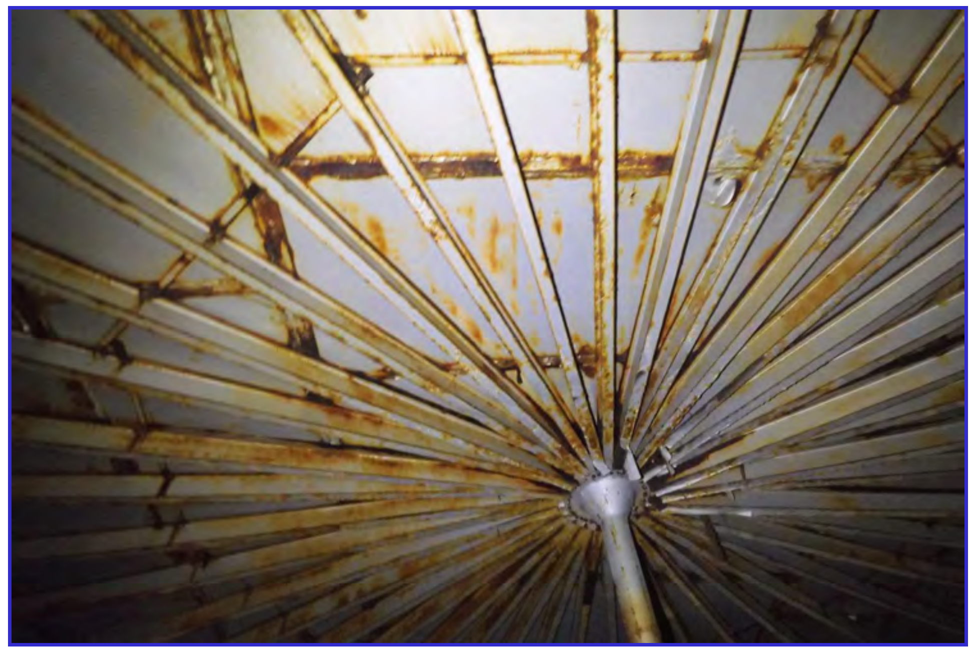


INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -024

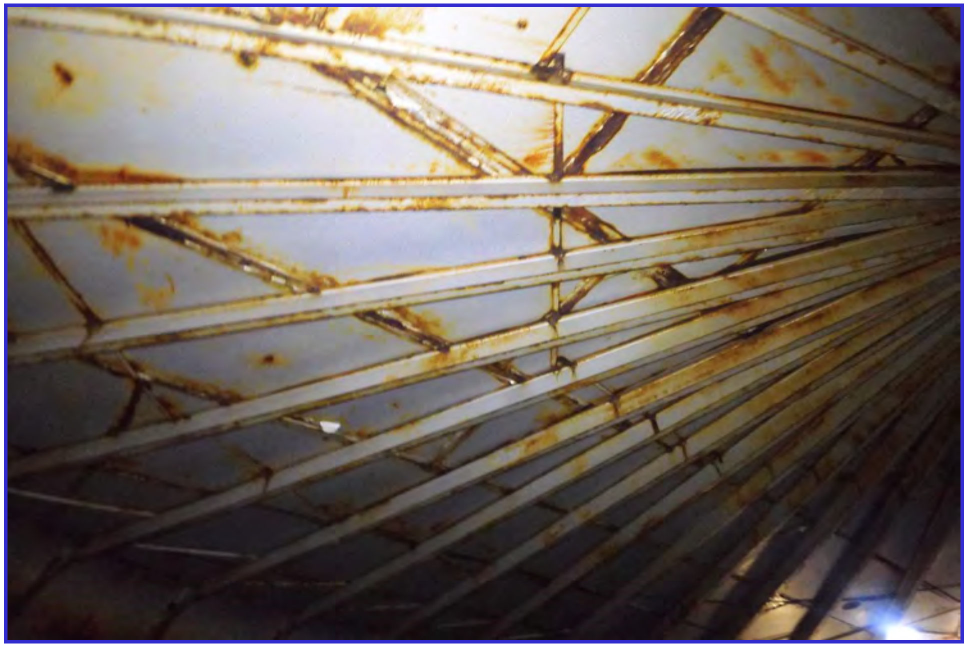


INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -025

INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -026

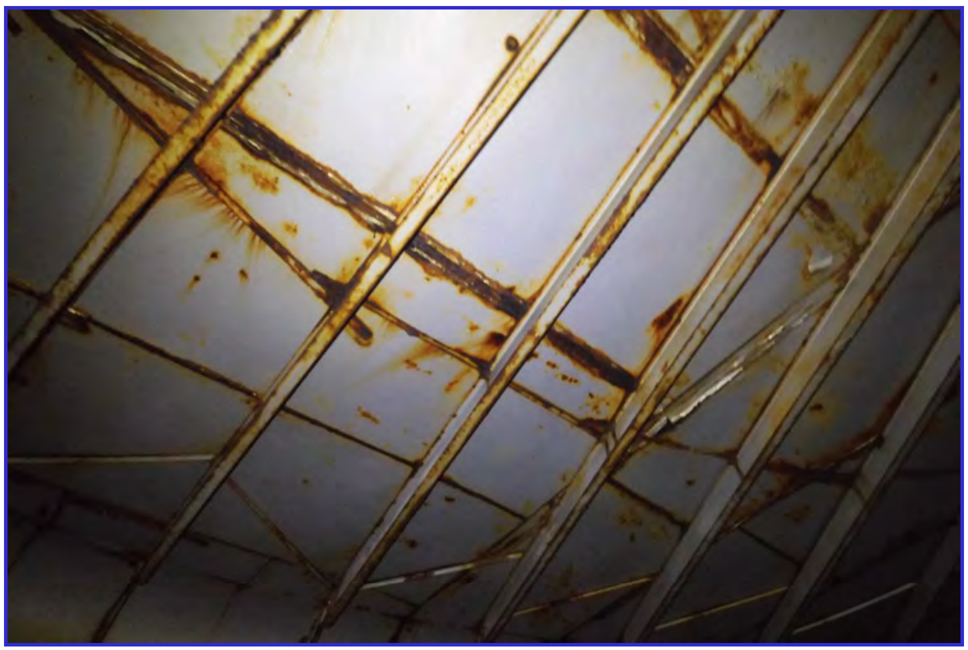


INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -027

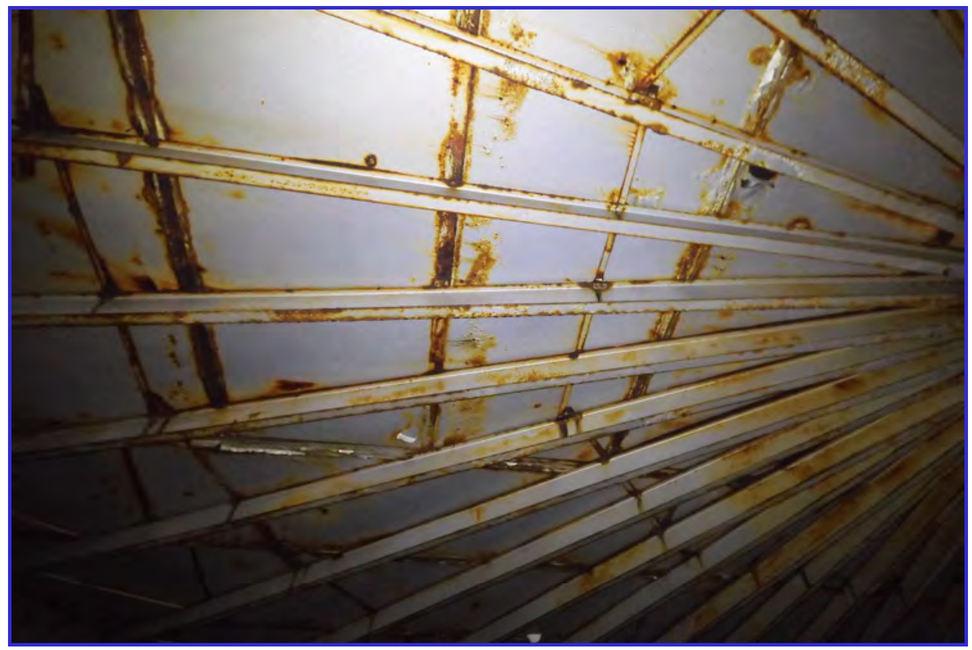


INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -028

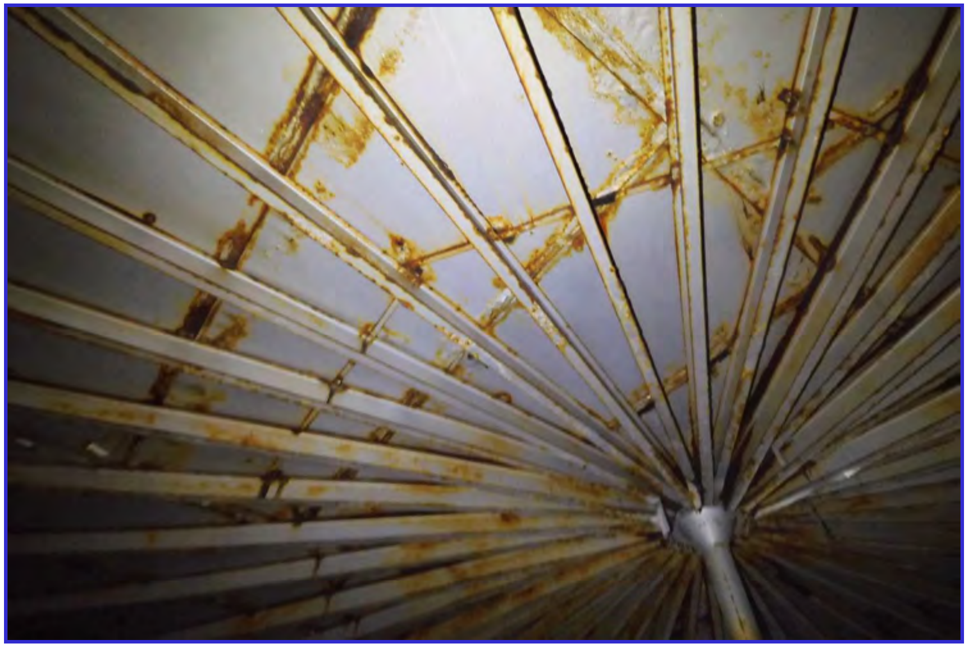
INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -029



INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -030

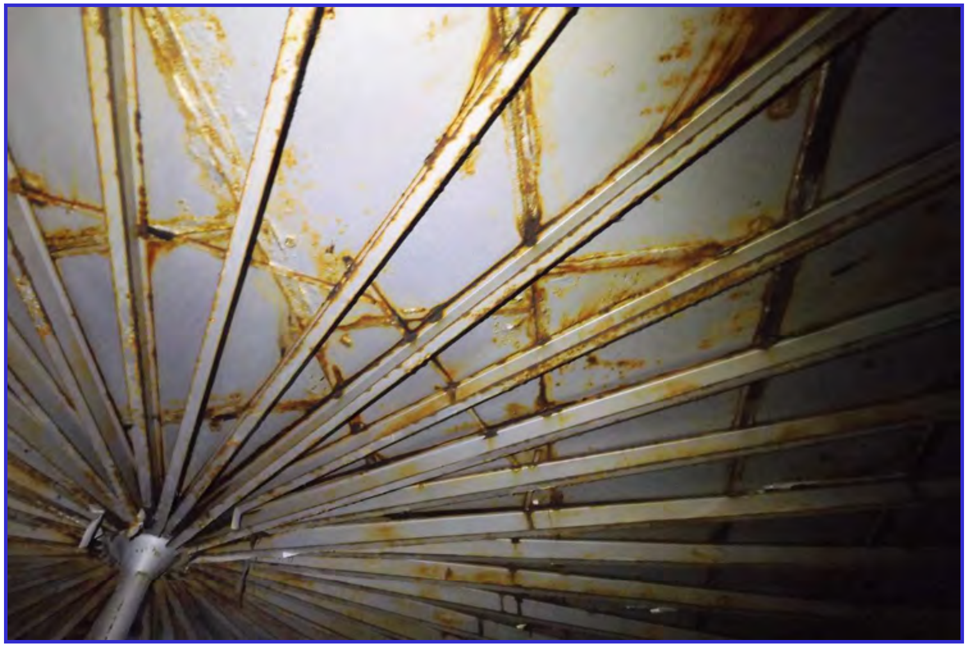


INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -031

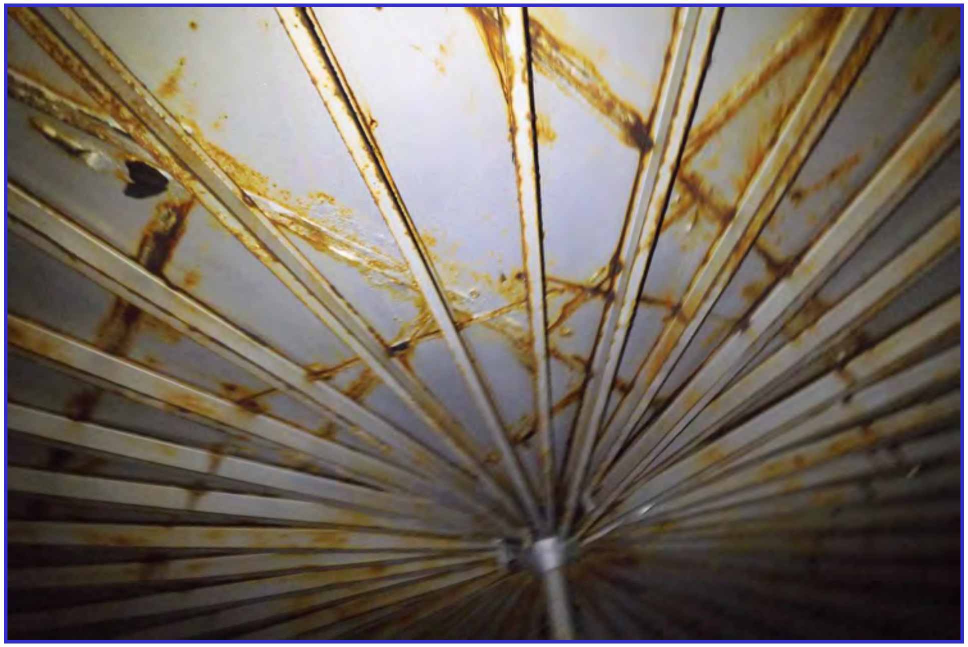


INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -032

INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -033

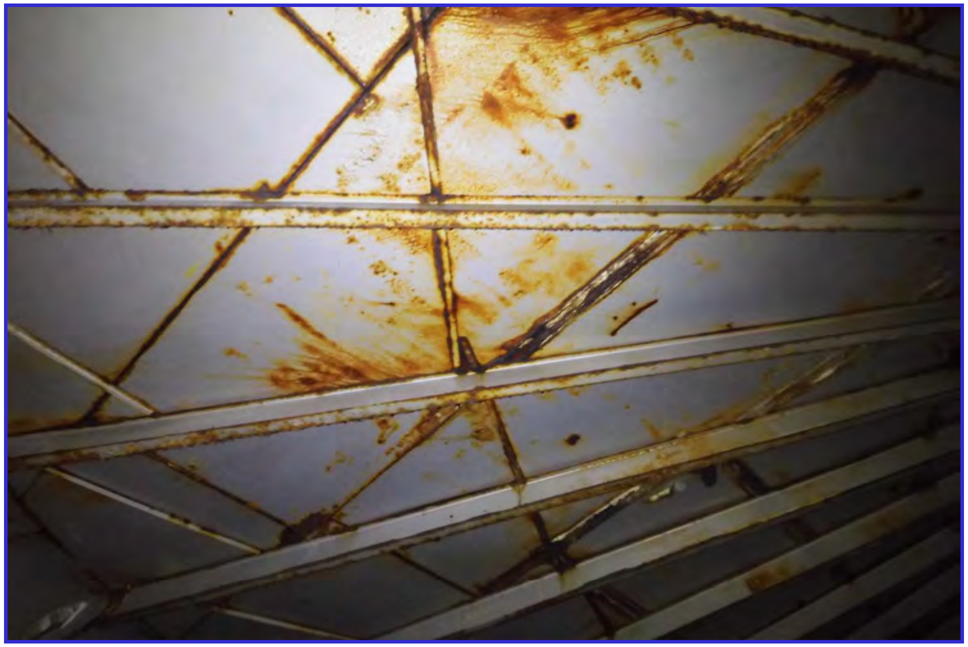


INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -034

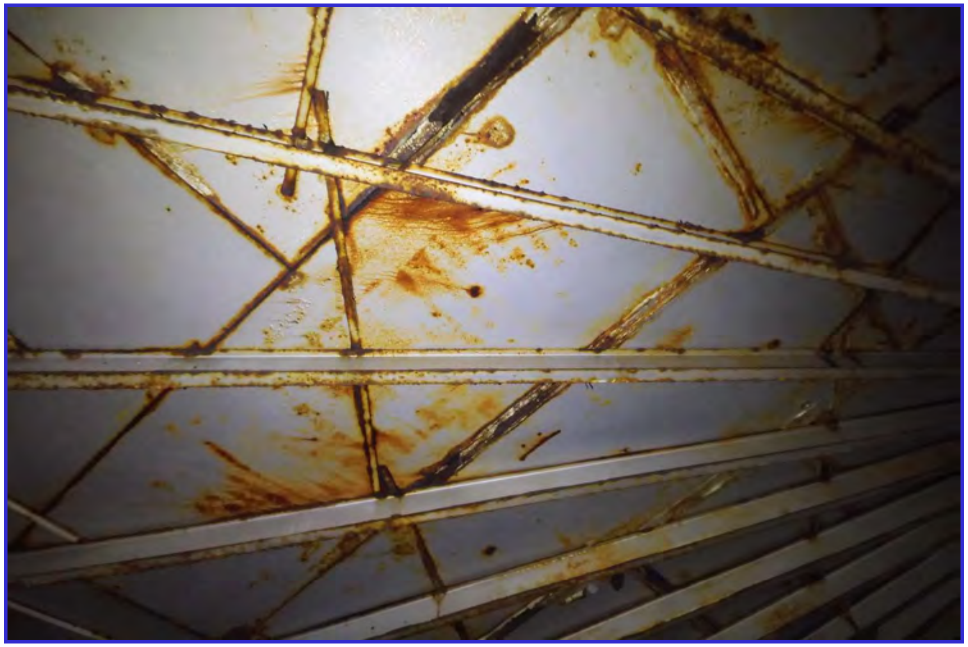


INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -035

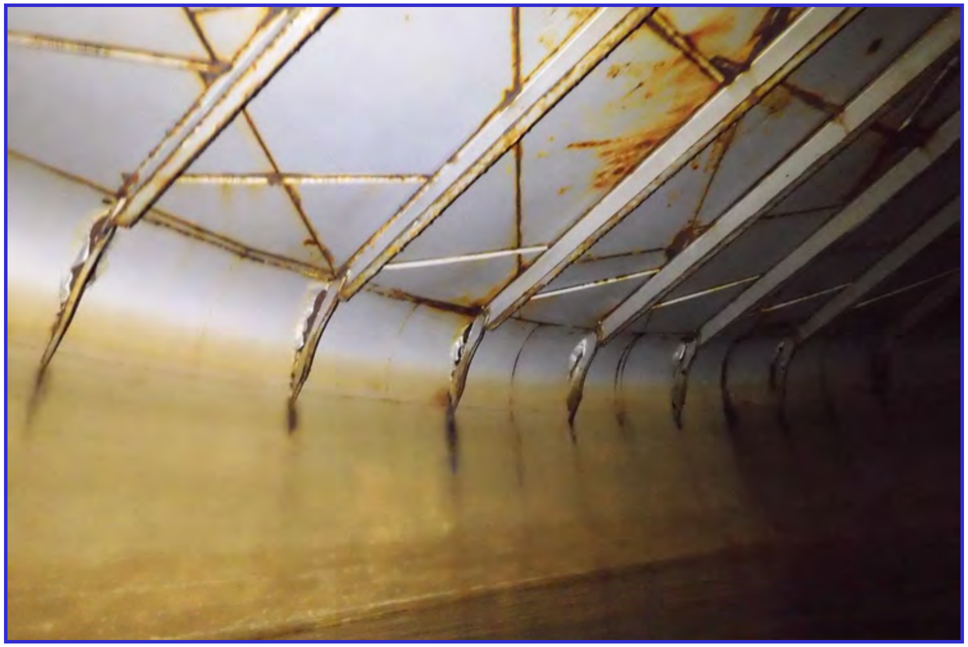
INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -036



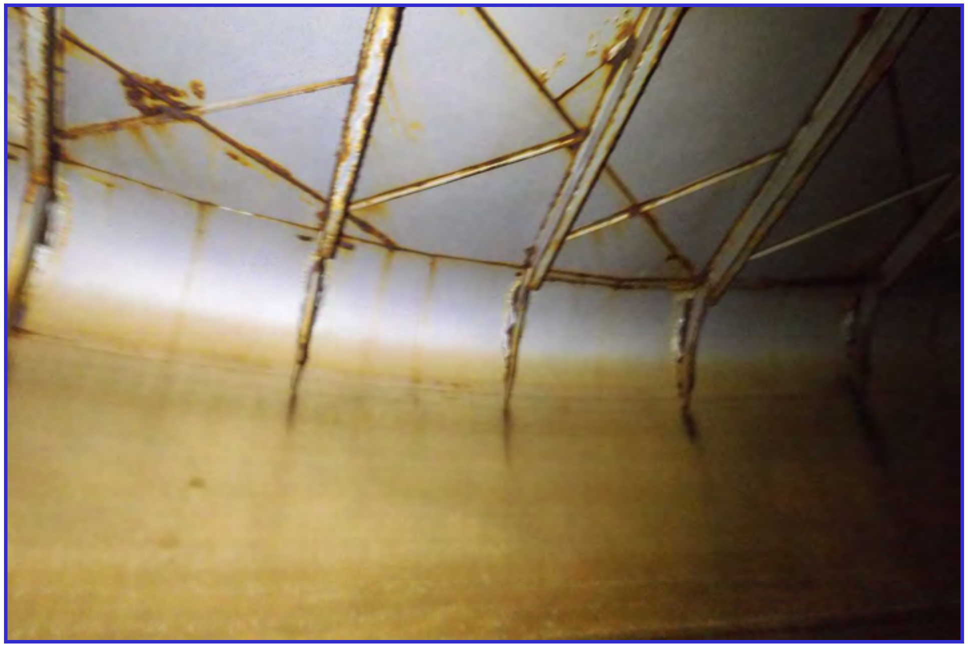
INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -037



INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -038



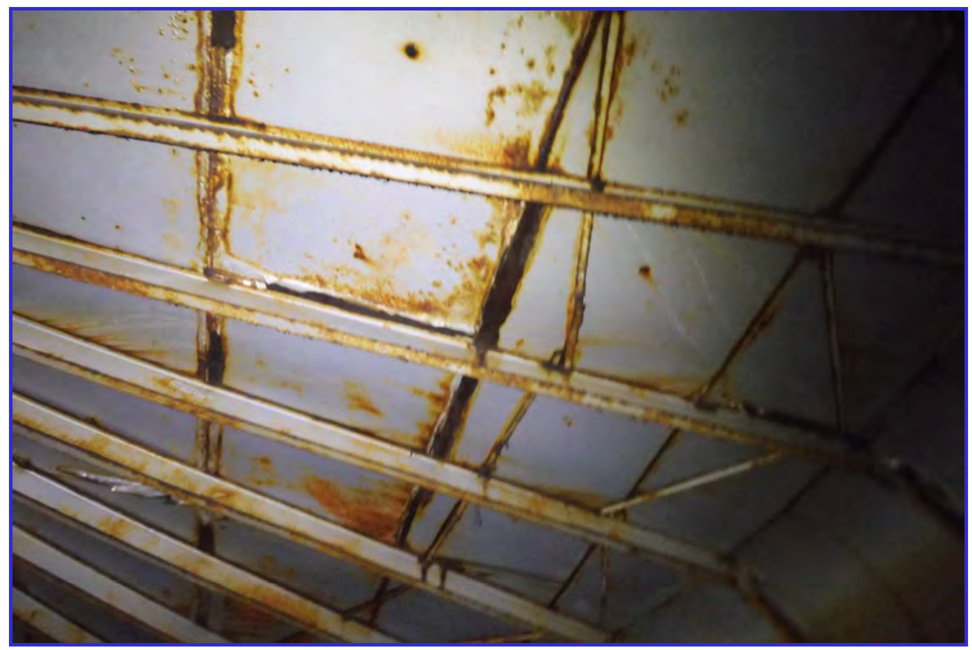
INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -039



INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -040

INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -041

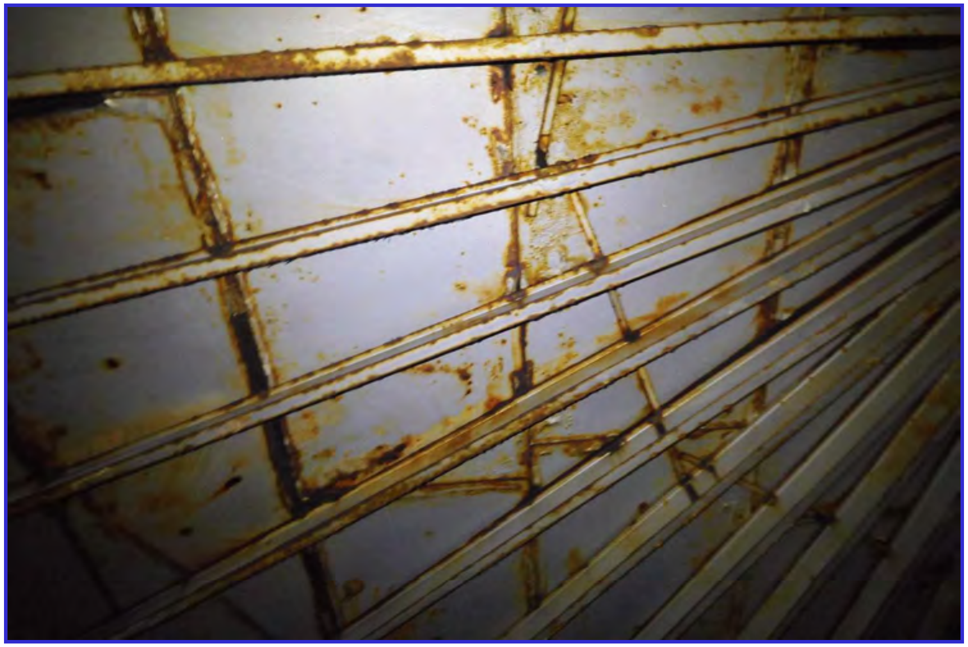
INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -042



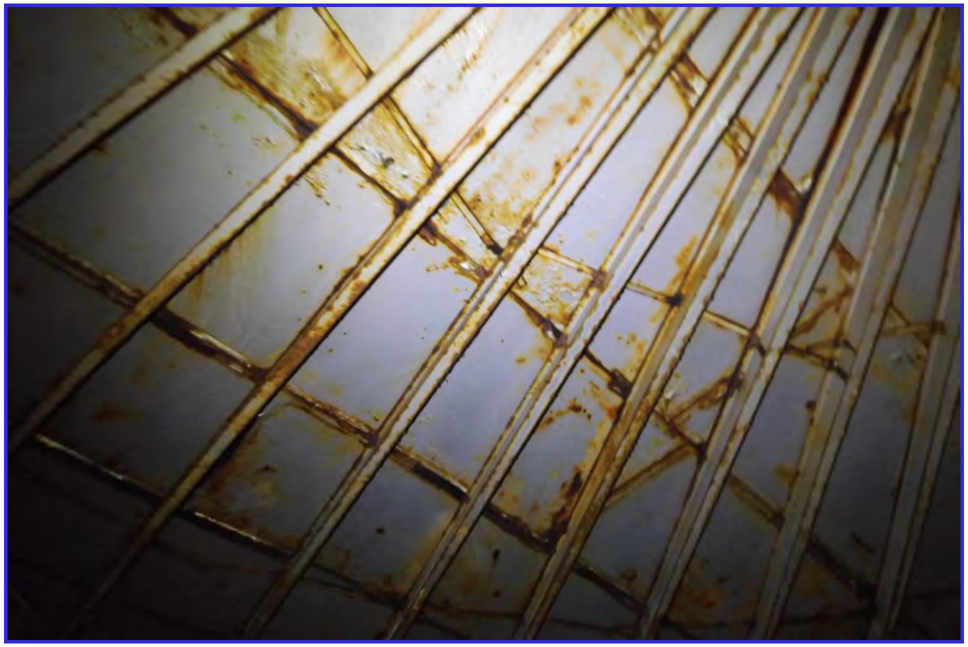
INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -043

INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -044

INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -045



INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -046



INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -047

INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -048

INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -049

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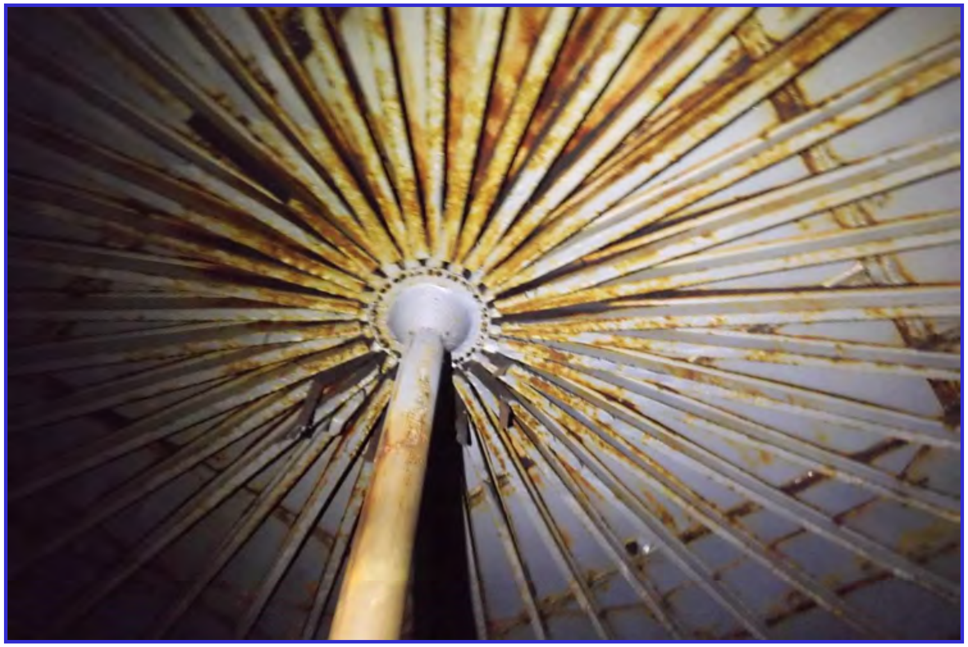
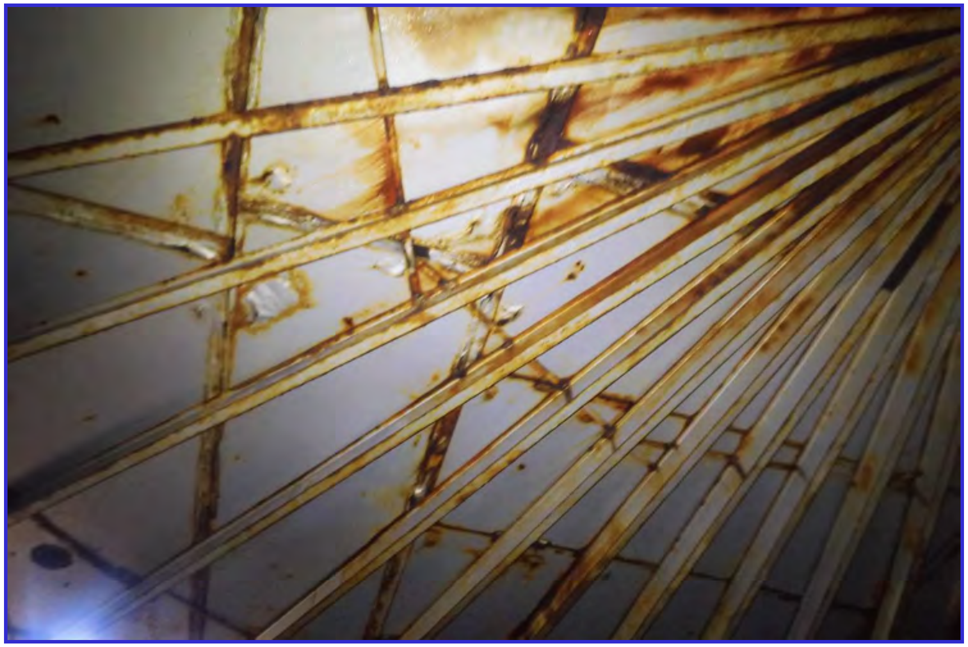
INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -051



INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -052



INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -053

INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -054

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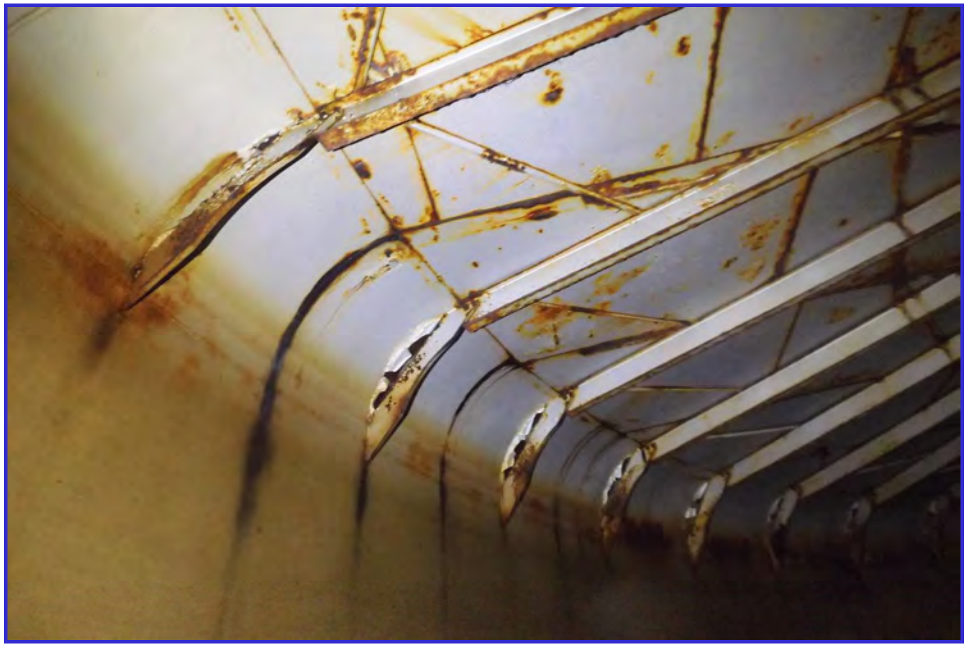
INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -056



INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -057

INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -058

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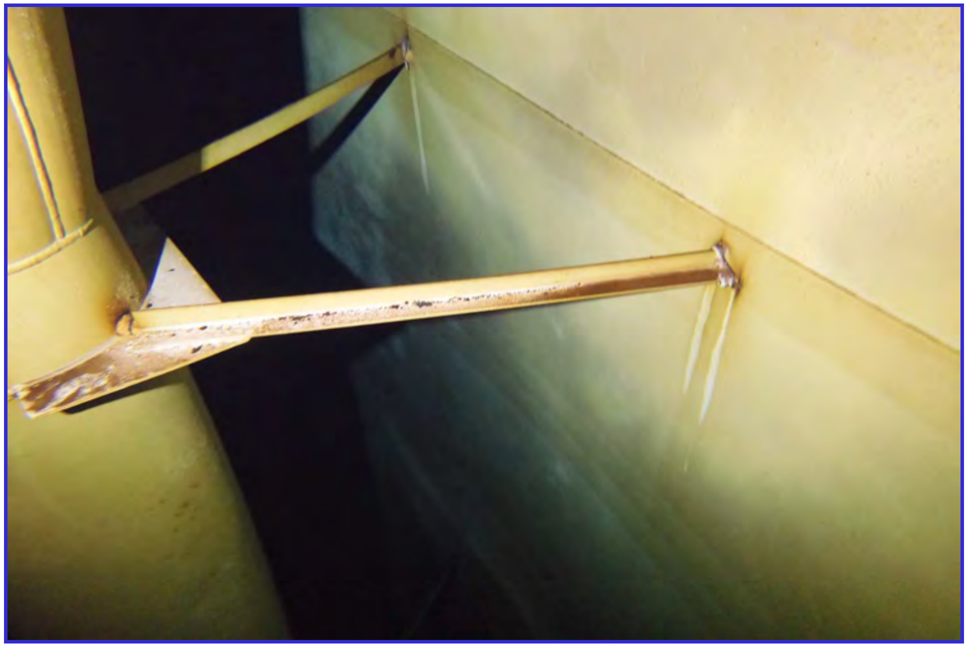
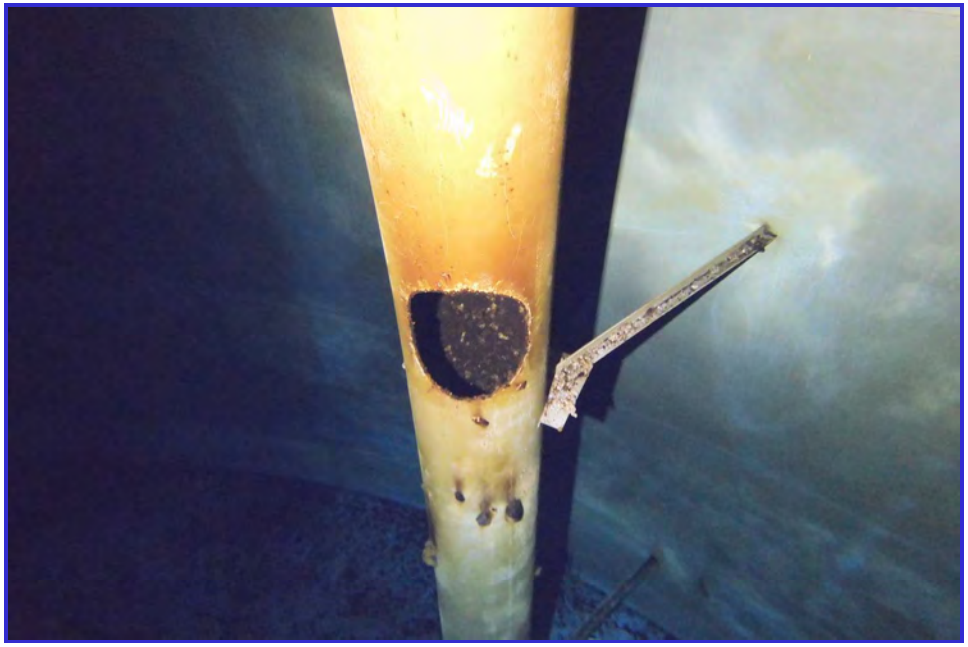
INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -060

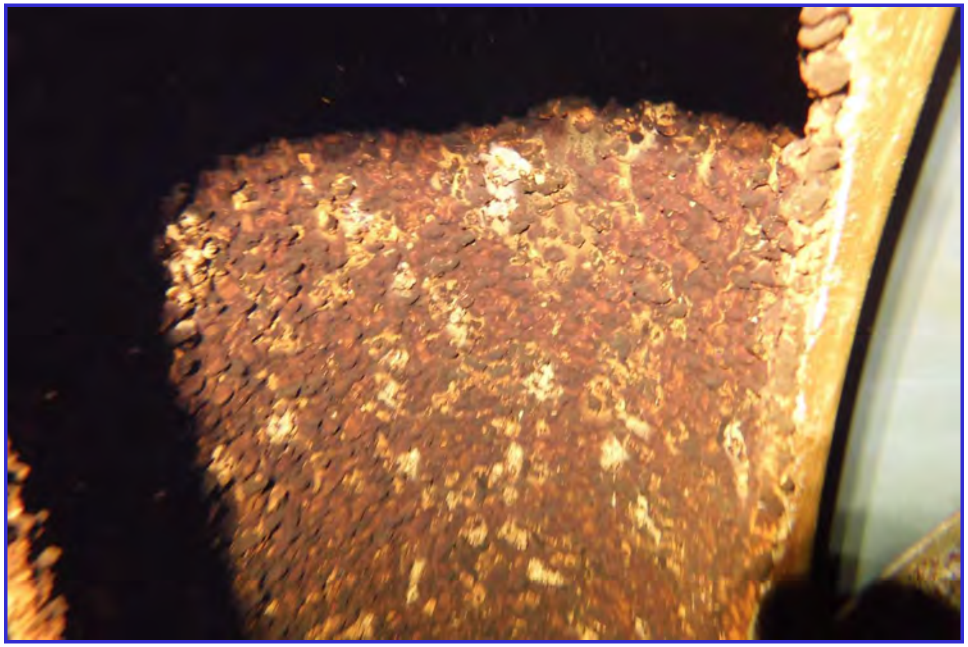


INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -061



INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -062

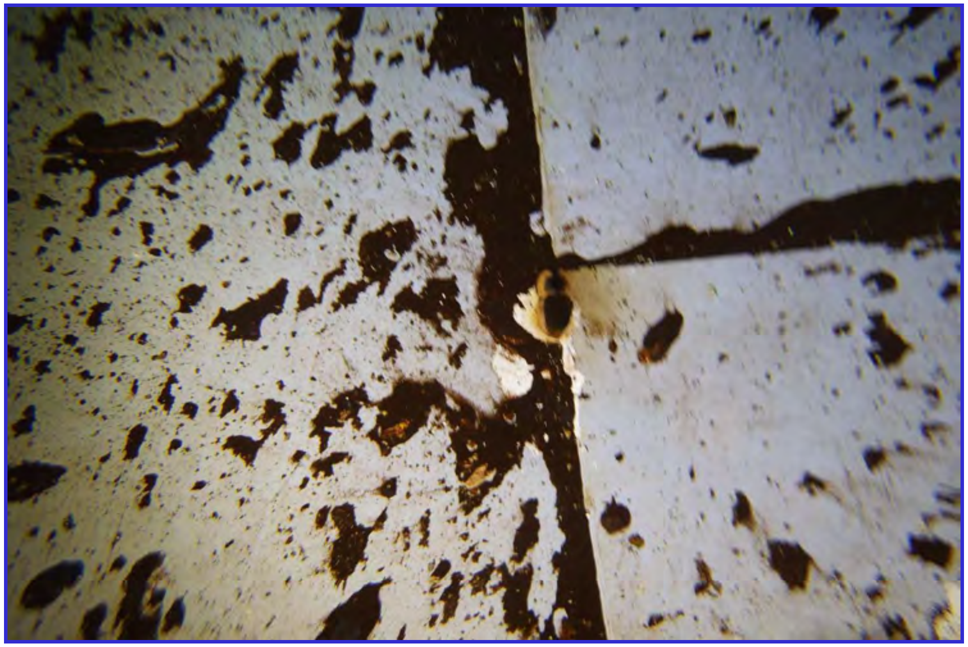
INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -063



INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -064

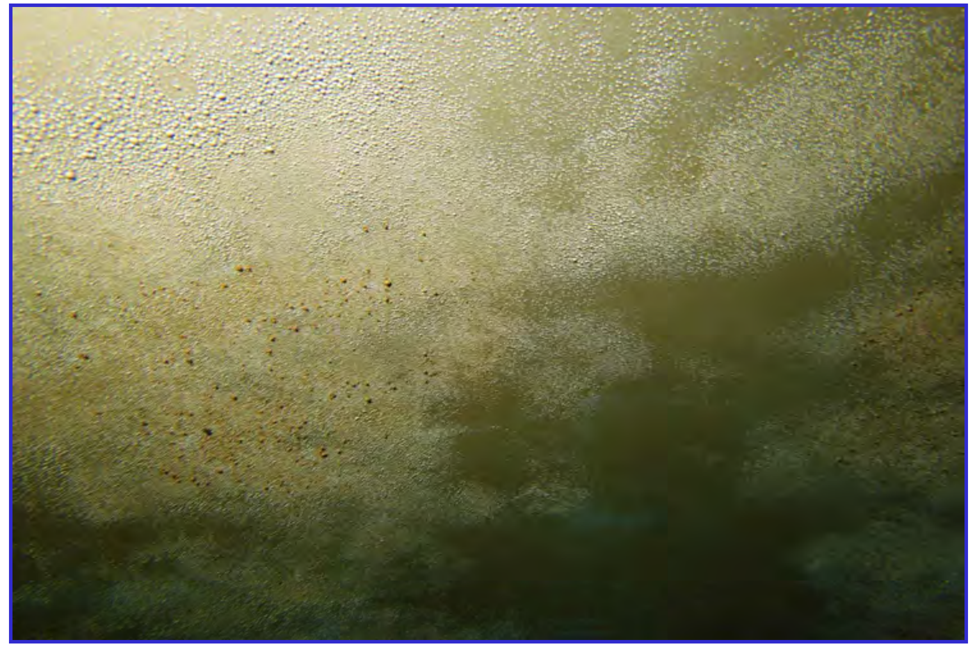
INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -065

INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -066



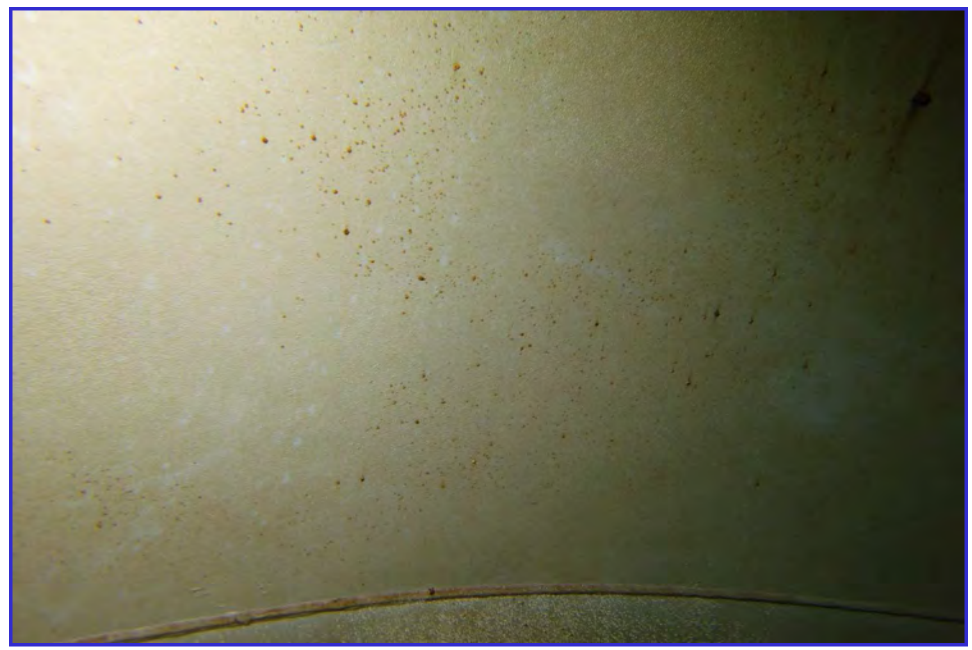
INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -067

INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -068

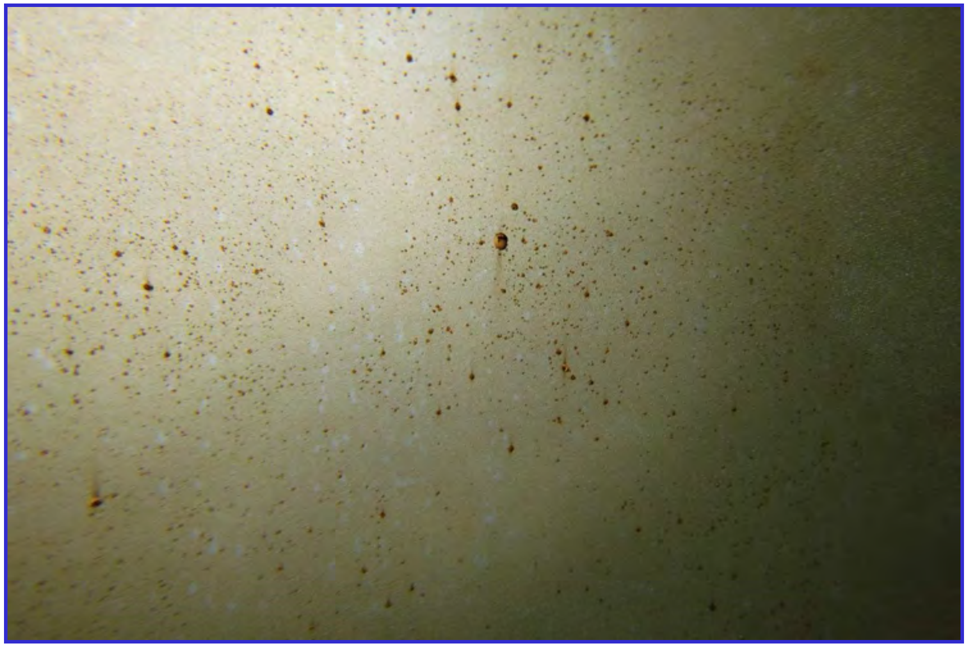


INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -069

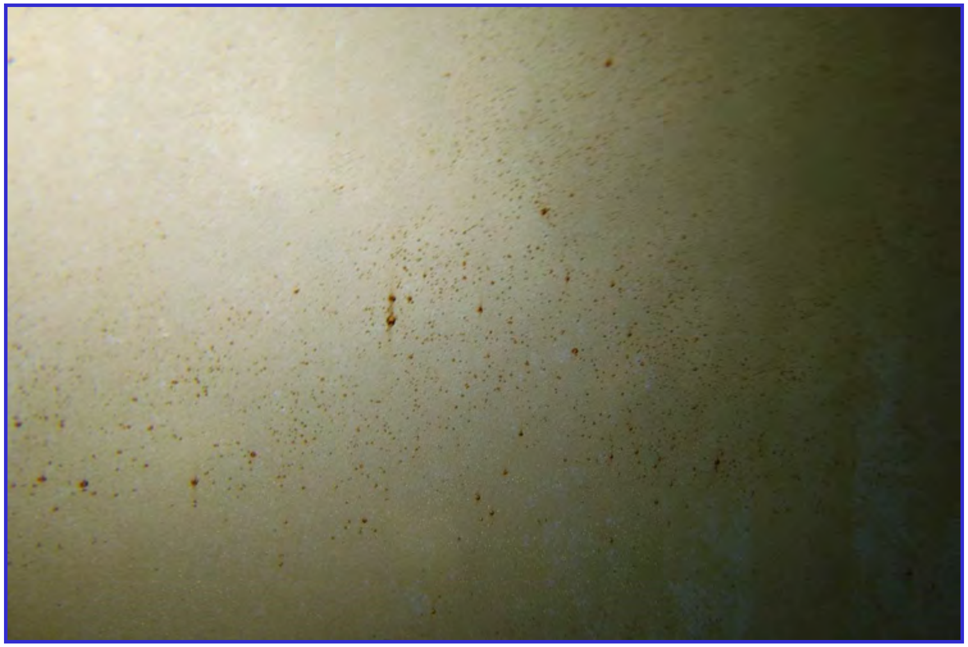
INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -070



INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -071

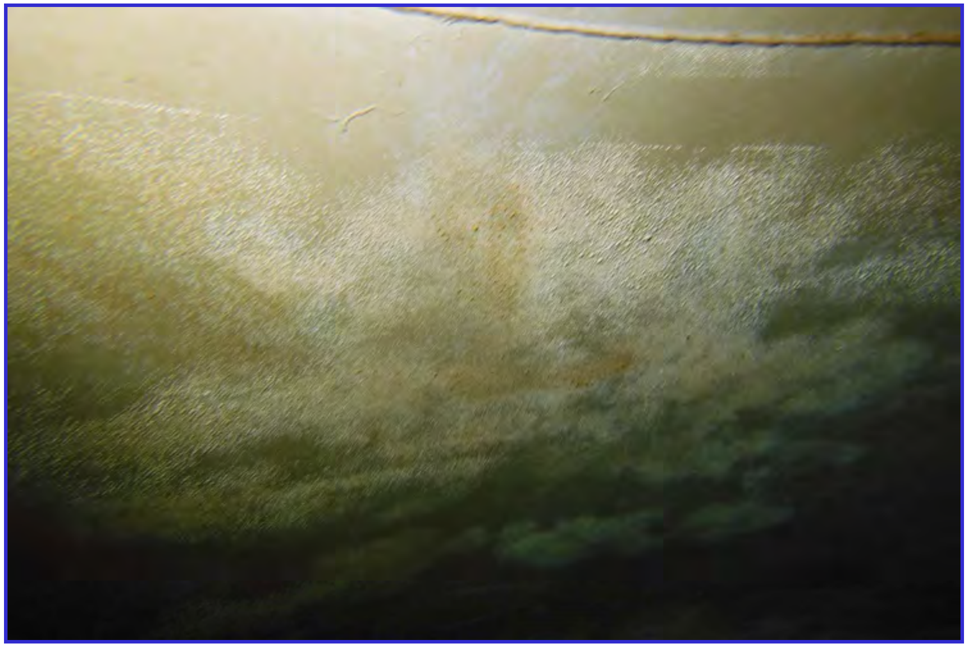


INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -072

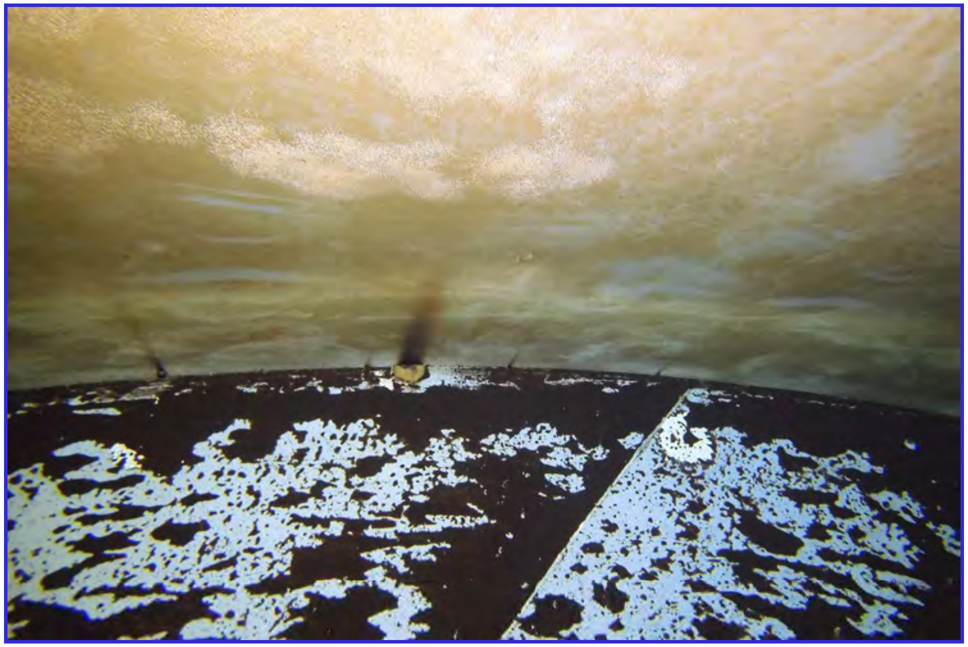


INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -073

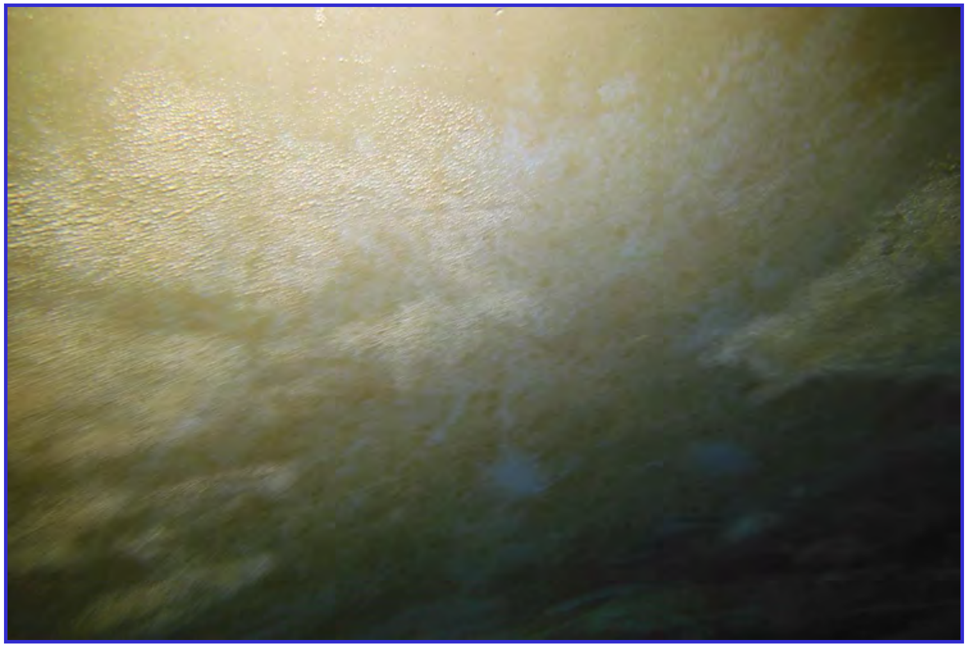
INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -074



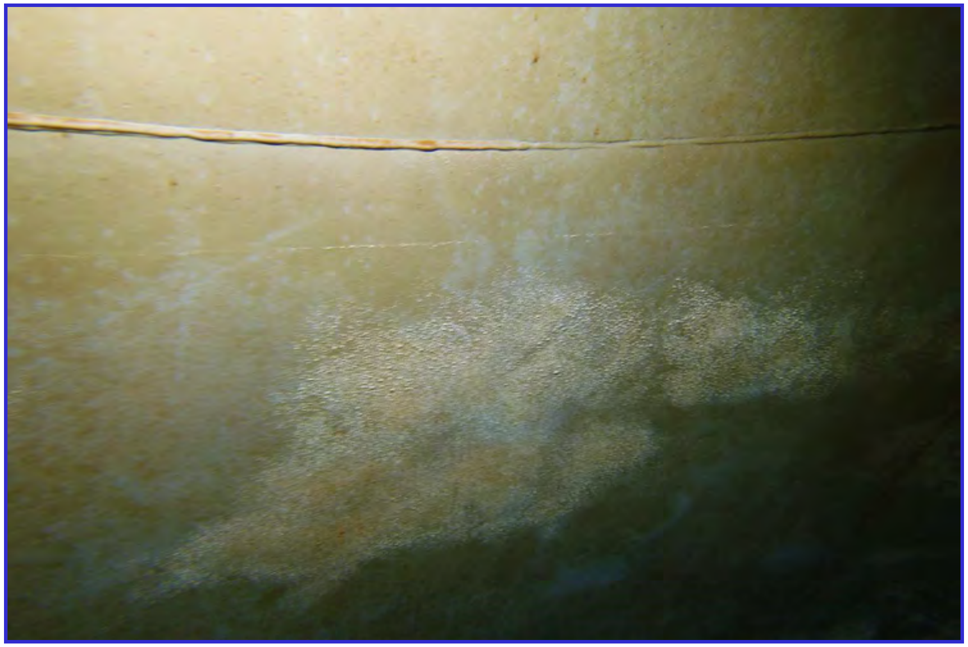
INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -075



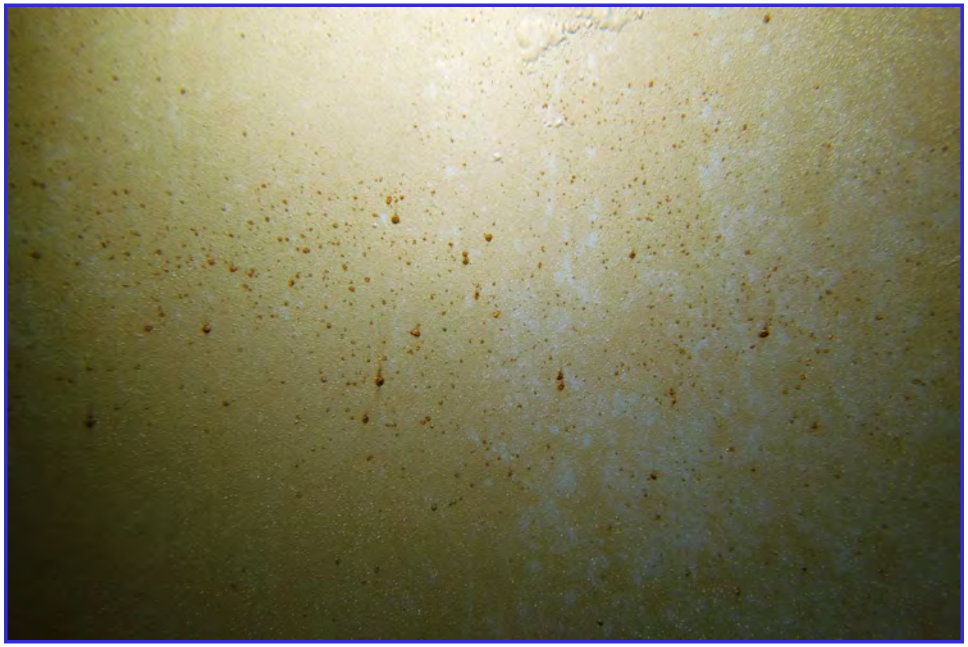
INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -076



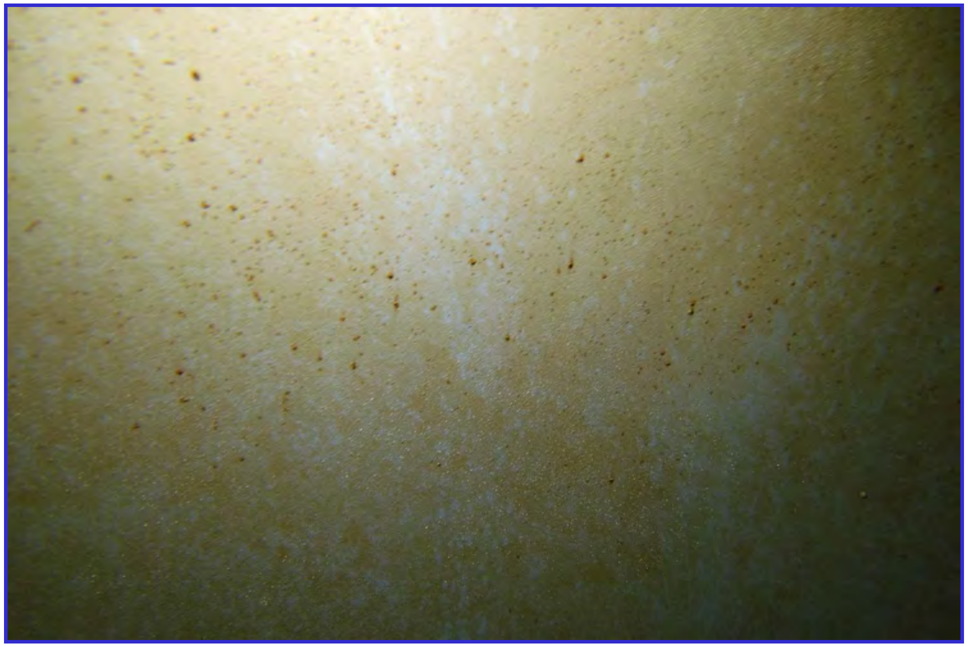
INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -077



INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -078



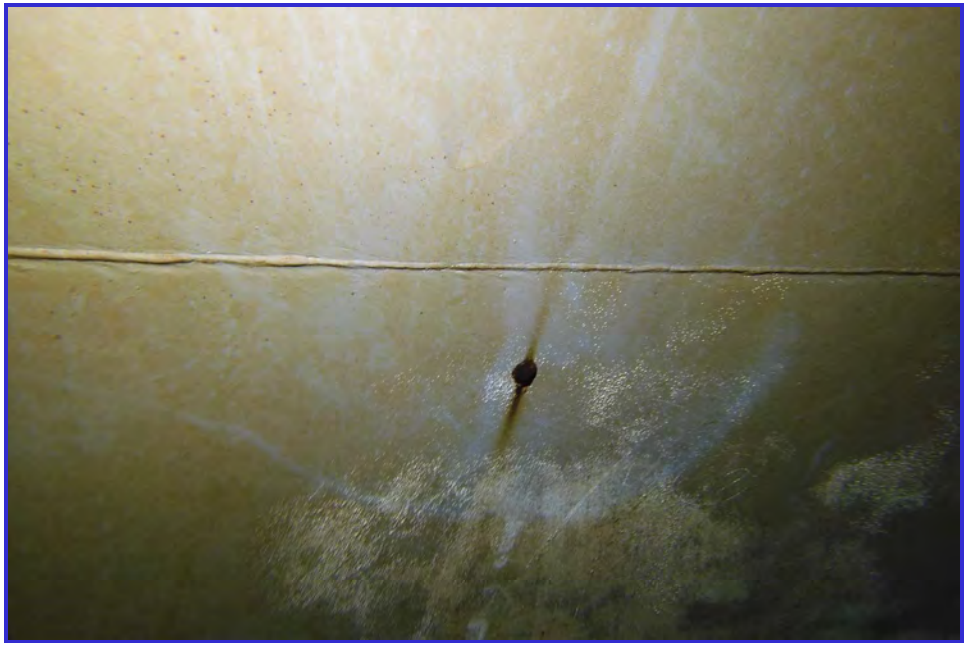
INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -079



INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -080

INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -081

INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -082

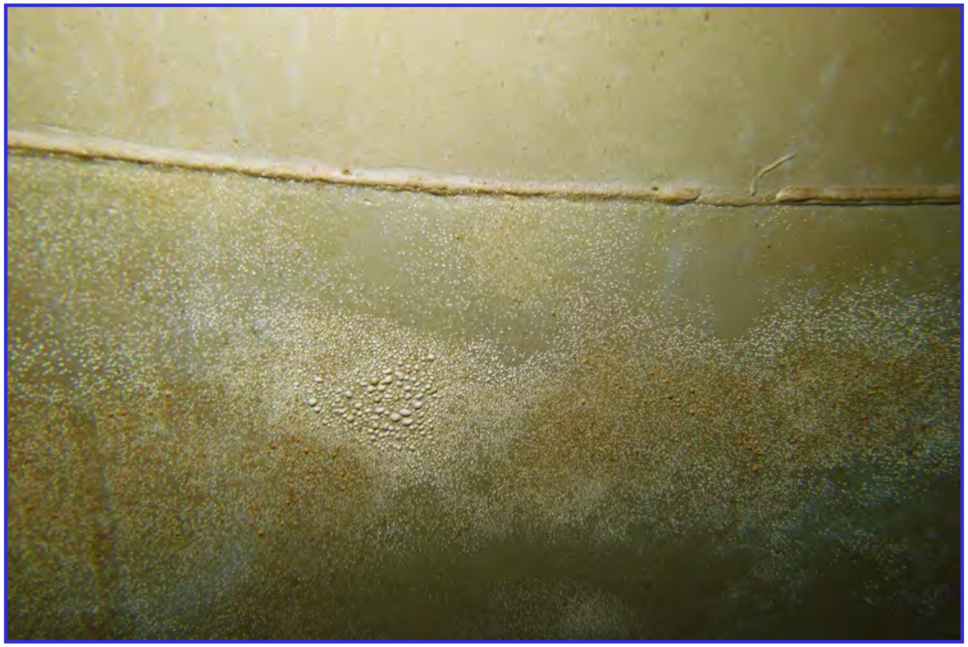


INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -083

INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -084

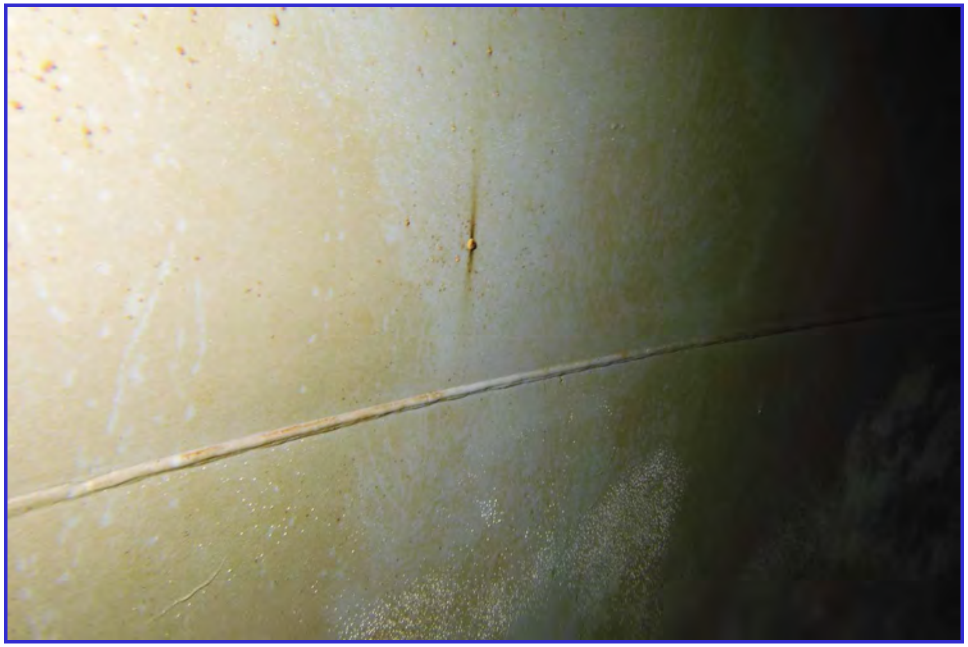
INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -085

INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -086



INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -087

INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -088



INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -089

INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -090

INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -091

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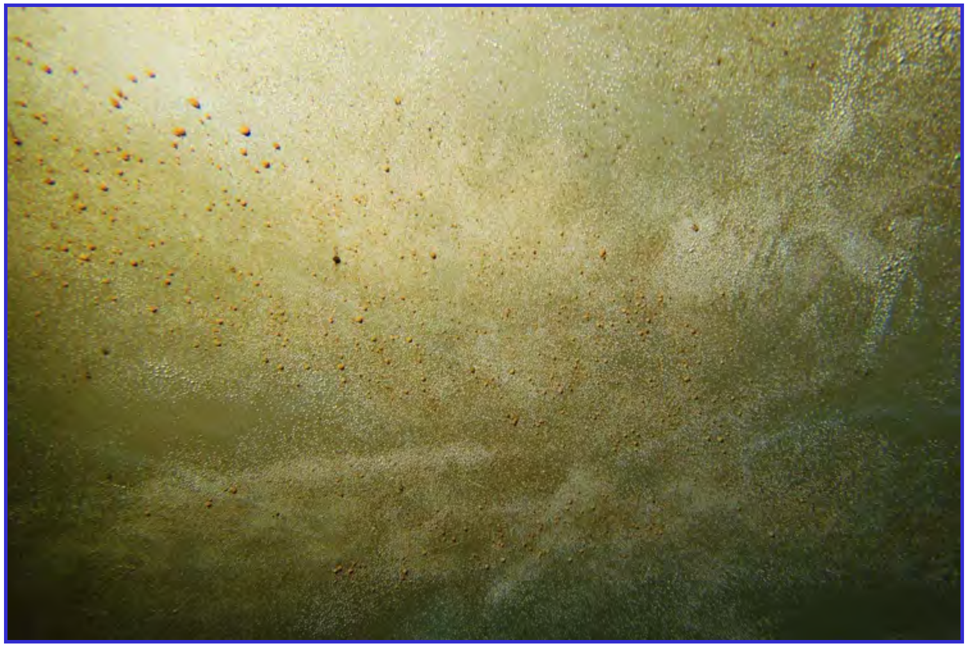
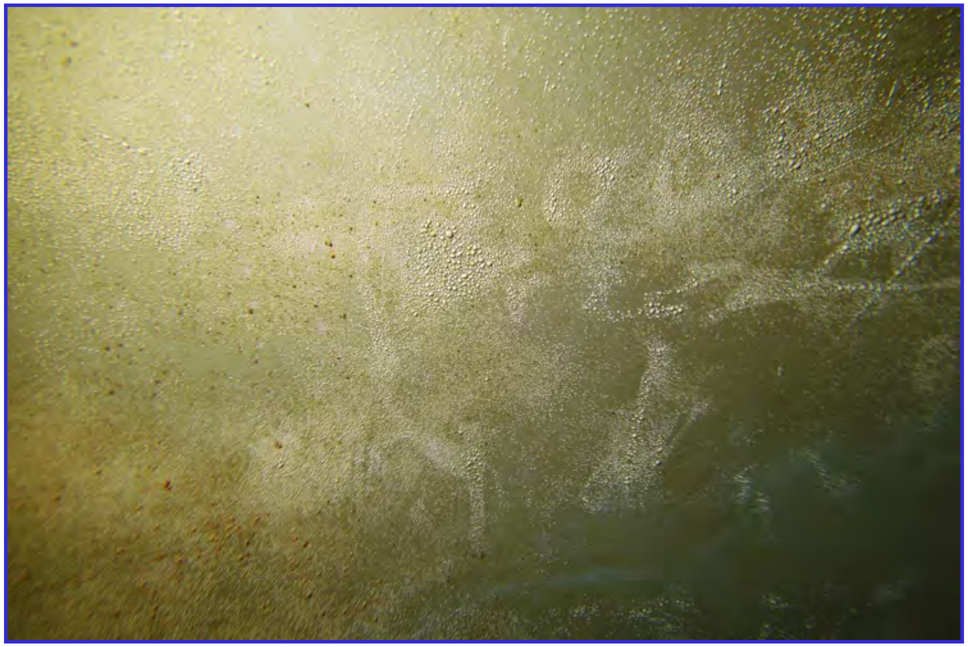
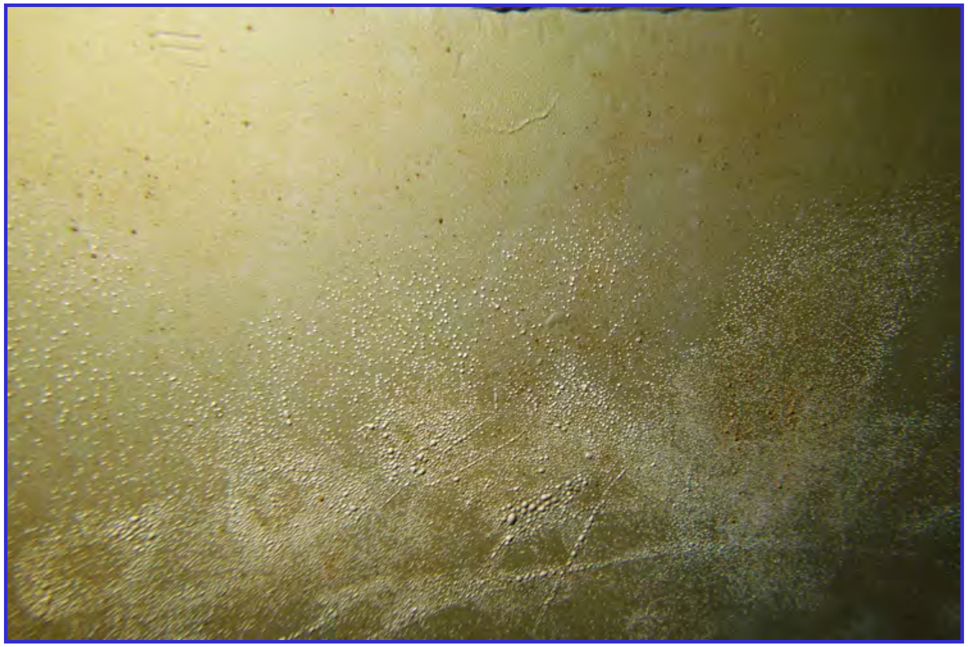


INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -094



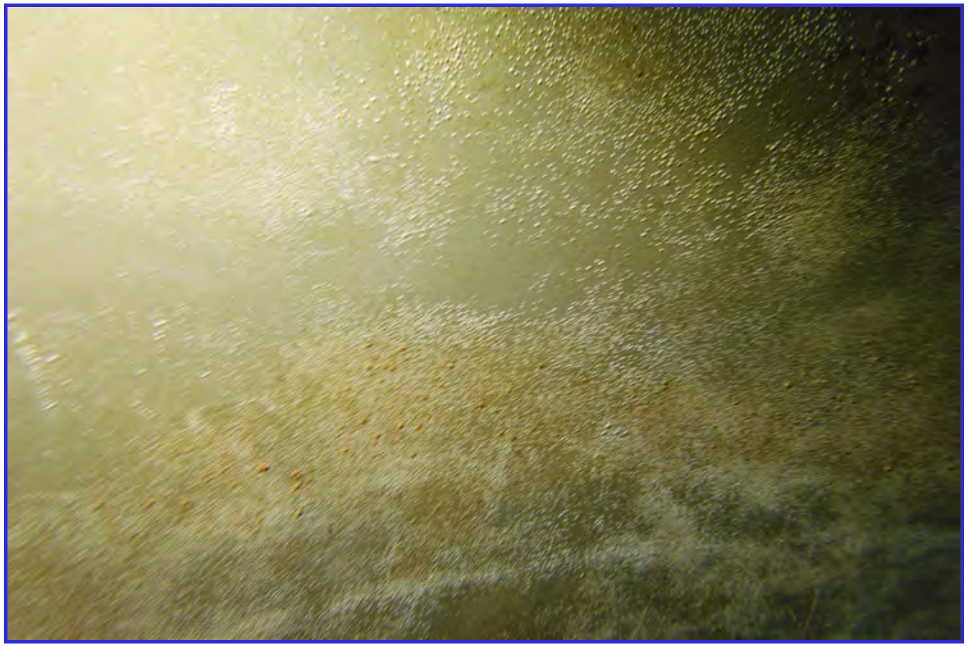
INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -095



INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -096

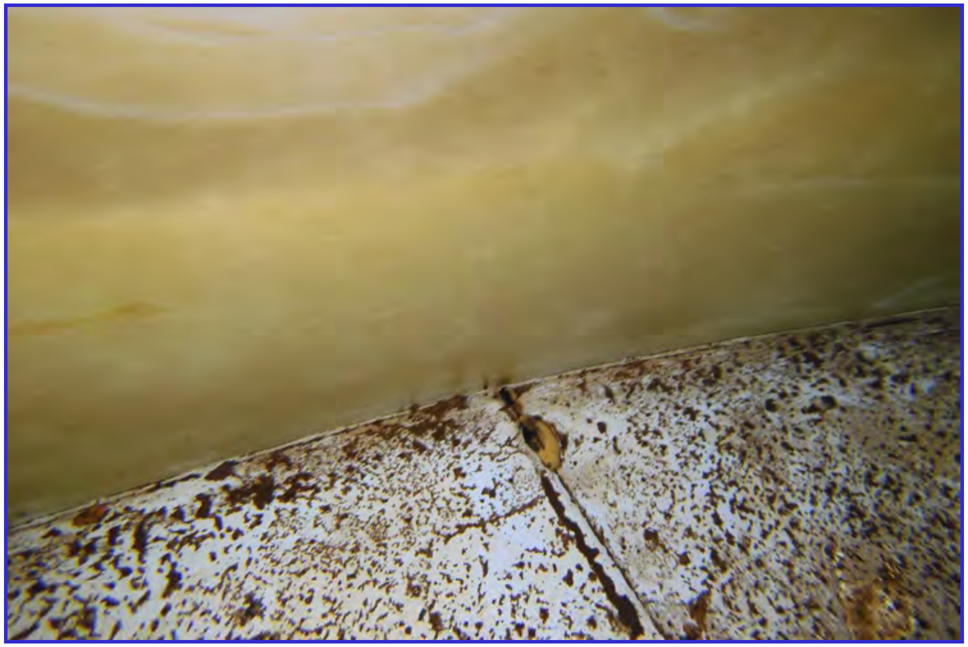
INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -097

INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -098



INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -099

INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -100



INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -101

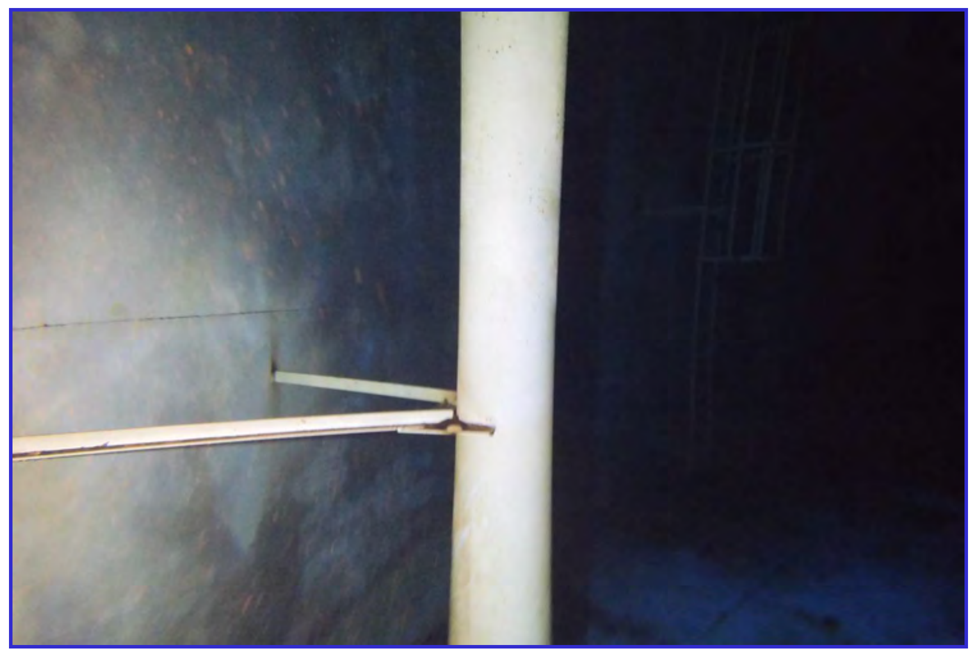
INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -102

INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -103

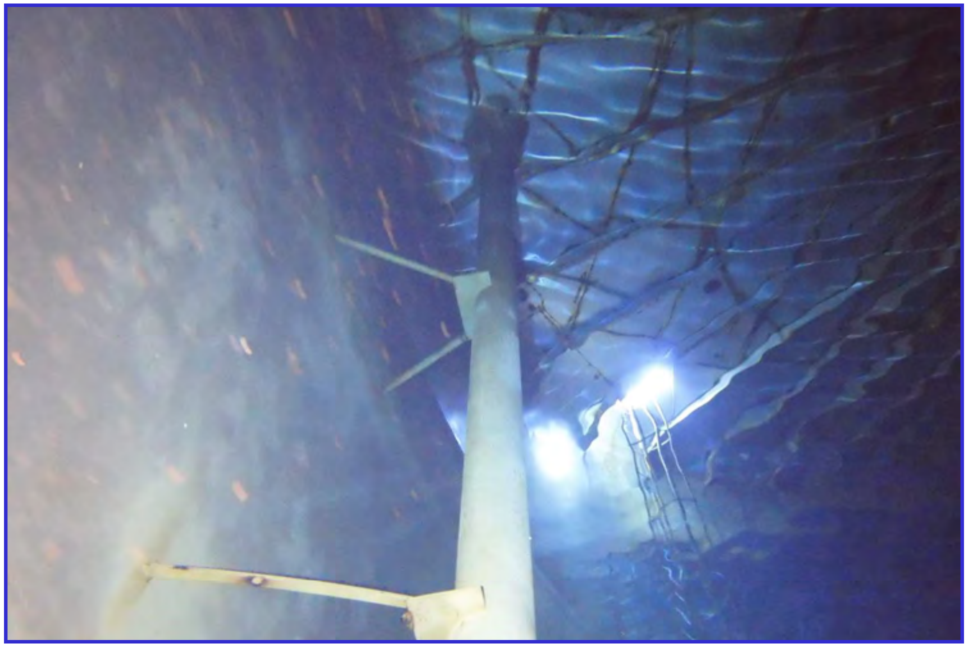
INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -104

INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -105

INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -106



INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -107

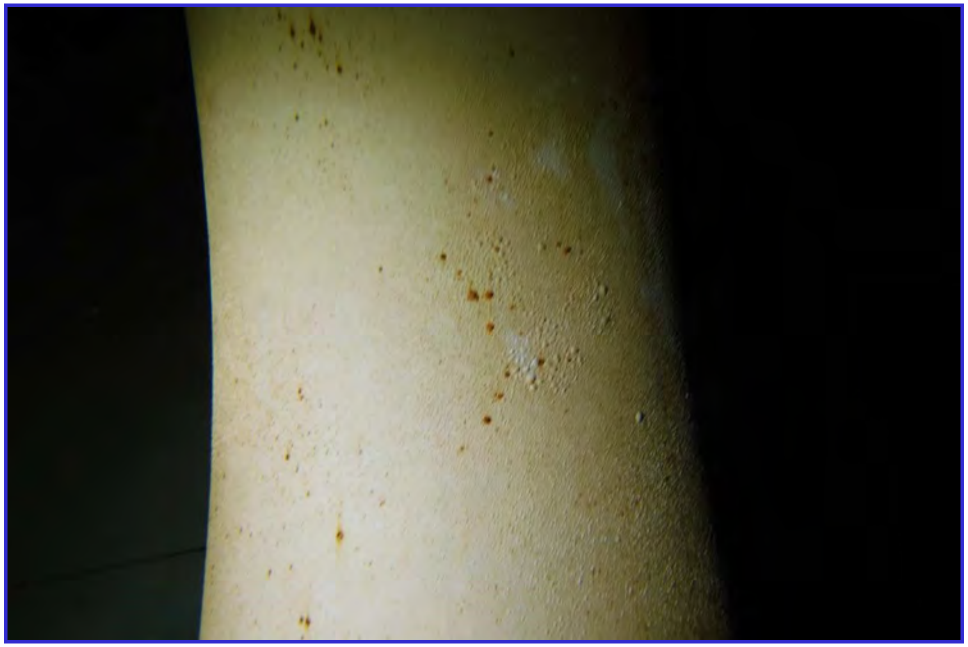


INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -108

INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -109

INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -110

INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -111



INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -112

INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -113

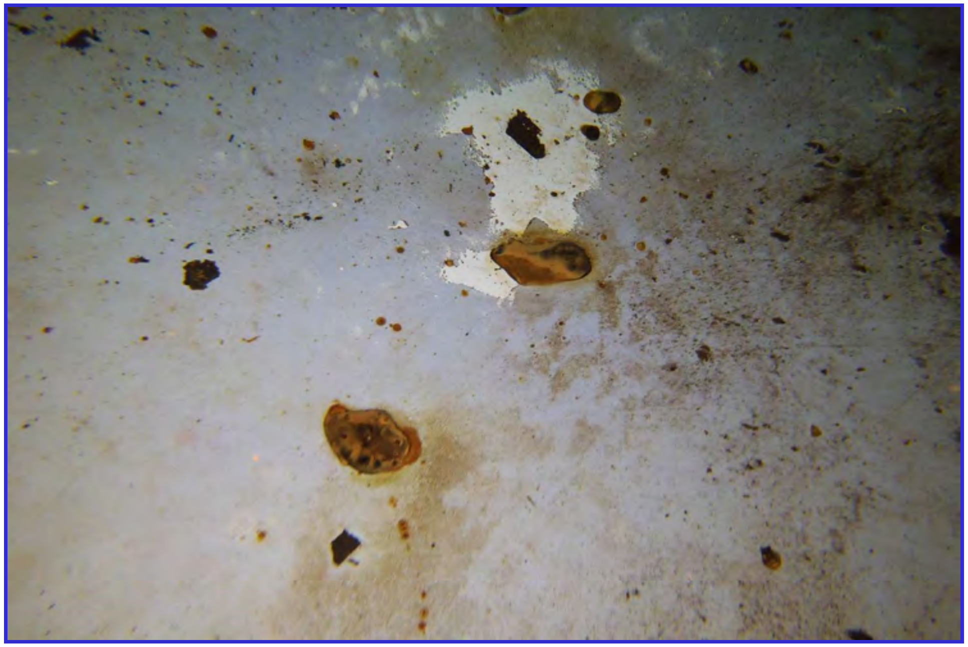
INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -114

INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -115

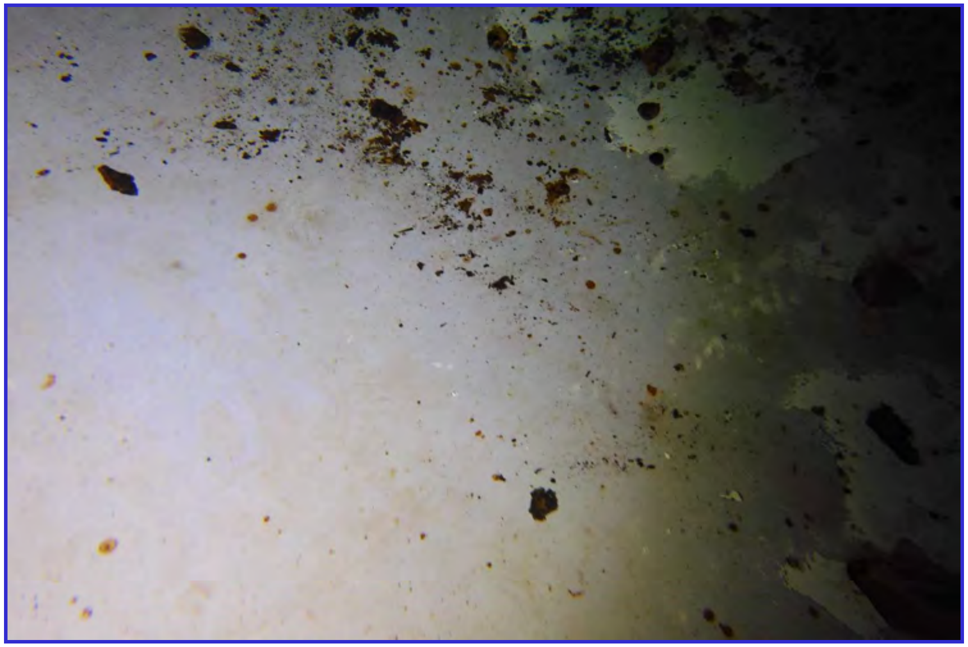
INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -116

INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -117

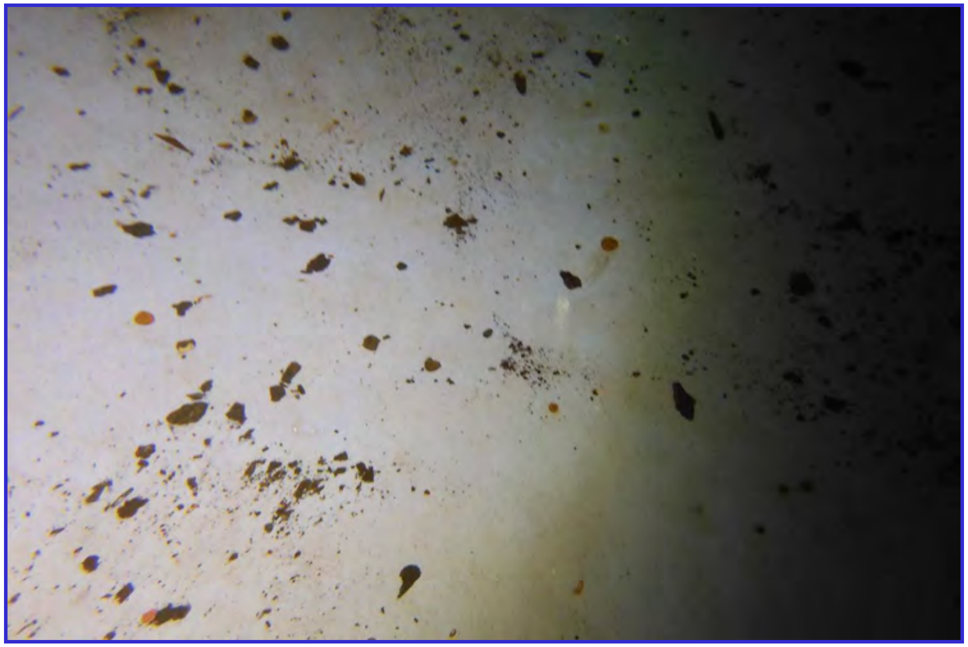
INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -118



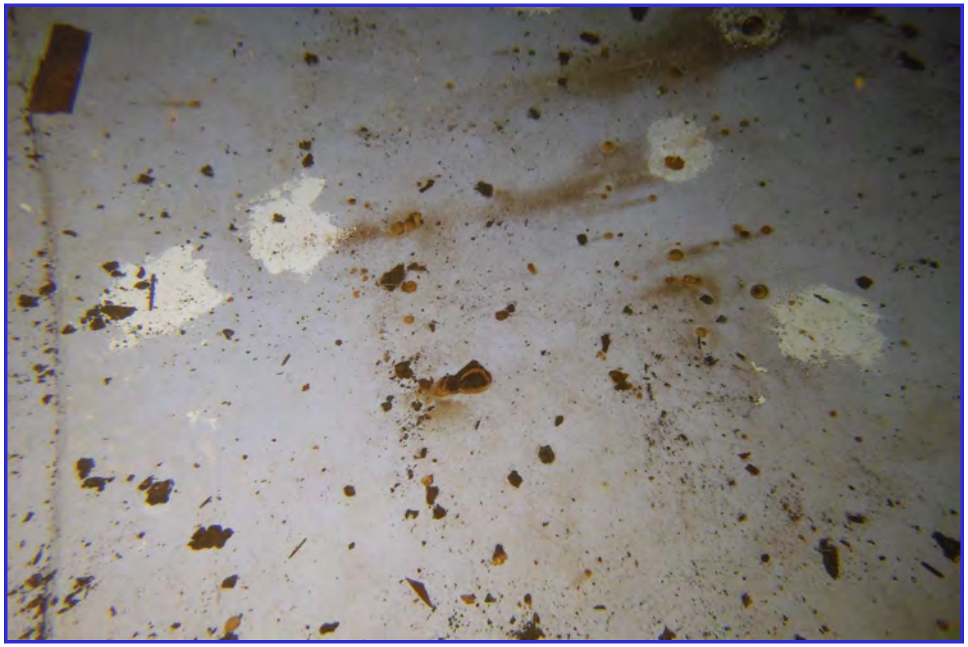
INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -119



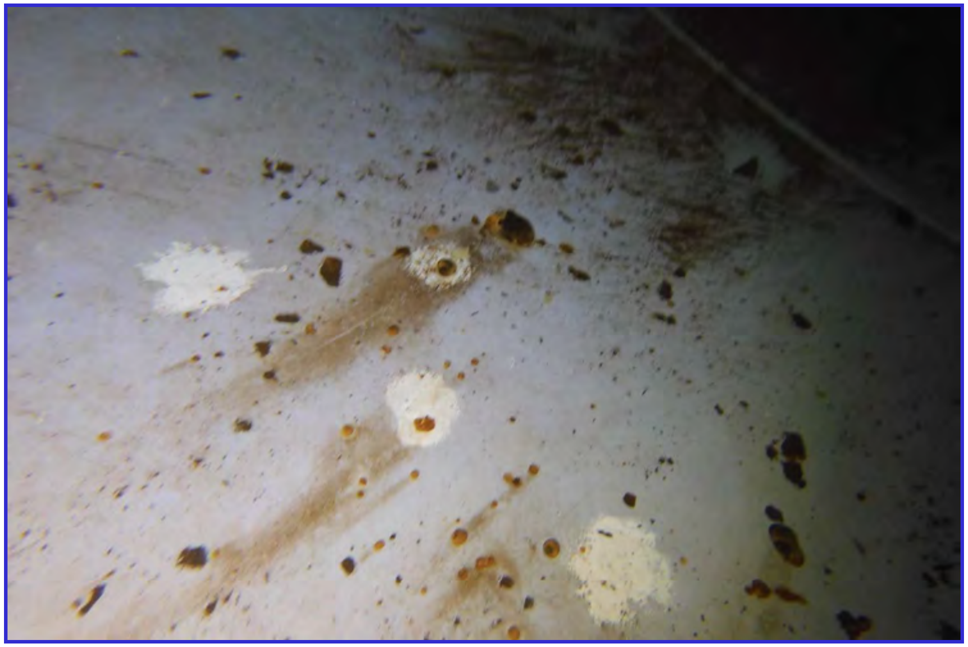
INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -120



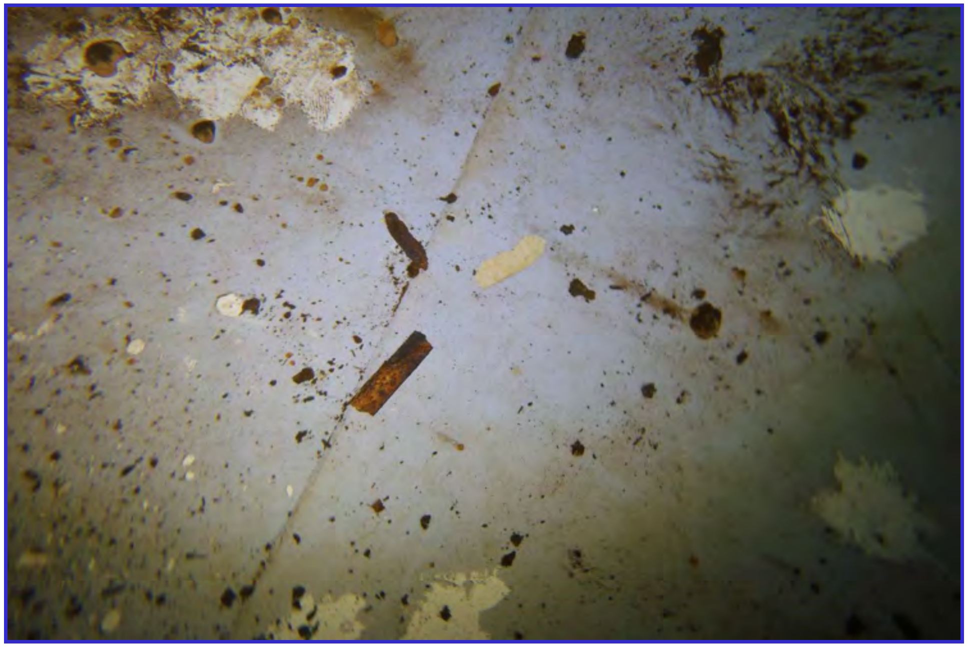
INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -121



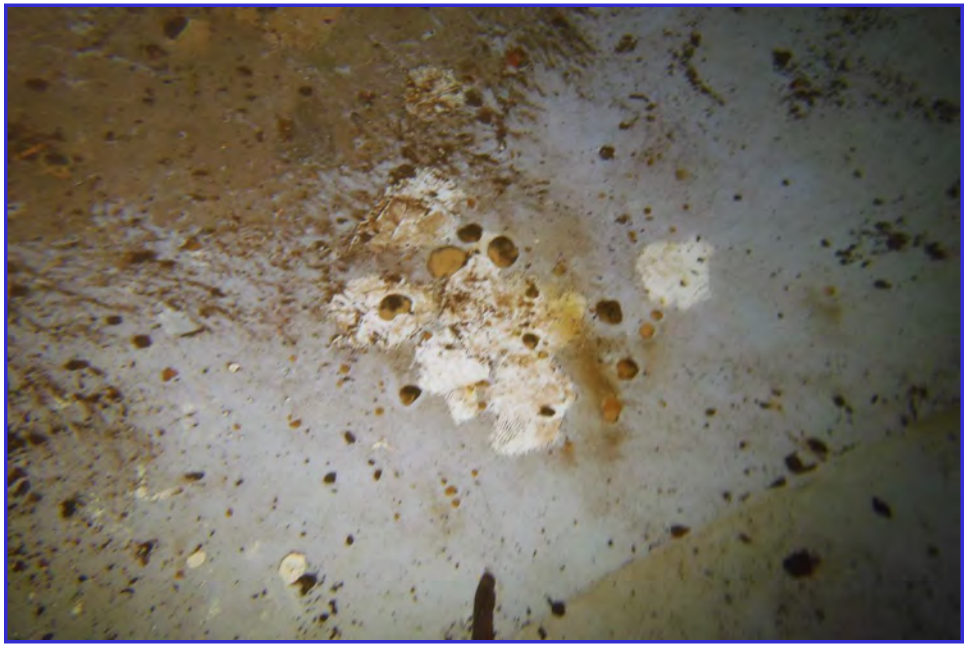
INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -122



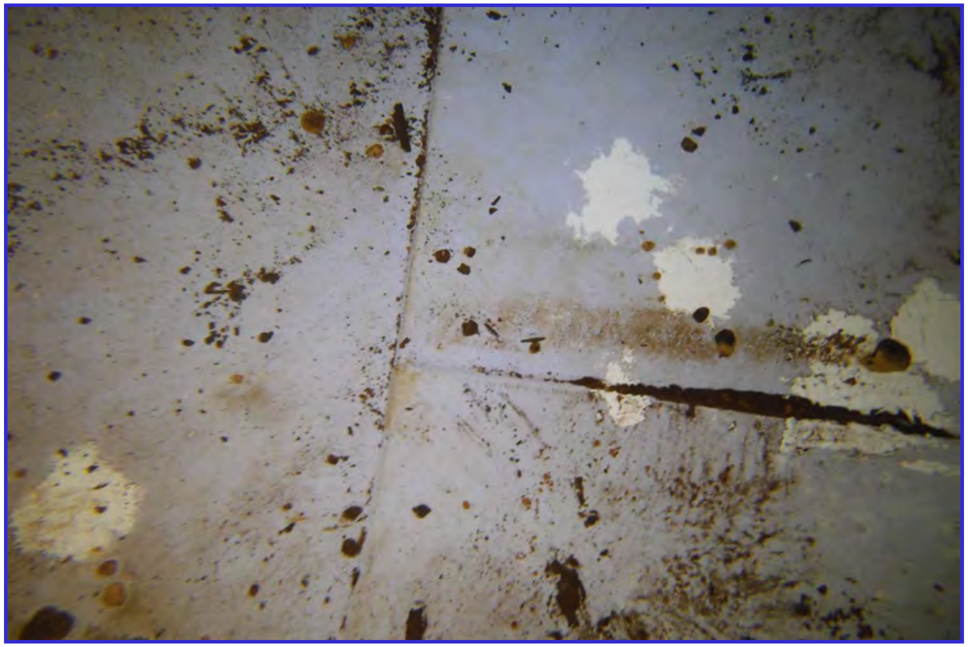
INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -123



INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -124



INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -125



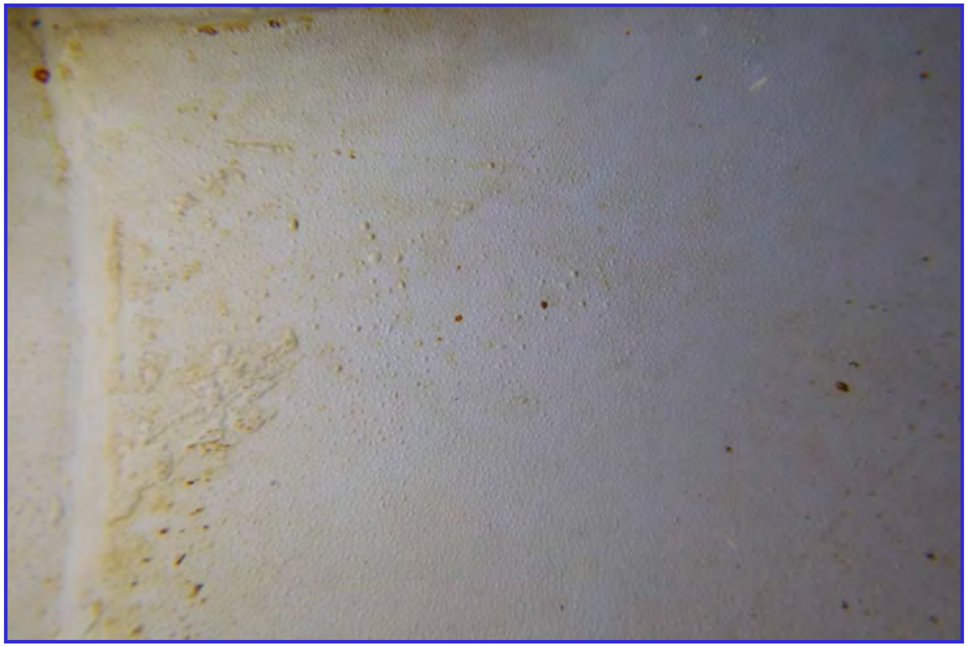
INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -126

INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -127

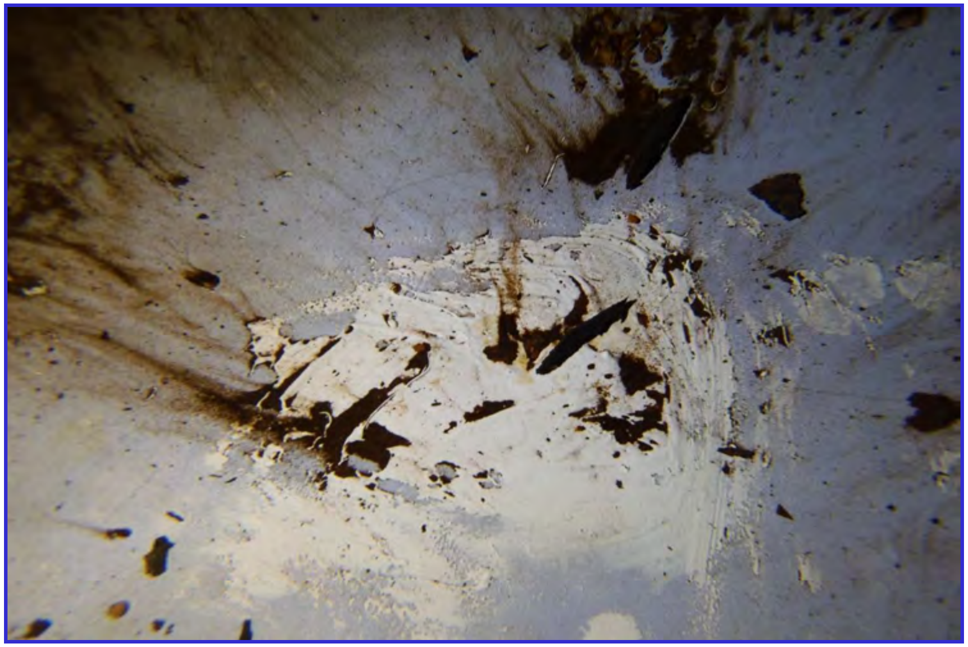
INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -128

INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -129

INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -130



INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -131

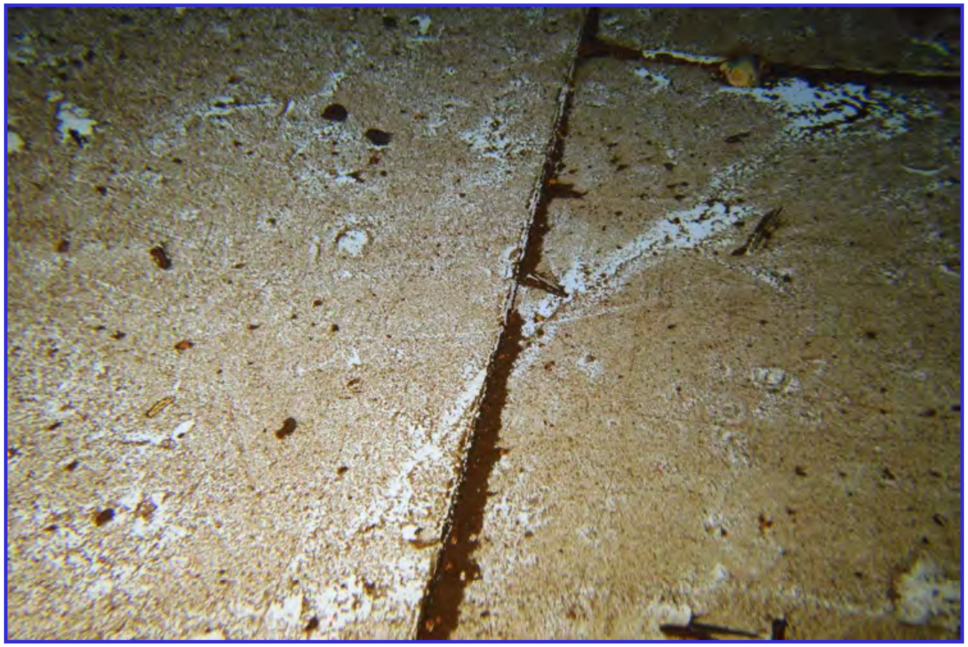


INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -132

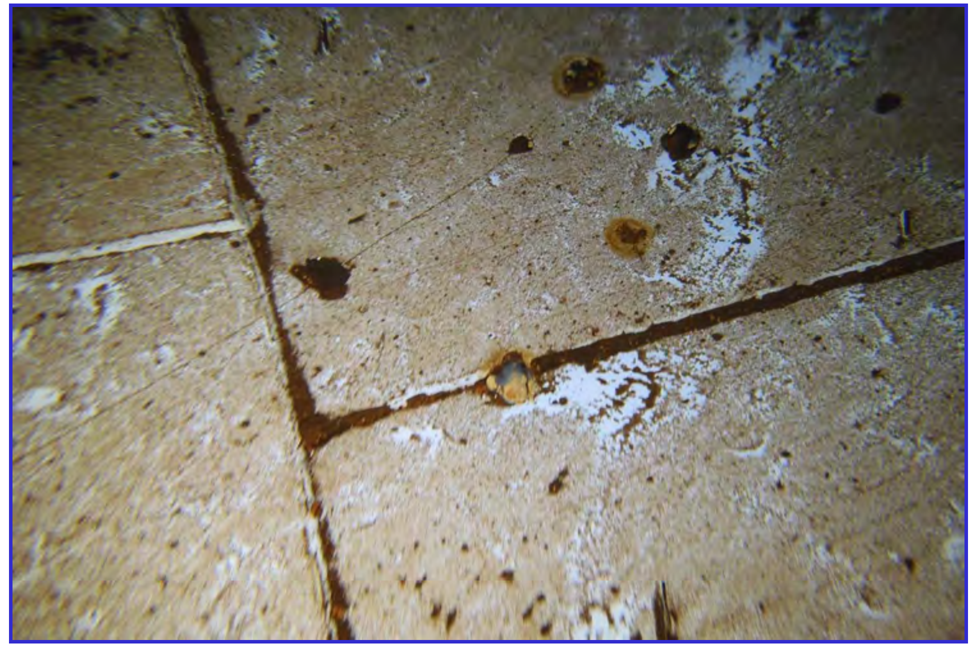
INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -133

INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -134

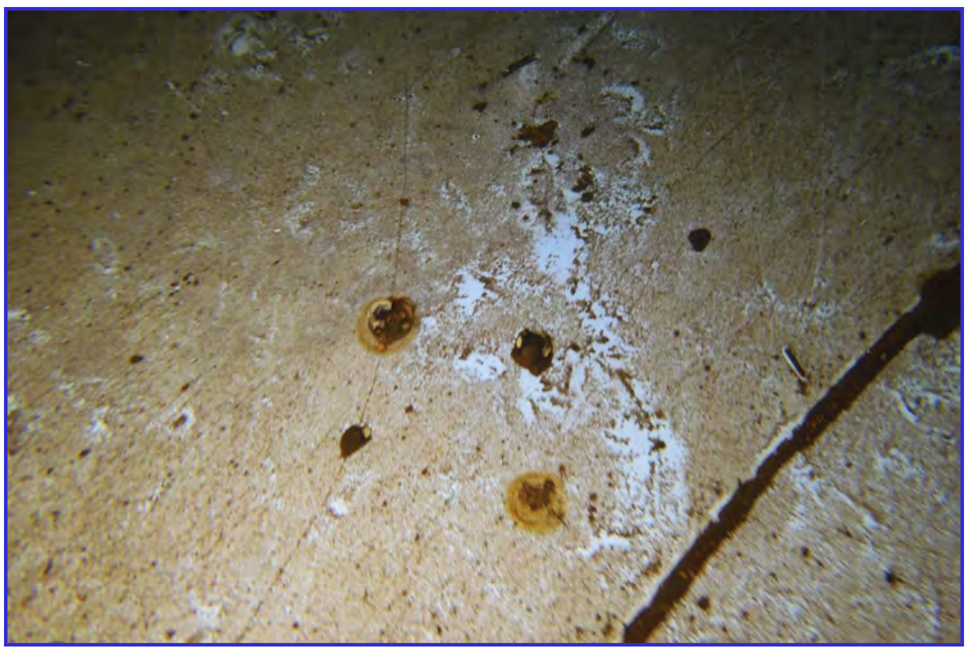
INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -135



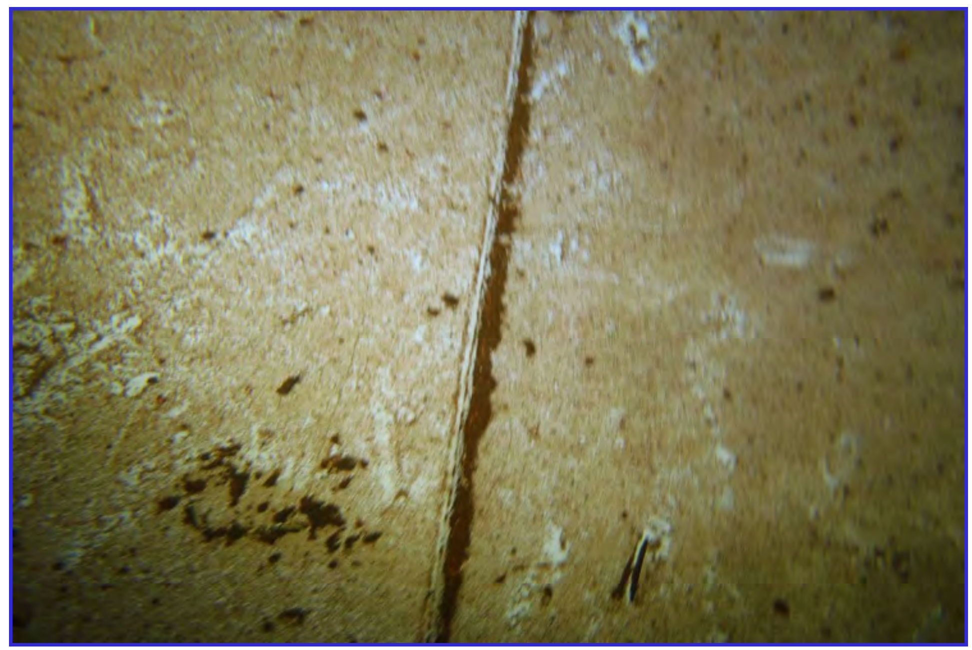
INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -136



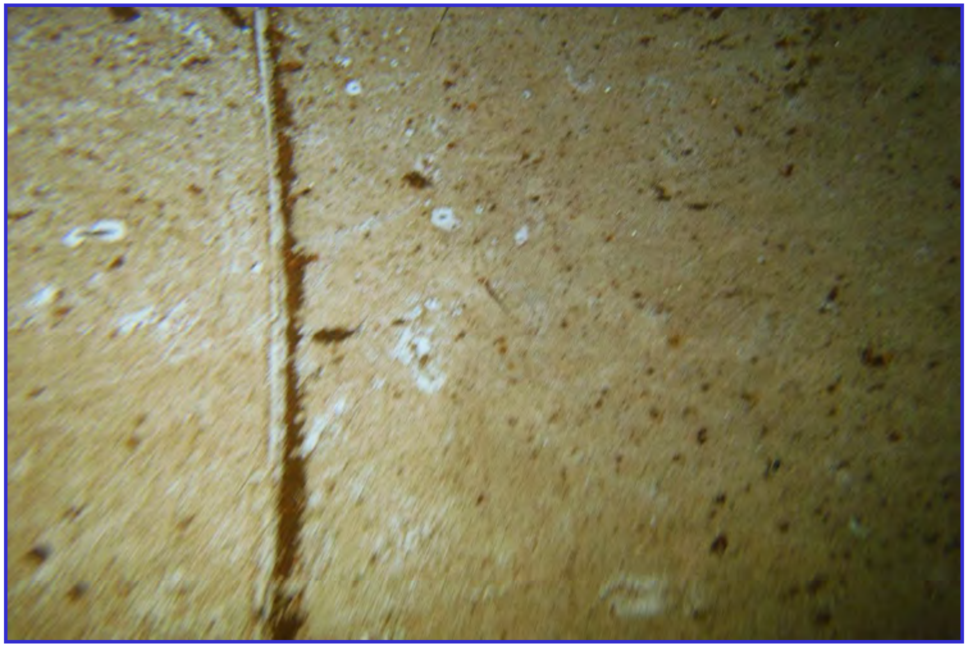
INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -137



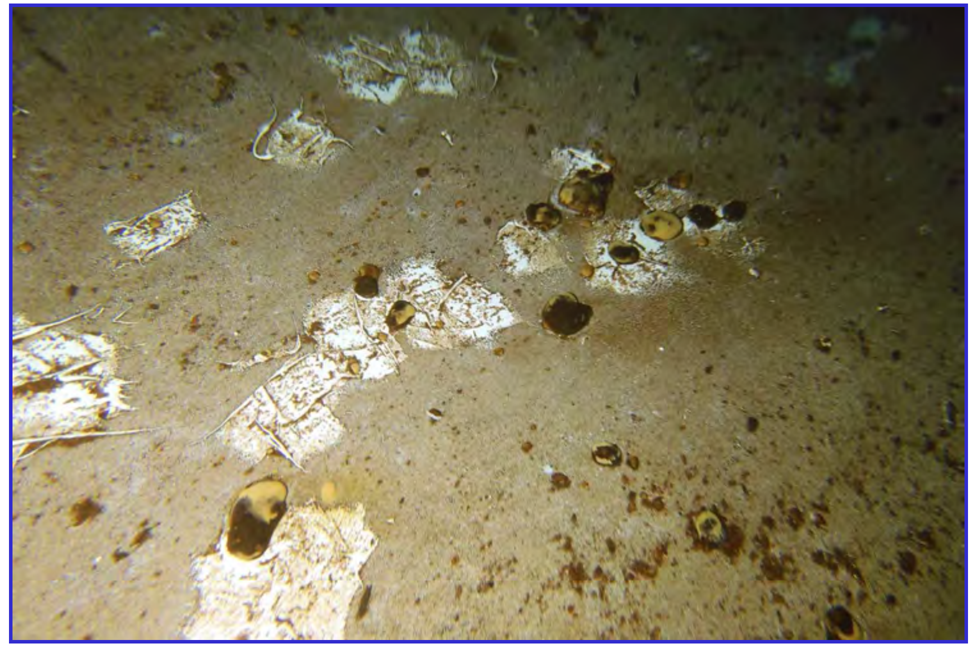
INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -138



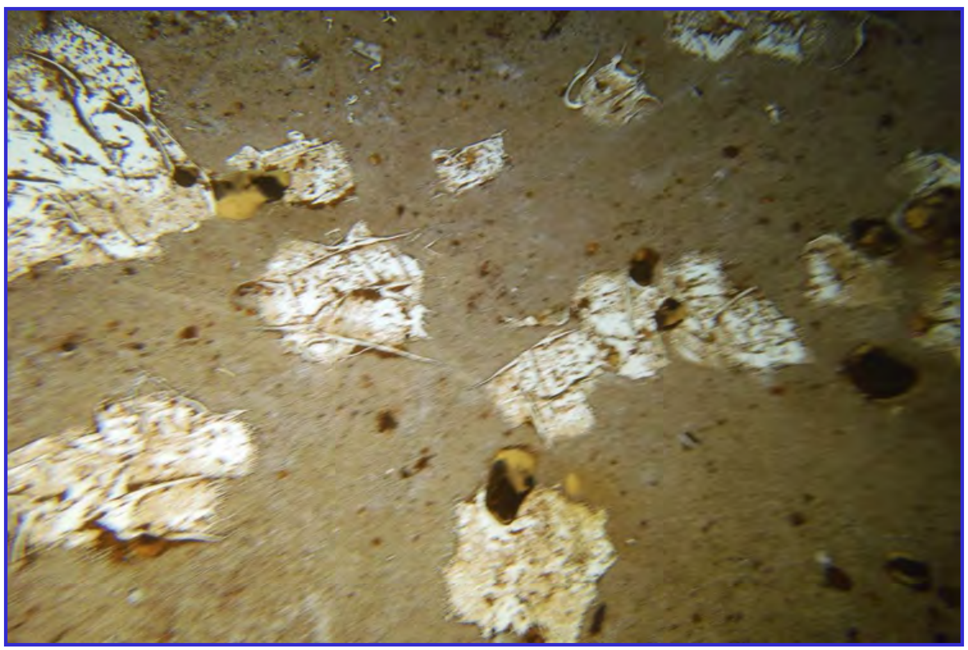
INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -139



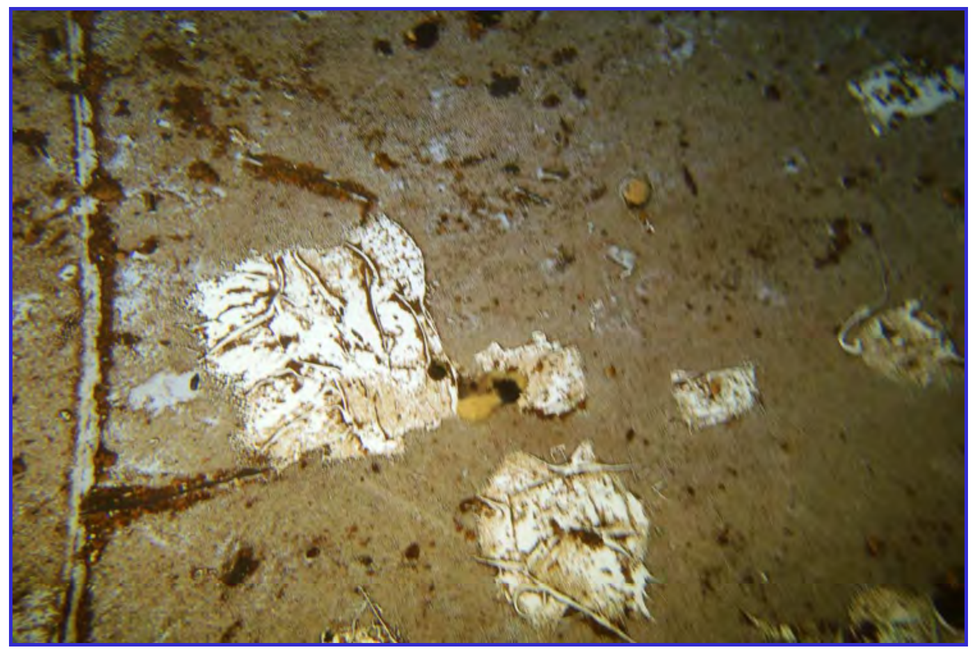
INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -140



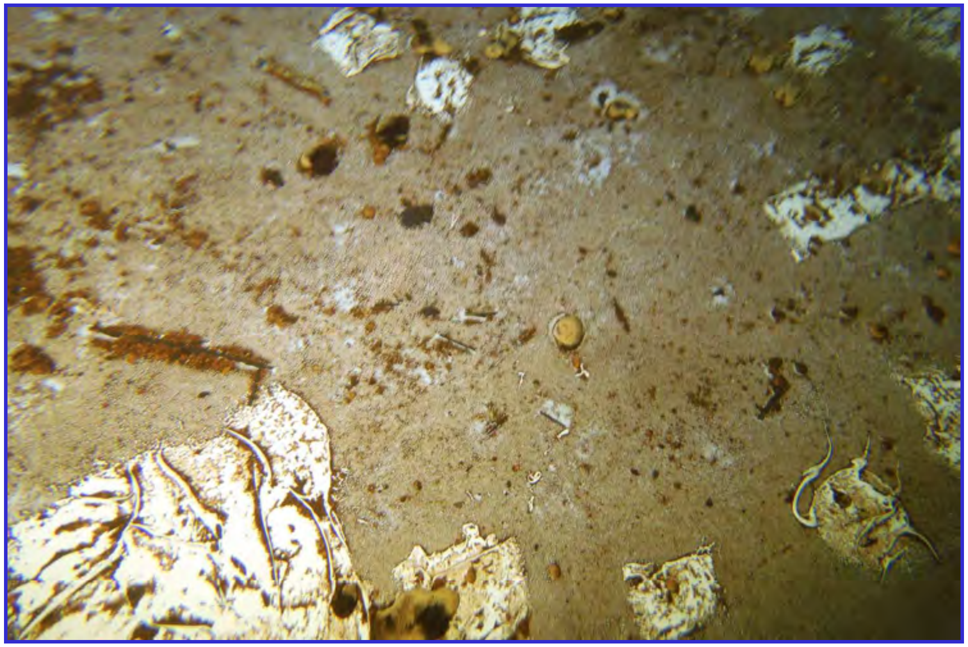
INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -141



INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -142

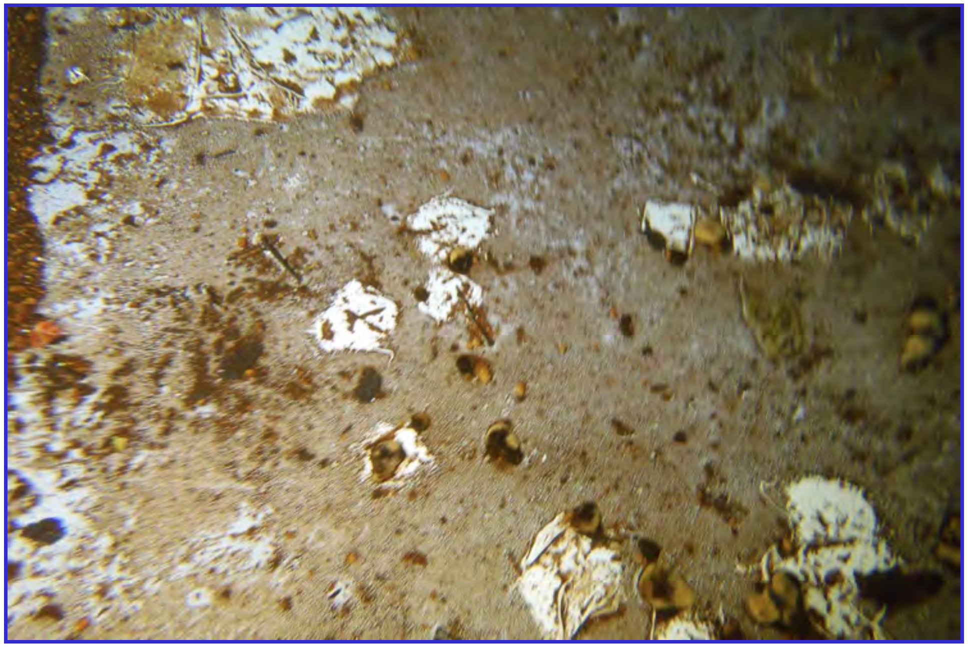


INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -143



INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -144

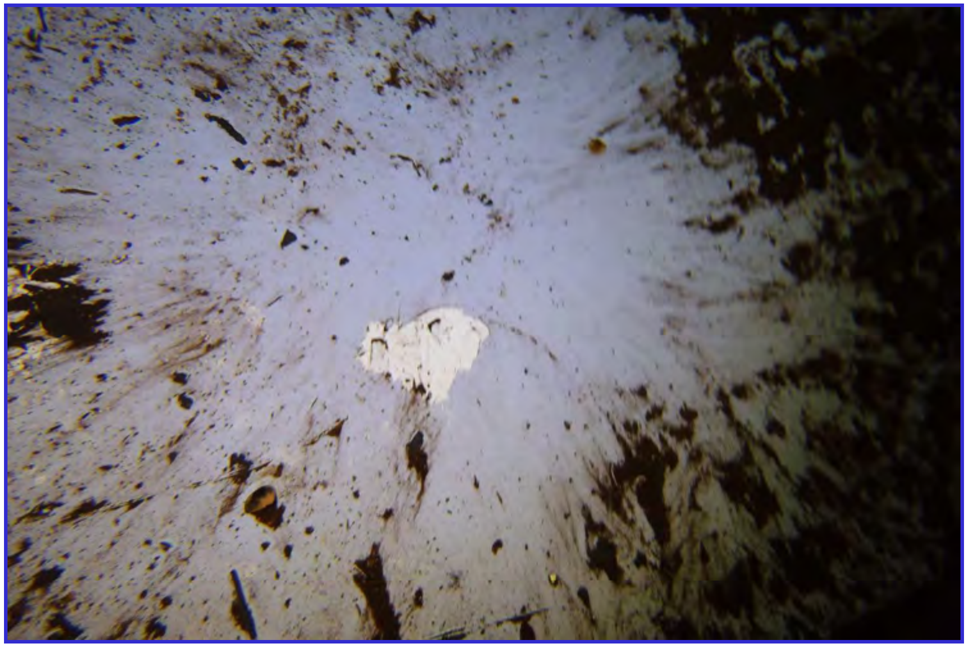
INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -145



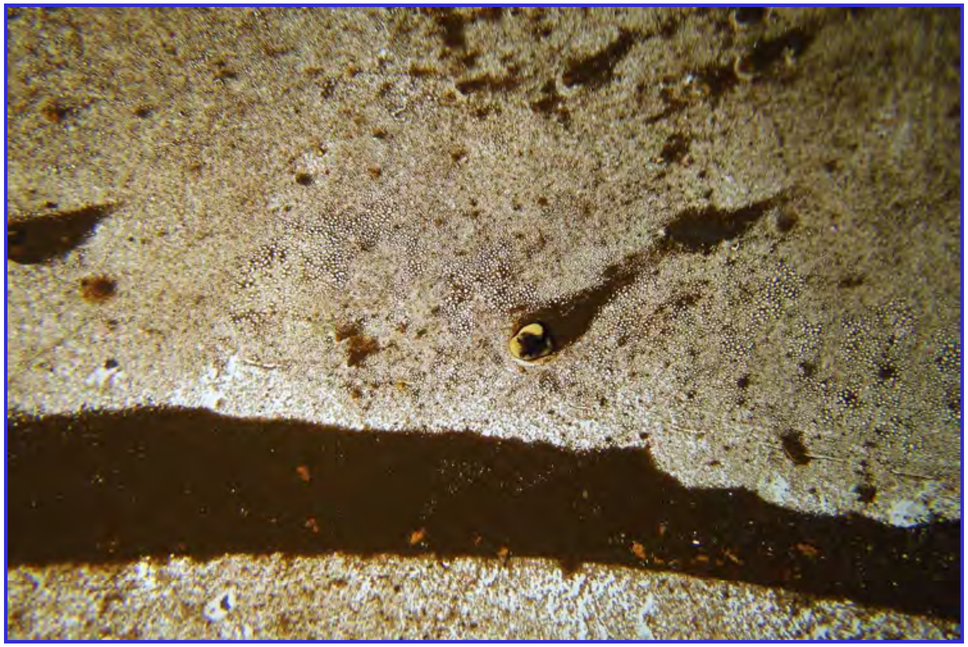
INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -146

INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -147

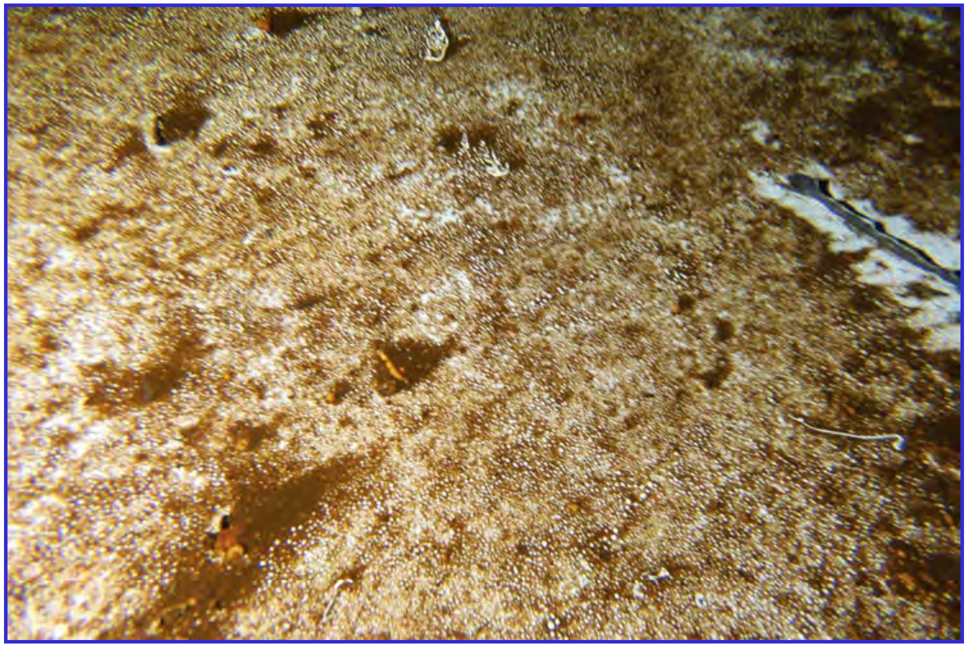
INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -148



INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -149

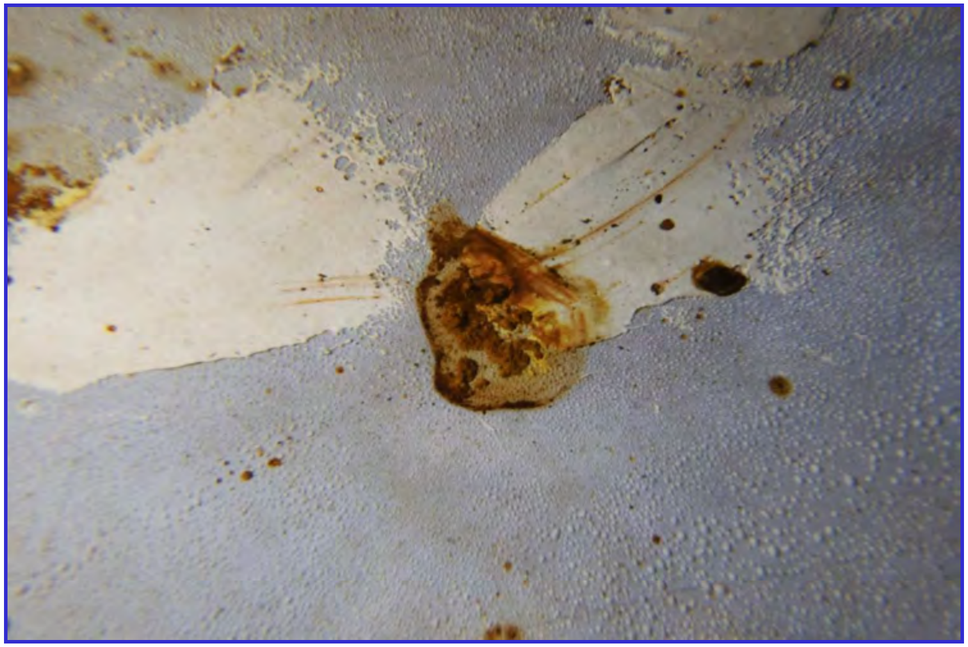


INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -150



INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -151

INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -152

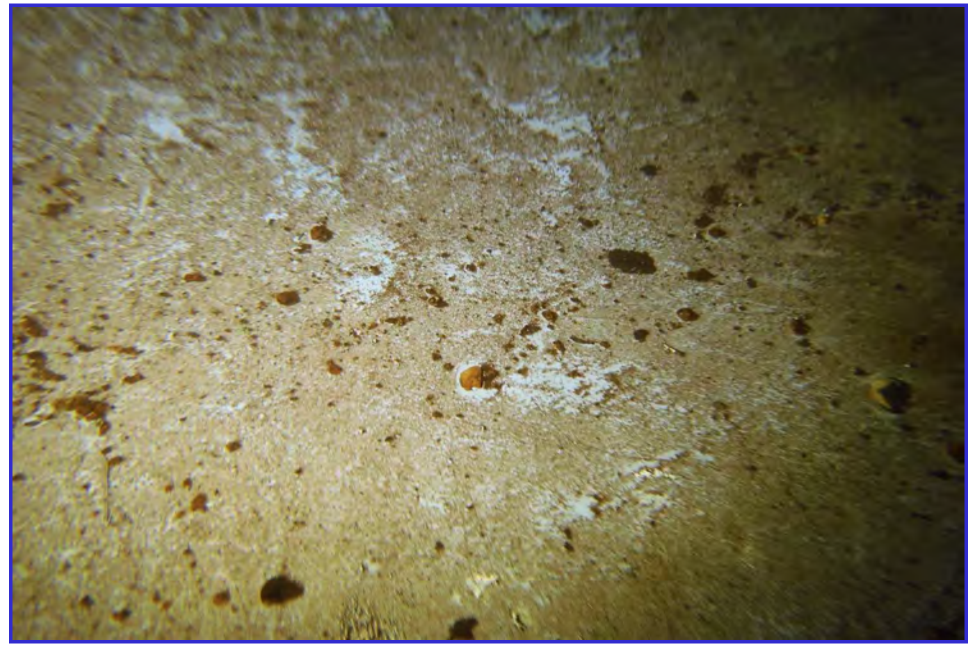


INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -153

INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -154

INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -155

INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -156



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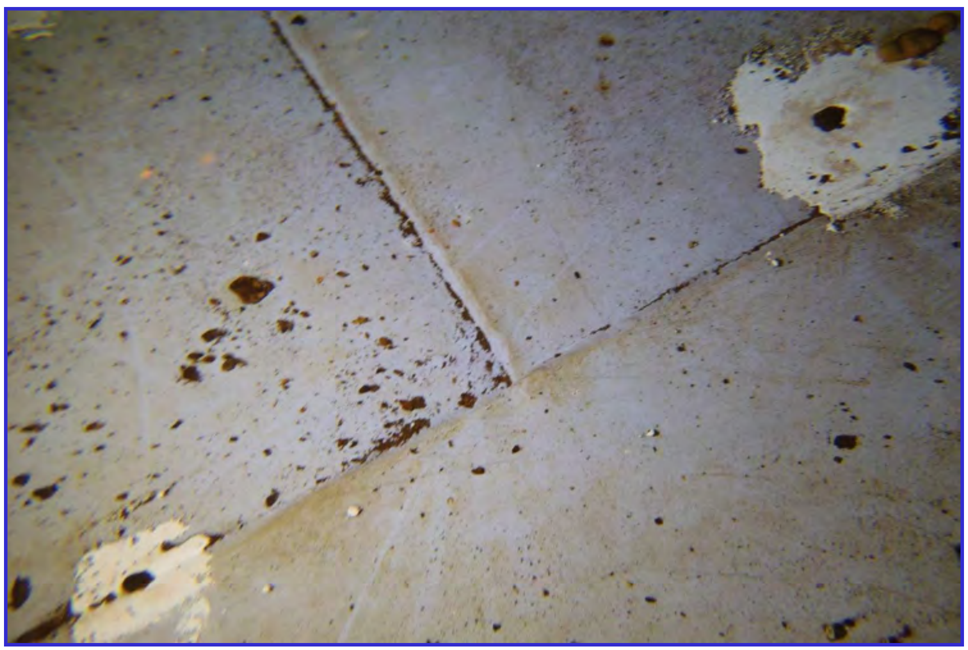
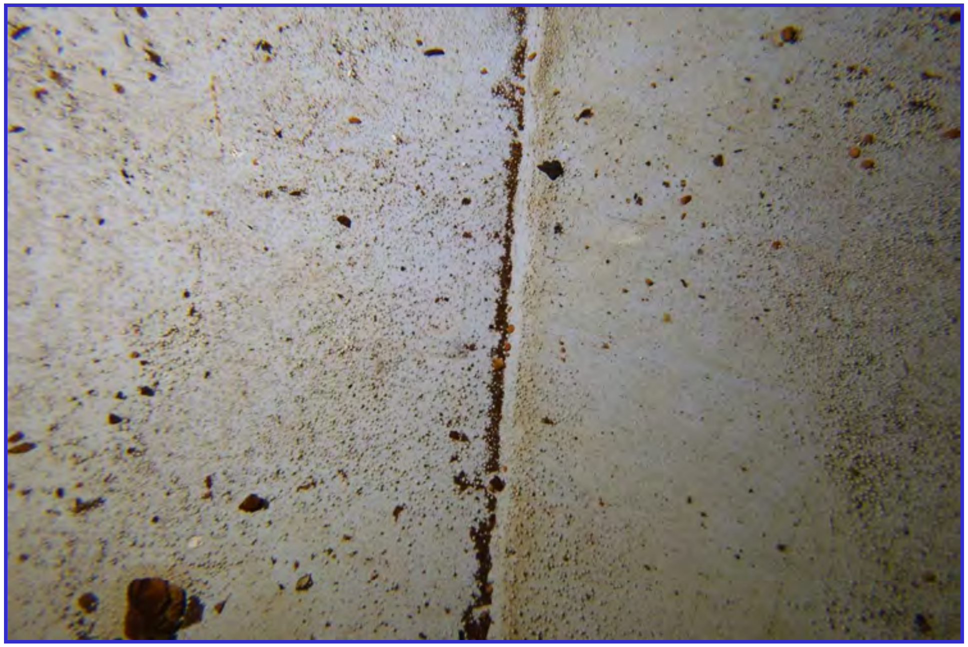


INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -158

INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -159



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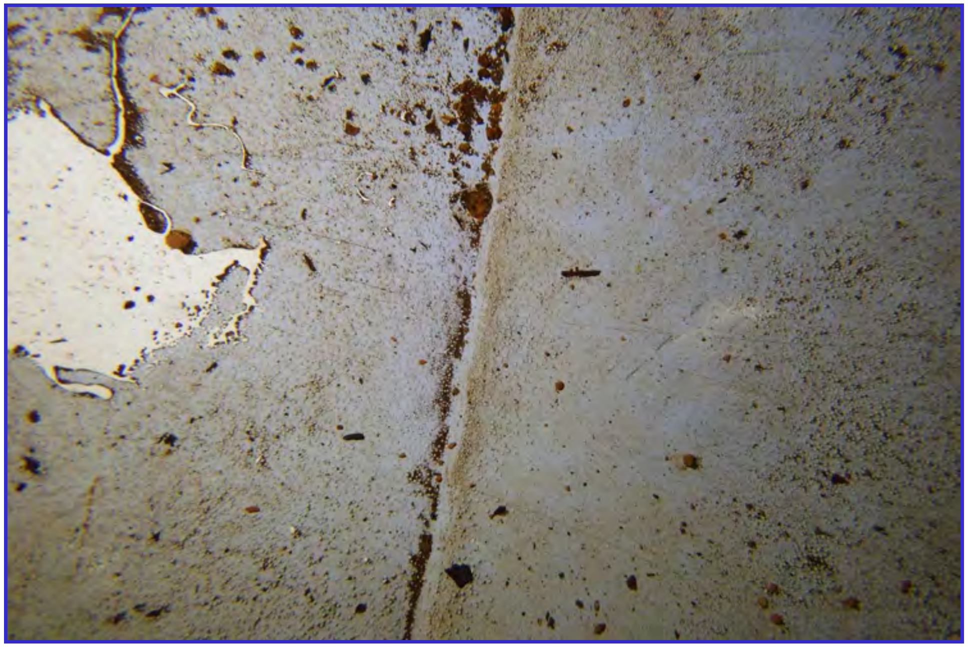
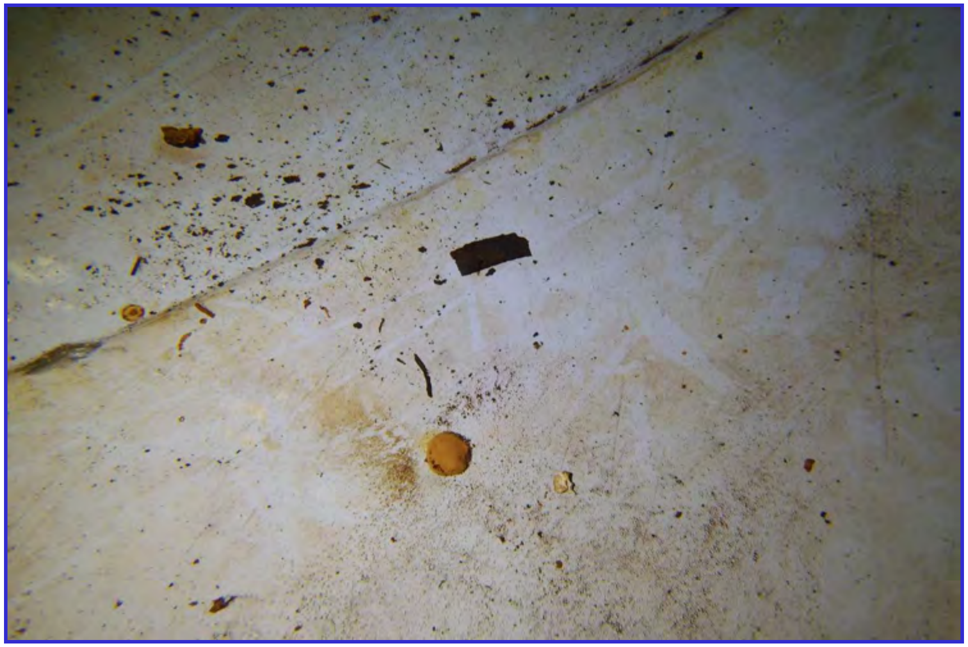


INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -161

INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -162



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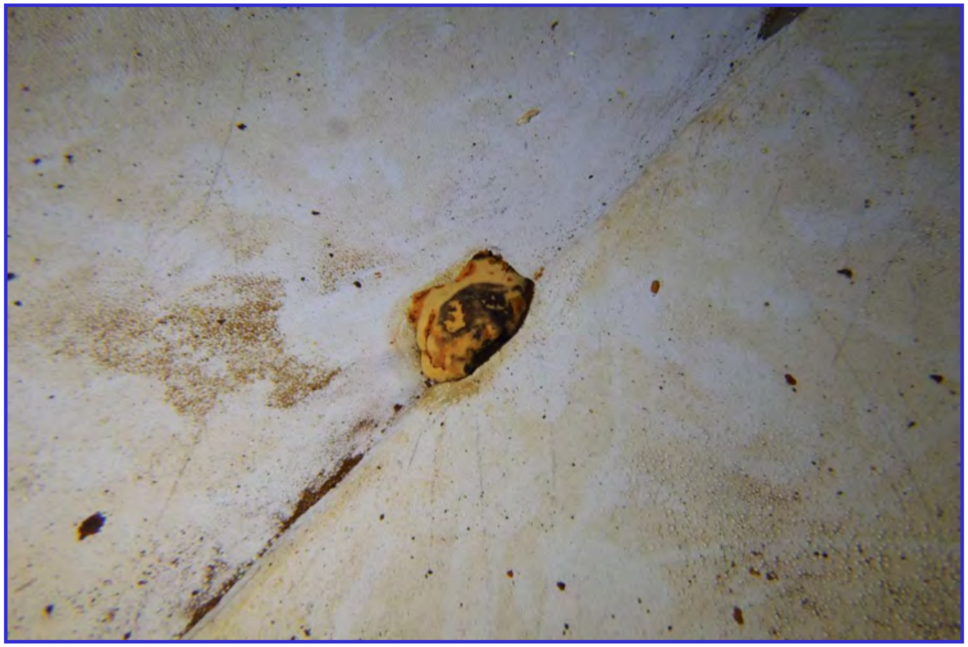
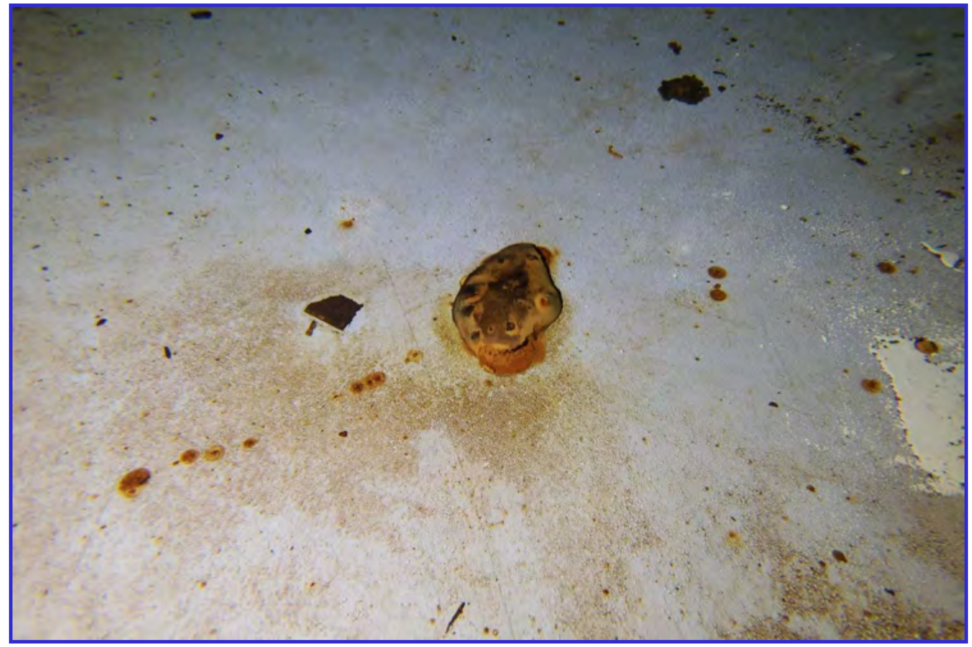
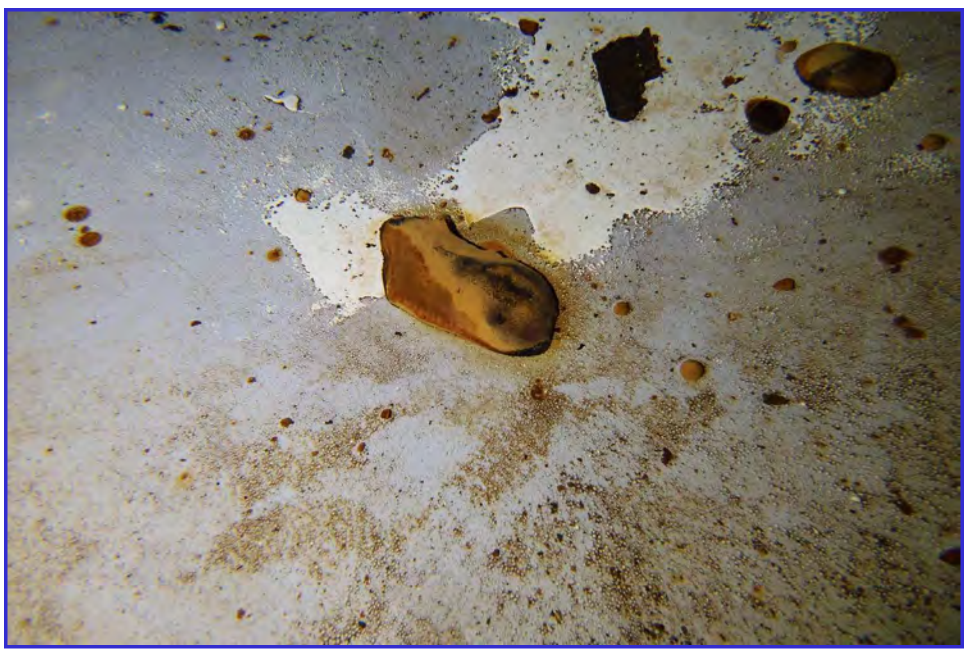


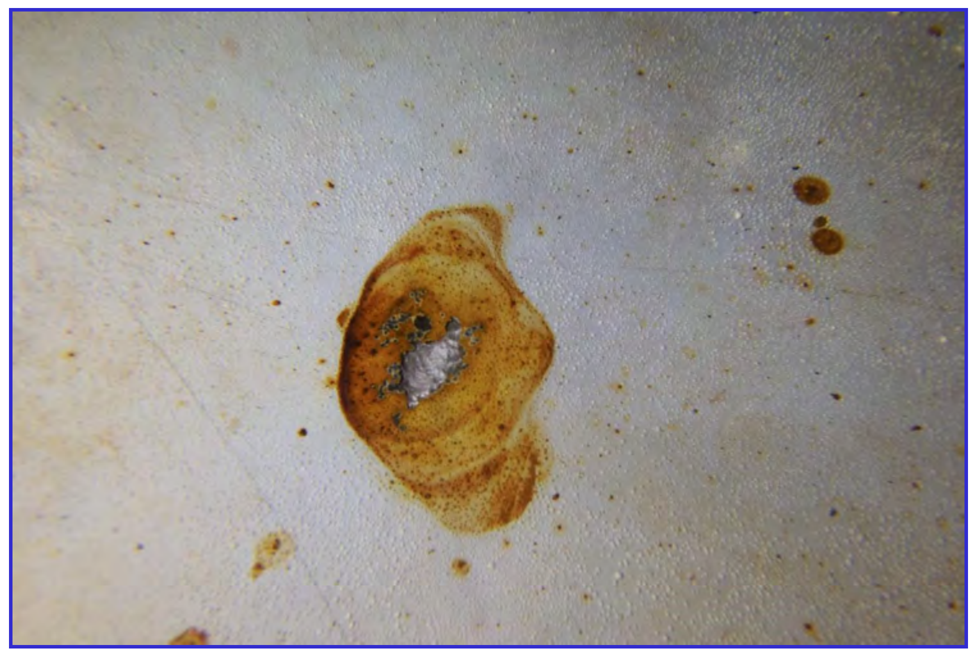
INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -164



INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -165



INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -166

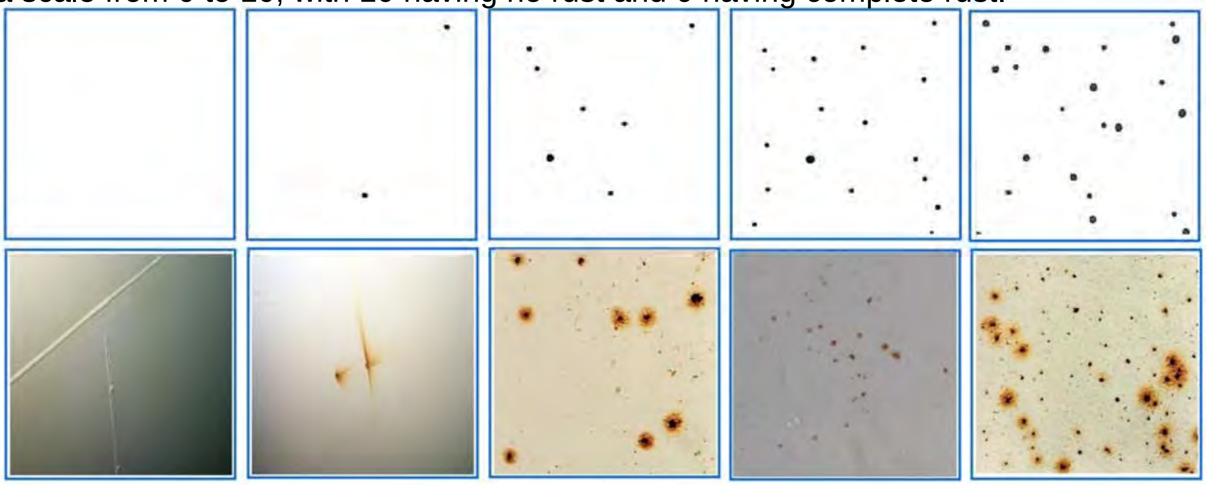


INTERIOR - CPUD - Mokelumne Hill Reservoir - Maintenance Inspection -167

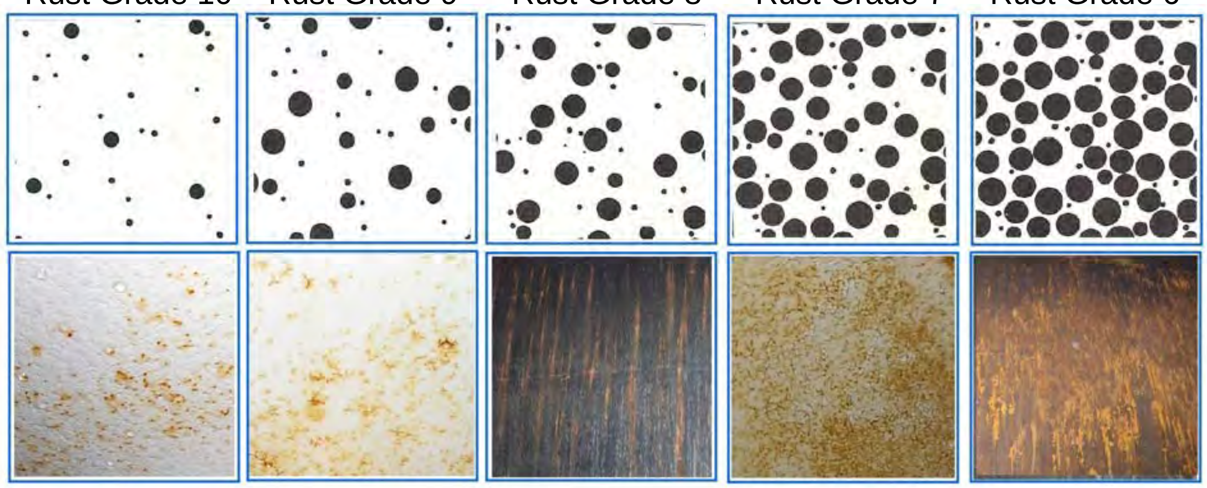
Chart 1 - Condition Rating The table below gives a basic description of the four different categories that CSI Services, Inc. uses to provide a general depiction of the condition of each defined area of a structure. The categories are Poor, Fair, Good, or Excellent. The development of these categories is based on historical knowledge and experience of various paint and lining systems over given periods of time in certain service environments. Basically, the rating is determined based on what should be expected of the paint or lining system at that point in its life cycle. As a result, different determinations are made for maintenance inspection versus warranty inspections. A detailed description of each rating with relative consideration addressed follows:

Rating	General Description of Conditions	
	Maintenance Inspection	Warranty Inspection
Poor	This condition is usually prioritized for rework in the short-term. Typically, these surfaces have considerably more coating defects and/or corrosion than what is expected for the age of the system.	This condition identifies an area with wholesale coating defects or corrosion concerns that will typically require significant removal and replacement of the coatings in the area.
Fair	Typically, these surfaces have a level of coating defects and/or corrosion that is slightly worse than what should be expected for the age of the system. This condition is placed on a short-term monitoring schedule.	This condition identifies an area with partial coating defects or corrosion concerns that will require significant rework.
Good	This condition is rated for areas without any considerable coating defects or corrosion. These surfaces are in a condition that is typical for the age of the coating system.	This condition identifies areas with coating defects or corrosion that is typically seen in one-year warranty inspections. Typically, only minor spot repairs are required.
Excellent	This condition is for areas without any considerable coating defects or corrosion. Typically, these surfaces are in a condition that is better than expected for the age of the system.	This condition identified areas that typically are in perfect condition and require no repair work.

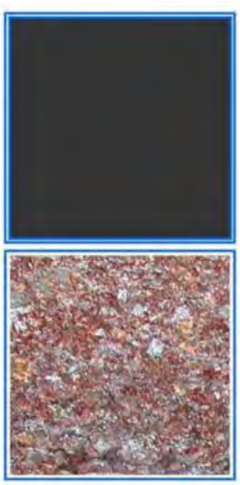
Chart 2 -Rust Grade The black and white figures below depict the standards referenced in ASTM D610 “Standard Test Method for Evaluating Degree of Rusting on Painted Surfaces.” Below each standard is a photographic depiction of each level of corrosion, as used by CSI Services, Inc. The standards depict the percentage of rust on a scale from 0 to 10, with 10 having no rust and 0 having complete rust.



Rust Grade 10 Rust Grade 9 Rust Grade 8 Rust Grade 7 Rust Grade 6



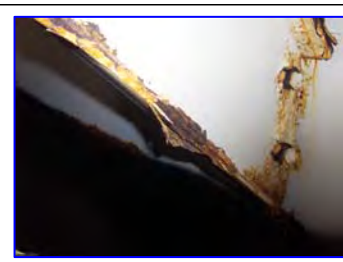
Rust Grade 5 Rust Grade 4 Rust Grade 3 Rust Grade 2 Rust Grade 1



Rust Grade 0

Rust Grade	Description
10	No rusting or less than 0.01% of surface rusted
9	Minute rusting, less than 0.03% of surface rusted
8	Few isolated rust spots, less than 0.1% of surface rusted
7	Less than 0.3% of surface rusted
6	Excessive rust spots, but less than1% of surface rusted
5	Rusting to the extent of 3% of surface rusted
4	Rusting to the extent of 10% of surface rusted
3	Approximately one-sixth of the surface rusted
2	Approximately one-third of the surface rusted
1	Approximately one-half of the surface rusted
0	Approximately 100% of the surface rusted

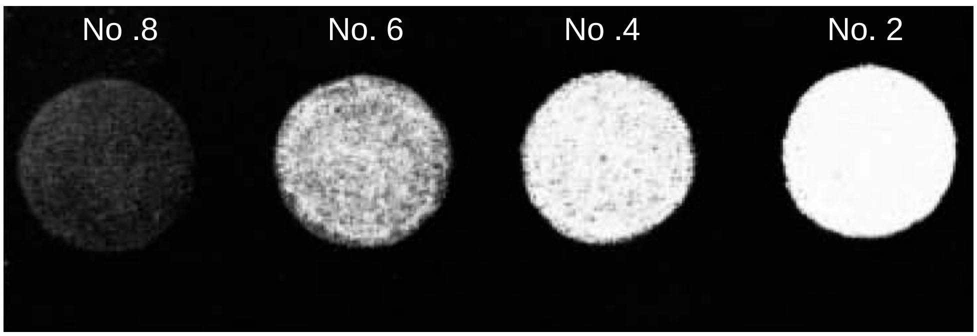
Chart 3 - Corrosion Grade The figure below depicts the photographic standards referenced by CSI Services, Inc. in the determination of the characteristics and stages of corrosion progression. This standard is used to better quantify the level of corrosion once it has progressed to Rust Grades 3, 2, 1, or 0 (see Chart 2). When applicable, CSI classifies an area as one or more of the five different Corrosion Grades. Corrosion Grades 1 through 5 are described below:

Grade	Description	Photo Examples
1	Light Rust - This condition involves relatively light colored rust that does not have any significant metal loss.	 
2	Dark Rust -This condition involves relatively dark colored, thicker rust that is progressing towards the next phase, significant metal loss.	 
3	Pitting - This condition involves isolated or widespread deep spot corrosion (pitting).	
4	Scale - Also known as lamellar or exfoliation corrosion. The edges of the affected area are leaf like and resemble the separated pages of a wetted book.	 
5	Structural Loss - This condition involves metal loss or failure where components will require structural consideration	 

The photos depicted are examples and were not taken on this project.

Chart 4 - Chalking The figure below depicts the photographic standards referenced in ASTM D4214 "Standard Test Method for Evaluating the Degree of Chalking of Exterior Paint Films," Method D659, Method C. Generally speaking, chalking is the degradation of a paint's binder leaving behind loose pigments as the binder reacts with the environment, primarily ultraviolet light and oxygen. Evaluating chalking is a means to measure the performance of a coating system and its life cycle projection. It is also important to quantify for consideration of future overcoating options. This test uses these pictorial standards to quantify the amount of chalking present on paint films. The depictions below represent the mount of colored chalk removed onto a cloth during the test. The scale ranges from 2 to 8 with the rating 2 having the most chalk.

Light Colored Paints



Dark Colored Paints

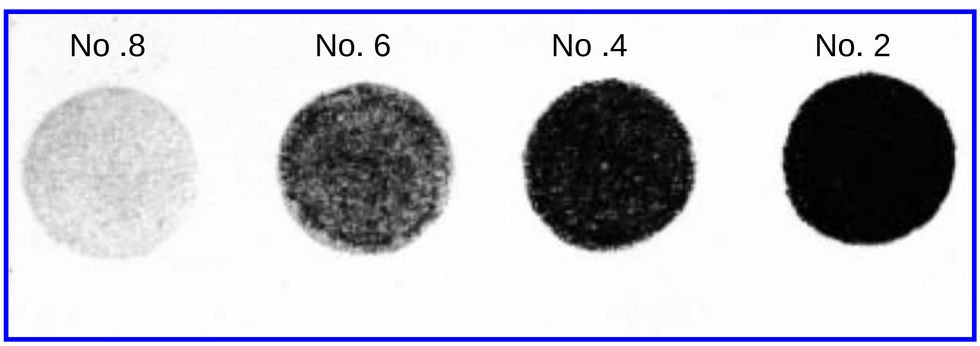
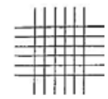
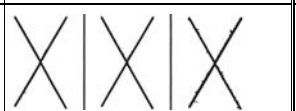
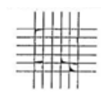
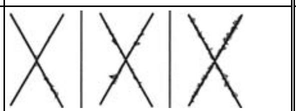
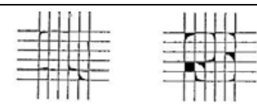
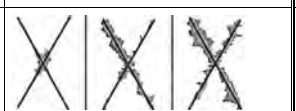
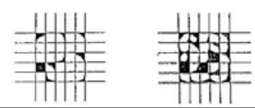
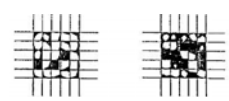
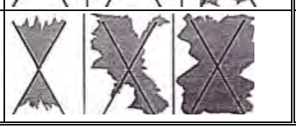
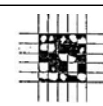
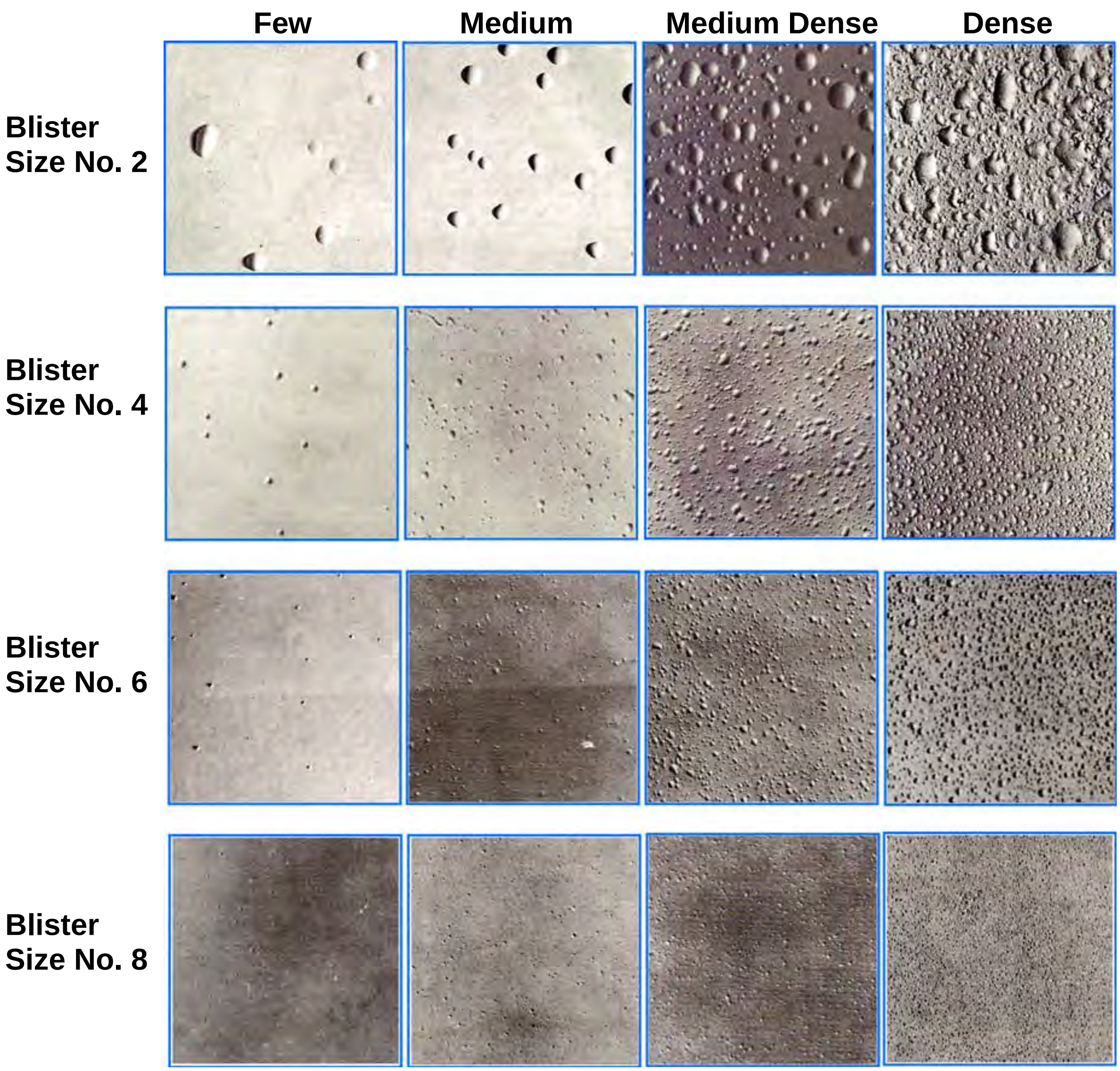


Chart 5 - Adhesion Rating The figures below depict the photographic standards and criteria referenced in ASTM D3359 “Standard Test Method for Evaluating Adhesion by Tape Test” and ASTM D6677 “Standard Test Method for Evaluating Adhesion by Knife.” Both Standards are used to assess the condition of a paint system for life-cycle projections. It is also used to evaluate an existing paint system’s ability to withstand the added stress that any overcoating strategies can create. Depending upon the thickness of the paint system, ASTM D3359 has two different test methods. The rating criteria for both standards follow:

ASTM D3359					
Method A			Method B		
Rating	**Observation**	**Surface of X-cut from which flaking/peeling has occurred**	**Rating**	**Percent Area Removed**	**Surface of cross-cut area from which flaking has occurred for six parallel cuts and adhesion range by percent**
5A	No peeling or removal	None	5B	0% none	
4A	Trace peeling or removal along incisions or their intersection		4B	Less than 5%	
3A	Jagged Removal along incisions up to 1/16” on either side		3B	5 – 15%	
2A	Jagged removal along most of incisions up to 1/8” on either side		2B	15 – 35%	
1A	Removal from most of the area of the X under the tape		1B	35-65%	
0A	Removal beyond the area of the X		0B	Greater than 65%	

ASTM D6677	
Rating	Description
10	Fragments no larger than $\frac{1}{32}$” x $\frac{1}{32}$” can be removed with difficulty
8	Chips up to $\frac{1}{8}$” x $\frac{1}{8}$” can be removed with difficulty
6	Chips up to $\frac{1}{4}$” x $\frac{1}{4}$” can be removed with slight difficulty
4	Chips larger than $\frac{1}{4}$” x $\frac{1}{4}$” can be removed with slight pressure
2	Once coating removal is initiated by knife, it can be peeled at least $\frac{1}{4}$”
0	Coating can be peeled easily to length greater than $\frac{1}{4}$”

Chart 6 – Blistering Rating The figure below depicts the photographic standards referenced in ASTM D714 "Standard Test Method for Evaluating Degree of Blistering of Paints". This test uses these pictorial standards to quantify both the size and density of blisters that may develop in linings. Although the standard uses a blister size scale of 0 to 10 this chart uses the most common sizes of blisters found in the field. The standard does not use a reference for the size of each of the blisters depicted. CSI used this scale as a means for further quantification by qualifying the largest blister depicted as being 1 inch in width (Blister Size No. 2) and the smallest blister being 1/32 of an inch in width (Blister Size No. 8).



P. O. Box 801357
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www.CSIServices.biz

Providing Quality Technical Services to the Coating Industry

November 19, 2023 ***Via Email:*** asmith@pbieng.com

Ashley Smith, PE
Peterson Brustad Inc.
80 Blue Ravine Road, Suite 280
Folsom, CA 95630

Office: 916.608.2212
Cell: 530.200.6309

Subject: **Final Report - Maintenance Inspection**

Re: **CPUD – Paloma Reservoir**

Dear Ashley:

Please find attached the final report for the evaluation that was completed on the above referenced tank. Also attached is our invoice.

Thank you for your business and please let me know if you have any questions or comments about our findings. I can always be reached by cell at 951.609.6991 or by e-mail at rgordon@csiservices.biz.

Sincerely,
CSI Services, Inc.

N. Randy Gordon

N. Randy Gordon, PCS
Technical Services Manager

CSI SERVICES

P. O. Box 801357, Santa Clarita, CA 91380 877.274.2422

Final Report
Maintenance Inspection
Paloma Reservoir
Calaveras Public Utility District

Prepared for:
Ashley Smith, PE
Peterson Brustad Inc.
80 Blue Ravine Road, Suite 280
Folsom, CA 95630

Prepared by:
CSI Services, Inc.

N. Randy Gordon, PCS
Technical Services Manager

PROTECTIVE COATING SPECIALIST • N. RANDY GORDON • No. 2018-621-011 • Exp. 12-31-26 • PCS • STATE OF CALIFORNIA

November 19, 2023

Hawaiian Office: P.O. Box 671, Aiea, HI 96701
Northern California Office: P.O. Box 371, Sonoma, CA 95476
Coating Specialists and Inspection Services, Inc.

Consulting ***Evaluations*** ***Tank Diving*** ***Inspection***

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Attachments

- Field Notes
- Exterior Photos
- Interior Photos
- CSI Chart 1 – General Description of Conditions
- CSI Chart 2 – Rust Grade Criteria
- CSI Chart 3 – Corrosion Grade Criteria
- CSI Chart 4 – Coating Chalking Criteria
- CSI Chart 5 – Coating Adhesion Criteria
- CSI Chart 6 – Coating Blistering Criteria

Introduction

Peterson Brustad Inc. authorized CSI Services, Inc. (CSI) to conduct a maintenance inspection on the Calaveras Public Utility District, Paloma Reservoir located at Paloma Road, Valley Springs CA. This report documents the findings of the inspection and services performed.

Any recommendations have been made in accordance with the applicable requirements of American Water Works Association's Standard (AWWA) D102 "Coating Steel Water Storage Tanks," AWWA Standard M42 "Steel Water Storage Tanks," and CSI's experience with evaluating over a thousand water storage facilities. A photo summary and narrated video are also included to document the condition of the tank.

The field-work was completed on August 9, 2023 by a team primarily comprised of Anthony Jackson, Steven Metcalf and Steven Metcalf Jr. The exterior shell observations were made mostly from grade level, while the exterior of the roof was examined close-up. The interior inspection was carried out with the tank’s water level at approximately 21 feet using special underwater diving equipment and techniques. Steve Metcalf was the site supervisor and Anthony Jackson was the lead diver. Mr. Randy Gordon, Technical Services Manager, reviewed the results of the field data and prepared recommendations for maintenance work. Mr. Gordon has over 30 years of experience through the evaluation of thousands of storage tanks and other structures. He is certified as an SSPC Protective Coating Specialist (PCS) and NACE/SSPC Level 3 Coating Inspector.

Summary

The estimated 40+ year old coating systems on the tank are in overall poor condition with widespread and pervasive corrosion. The exterior paint system is severely weathered but has satisfactory adhesion, making it an ideal candidate for overcoating strategies. The exterior paint is believed to be the original system applied and very likely has high concentrations of heavy metals (e.g. lead, chromium, etc.) that will require special precautions to protect the workers and environment when it is disturbed.

The lining in the tank is in an overall unsatisfactory condition with widespread rust including undercutting, pitting, exfoliation, and structural loss. Blistering of the lining below the MWL is extensive and widespread. The most advanced corrosion spots below the CWL were patched during this inspection using an NSF certified underwater curing epoxy. The existing lining conditions dictate that the lining system should be removed and replaced within the next 1 to 2 years to prevent any additional structural loss.

Background

The Paloma Reservoir is a welded steel on grade structure where the year of construction is unknown as the nameplate is weathered and unreadable but estimated to be a 1980's era structure. The tank is approximately 30 feet in diameter by 24 feet high providing a nominal capacity of 125,000 gallons.

The tank shell has three courses that are connected to a conical roof with rafters, girders and one center column. The tank has one roof vent, one roof hatch, and two shell manways. There is one interior ladder and one exterior ladder. The exterior ladder has fall protection and a vandal deterrent. The tank is not seismically anchored to its concrete foundation. There is no internal or external cathodic protection (CP) system associated with this tank. The tank has a full-travel water level indicator, rigid piping connections, and the overflow is external.

It is believed that the interior linings are the original coatings applied. The interior steel surfaces, including the roof and roof support members are coated with a coal tar epoxy system and the tank bottom is lined with a hot applied enamel. The exterior roof, shell, and appurtenances are painted with what appears to be an alkyd system. The internal roof lap seams are not caulked.

Field Evaluation

The purpose of this survey was to assess the condition of the existing coatings and recommend maintenance coating work, where needed. The evaluation mainly involved visual observations, but also involved various testing procedures. Photographs and video were taken to document the field inspections, and a photo summary and narrated video is included within this report.

For survey purposes, the tank has been segmented into defined areas: exterior roof, exterior shell, interior roof, interior shell, and interior floor. The various appurtenances within each of these areas have also been evaluated. A rating system has been developed to quantify the condition of these various tank areas. Each of the rating criteria is found in the Attachments (Charts 1 through 6).

The condition of the coating systems was rated as being poor, fair, good, or excellent (Chart 1). The extent of any rust defects identified within each of the areas was generally determined using the guidelines set forth in ASTM D610 "Standard Test Method for Evaluating the Degree of Rusting of Painted Steel Surfaces" (Chart 2). Where applicable, the characteristic or stage of corrosion was determined in accordance with CSI Corrosion Grade criteria (Chart 3). The degree of paint chalking was determined in accordance with ASTM D4214 “Standard Test Method for Evaluating the Degree of Chalking of Exterior Paint Films,” Test Method D659, Method C (Chart 4). Coating adhesion was assessed in accordance with ASTM D3359 “Standard Test Method for Evaluating Adhesion by Tape Test, modified Method A and/or a modified version of ASTM D6677 “Standard Test Method for Evaluating Adhesion by Knife” (Chart 5). The modified version of ASTM D6677 was used in areas where destructive testing was not found to be practical. Any blistering that may have been present was rated in accordance with ASTM D714 “Standard Test Method for Evaluating the Degree of Blistering in Paints” (Chart 6), and the paint dry film thickness was measured with a Positector 6000FN3 Type II gage in accordance with the applicable guidelines set forth SSPC PA2. The visual observations and data collected from the various areas of the tank are found in the charts below:

Exterior

Close-up visual examination of the coating was limited to the first (lowest) shell course, upper shell areas adjacent to the ladder, and the roof. The exterior paint on the heavily weathered roof is in poor condition and the shell was in fair condition, both with moderate chalking (ASTM D4214, No. 8). Dark rust (CSI Corrosion Grade 2) was present in areas that had been mechanically damaged from operations or vandalism and areas where paint was peeling. The amount of rust on the roof was less than 0.1 percent of the overall surface area (ASTM D610, 8). Areas where paint was found to be cracking were rated a 2 in accordance with ASTM D661. The paint thickness was found to range from 3.0 to 4.0 mils, and the paint was estimated to exhibit satisfactory adhesion (ASTM D6677, 5A). Some of the specific data collected follows:

Exterior Paint — Overall Condition: Fair

Paint Defects	Roof Quadrant				Shell Quadrant				Tank Support			
	Exterior		Poor		Exterior		Fair		Exterior		Fair	
	S	W	N	E	S	W	N	E	S	W	N	E
Rust spots (ASTM D610)	8	8	8	8	8	8	8	8	8	8	8	8
Corrosion Grade	2	2	2	2	2	2	2	2	2	2	2	2
Rusting at crevices												
Spot peeling												
Delamination												
Cracking (ASTM D661)												
Checking (ASTM D660)												
Chemical staining												
Chalking	8	8	8	8	8	8	8	8	8	8	8	8

Interior

The roof area is defined as those surfaces above the highest water level (HWL). Close-up visual examinations were made to all areas below the waterline and all other areas were assessed from the water level. The coating on the underside of the roof plates and roof support structure is in poor condition with corrosion common to the edges of the support member flanges and roof plates (CSI Corrosion Grade 2). Spot peeling, cracking, exfoliation and structural loss was observed throughout (CSI Corrosion Grade 2, 3, 4, 5). The total amount of corrosion on the roof was rated to be approximately one sixth of the total surface area (ASTM D610, 3), and there was a moderate amount of rust staining present at the faying surfaces of the roof structure.

The shell surfaces are covered with a dark sediment, but spot checking revealed the lining on the shell was found to be in poor condition with areas of dark rust (CSI Corrosion Grade 2), especially below the high-water level segment of the shell. The total amount of corrosion on the shell was rated to be excessive but less than 1 percent of the total surface area (ASTM D610, 6) with some minor pitting observed. Fields of intact and broken, medium dense blisters were observed (ASTM 714, 2-few).

The floor had sediment upon it, but spot checking revealed an epoxy system that was estimated to be in poor condition, (ASTM D610, 6) with fields of small, medium-dense blisters (ASTM 714, 2-few). Some pitting uncovered upon the floor was patched during the inspection and the prior patches were observed to be performing properly.

The data collected from the underwater inspection follows:

Interior Paint			**Above Water Condition**			Poor		**Below Water Condition**			Poor	
Paint Defects/Overall Grade	**Roof Quadrant**				**Shell Quadrant**				**Floor Quadrant**			
	Interior		Poor		Interior		Poor		Interior		Poor	
	S	**W**	**N**	**E**	**S**	**W**	**N**	**E**	**S**	**W**	**N**	**E**
Rust spots (ASTM D610)	3	3	3	3	6	6	6	6	6	6	6	6
Rust areas (ASTM D610)												
Corrosion Grade	2,3,4,5	2,3,4,5	2,3,4,5	2,3,4,5	2	2	2	2	2	2	2	2
Rust staining												
Rusting at crevices												
Spot peeling	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Delamination												
Cracking (ASTM D661)	2	2	2	2	2	2	2	2	2	2	2	2
Blistering (ASTM 714) Size/Densit					2/Few	2/Few	2/Few	2/Few	2/Few	2/Few	2/Few	2/Few
Pitting (Estimated Amount)												
Pitting (Estimated Deepest Mils)												

Dive Inspection Video

Click on link or cut and paste the external link: https://youtu.be/SBcayd1PcEg

Discussion

The paint system on the exterior was found to be very thin and in fair condition on the roof and fair condition at the shell. Although these surfaces have some isolated spot rust and areas of peeling, the paint system was found to have significantly weathered from chalking.

Generally speaking, there are four possible approaches to maintenance coating work. The coatings can be either completely removed and replaced (repainted), spot repaired, spot repaired and overcoated, or simply overcoated. In evaluating the condition of a coating to determine the best approach there are a number of different factors to consider. The first set of factors includes the determination of the coating's ability to withstand the added stress of an additional coat(s). Attributes impacting this decision include film thickness and adhesion. If a film is too thick or has poor adhesion, the tension from the curing stresses and/or the weight of the additional paint can cause the existing system to disbond. The second set of factors to consider when determining what maintenance coating approach to take is the amount of surface area requiring repair, the overall difficulty in providing access to the structure, and whether the coating system contains heavy metals. The final factor is the condition of the substrate.

When considering whether a spot repair approach is a viable option, a good rule of thumb is that up to 10 percent of the surface area requiring repair is the point at which making spot repairs with overcoat becomes a diminishing return. With 10 percent rusting, overcoating may be an option if the adhesion is better than fair. If there is more than 10 percent rusting and the substrate is free of mill scale, overcoating may be considered an option if the adhesion is satisfactory. Once the amount of surface area exceeds this range, the cost of cleaning and coating the individual rust spots approaches (or exceeds) the total cost of removal and replacement.

Chalking is the term for the powdery characteristic of an aged coating that may also have a faded finish. Chalking is a result of the natural breakdown of a paint system's binder when it is exposed to sunlight. The binder (or resin) degrades in ultraviolet light, which leaves behind the unbound pigment or chalk. A side from a faded appearance, chalking can result in corrosion as the film weathers (thins) away through cycles of wind and rain. As the paint endures years of direct sunlight, it begins to weather away, which results in the paint no longer providing enough barrier protection from corrosion.

Peeling or delaminating coating is a symptom of an adhesion problem between the coating and substrate or from within layers of coating system. Adhesion is a function of a coating system's strength. Peeling is often a result of coated over contamination, incompatibility between coats, or from an undercoat being coated after its recoat window had closed. Catalyzed coatings, such as epoxies and urethanes continue to dry and then cure to a point where they become too hard for topcoats to chemically adhere. Once the window for a chemical bond is closed, special procedures such as scarification are required to allow for a mechanical bond.

Industrial paint systems such as those applied to industrial facilities (i.e. piping, structural steel, storage tanks) typically have a life expectancy of 25 to 35 years before any spot maintenance coating repairs are required. The exterior paint system is aged yet remains suitable for overcoating. Therefore, It is recommended that the paint system on the tank be spot repaired and overcoated with a new epoxy urethane system within the next 4 to 6 years.

Overall, the tank interior lining is in poor condition in the area above the highest water level (HWL), and in poor condition below the HWL. The vapor area is replete with corrosion and has advanced to exfoliation and structural loss, primarily at the roof structure. The lining on the underwater areas of the tank is mostly free of widespread corrosion, but there are many rust spots that were patched during the course of the inspection. Many groupings of blisters were encountered at the shell and at the tank bottom.

A tank roof, including its roof support structure has many open, unsealed areas by design. These open areas are primarily at the inaccessible crevices that are between the top of the roof beam flanges and the roof plate. The cost of properly sealing these areas becomes a diminishing return, notably when one considers that small crevice areas often develop into dead-air space. Since corrosion requires oxygen to advance and the initial development of corrosion depletes the majority of the available oxygen, the rate of corrosion is very low. The side effect of this design is rust staining that runs from these areas as they initiate corrosion. Unsealed areas can also include lapped, un-welded roof plates. However, these lapped seams areas can be sealed with caulking at a very cost-effective cost.

Cracking is the result of some form of stress within the coating system that extends through a complete layer of coating. The stress is often a result of some internal coating pressure or from some form of structural movement. The internal pressures can result from a shrinking film when it is applied too thick or if coating a coating does not have the elongation properties required to bridge existing breaks. Checking is related to cracking, but the coating breaks do not extend through the entire system.

Exfoliation corrosion is a form of intergranular corrosion which involves selective attack of a metal at or adjacent to grain boundaries. In this process, corrosion products force metal to move away from the body of the material, giving rise to a layered, laminar appearance. Exfoliation corrosion is also known as layer corrosion or lamellar corrosion.

Undercutting is a characteristic of corrosion when it travels laterally up under a coating that has inadequate adhesion. A coating with an excellent bond to the substrate inhibits the exponential advancement of rust from growing from a small rust spot.

Since all of the blisters were underwater and below the common water level, it is presumed that the blisters are a result of osmotic forces. Osmotic blistering is typically caused when coatings that are to be placed into immersion service are applied too thick, overcoated too soon, under colder weather conditions, and/or over contaminated surfaces. One form of osmotic blistering is solvent entrapment. Solvents are added to coatings to act as a vehicle during application. When coatings are applied too thick the coating solvents that were designed to be released during application are locked in-place when the catalyzed coating reaches a full chemical cure. Additionally, if coatings are applied under cold or cooler conditions, the solvents have a difficult time escaping from the film before it gets hard. Blisters that result from solvent entrapment tend to be localized to the coolest and lowest areas of a tank. Solvent vapors are typically heavier than air, and the lowest portion of a tank tends to become saturated with these gases without proper ventilation at the time of application. Coated over contamination creates a source for osmotic forces. This contamination attracts fluid that creates pressures that exceed the film's ability to bond, creating blisters.

The surfaces below the HWL waterline had areas of coating defects in the form of small, isolated rust spots, but it should be noted that the most advanced coating defects below the HWL were patched during this inspection using NSF certified underwater curing epoxy.

There are many areas that have been patched underwater and it is believed that these maintenance activities will extended the life of the lining by preventing widespread undercutting corrosion from developing below the highest water level (HWL). It should be noted that underwater patches were applied during this inspection using underwater curing NSF 61 certified underwater curing epoxy. This process will prevent any coating breaks from exponentially growing in the form of undercutting.

Isolated corrosion pits can develop within a coating system that may have only a few small breaks that were not corrected through periodic maintenance repairs. If the remaining, adjacent coating has excellent adhesion, it will inhibit undercutting corrosion. As a result, the corrosion forces will have a tendency to concentrate on the exposed bare metal, which results in pitting. Pitting can be critical in some instances. The maximum corrosion rate for steel in fresh water is typically no more than 30 mils per year (MPY). As a result, the pitting can develop into a perforation if not repaired. If a thru-hole develops within a tank bottom, the isolated issue can develop into a much larger corrosion problem. Corrosion requires oxygen to advance, and the underside of the tank bottoms are considered a dead-air space. As a result, the bottom of tank floors are typically not coated. A perforation or thru-hole with even a small trickle of water will reintroduce oxygen into the environment creating active corrosion that is difficult to identify until the steel floor plate requires replacement.

Thin film epoxy systems are typically designed for 25 to 30 years of service, and the interior lining, at an estimated 40+ years of age, appears to have reached the end of its serviceable lifespan. Therefore, it is recommended that the tank interior lining be removed and replaced within the next 24 months.

The tank ventilation was found to have screening installed without gaps or penetrations.

Recommendations

The following activities are recommended for remedial work:

Exterior:

Within the next four to six years, spot repair and overcoat the exterior coating. This work should include the following:

1) This work should include cleaning all active rust sites in accordance with SSPC's Surface Preparation Standard No. 15, "Commercial Power Tool Cleaning" followed by 4-6 mils of an industrial epoxy primer and 3-5 mils of a polyurethane finish coat.

2) Test the paint system for heavy metals to determine if any special actions are required to protect workers and the environment during paint disturbance.

Interior:

Within the next 1 to 2 years, remove and replace the interior lining. This work should include the following:

3) Remove and replace the lining system at all interior surfaces. This work should include cleaning all surfaces in accordance with SSPC's Surface Preparation Standard No. 10 "Near-White Metal Blast Cleaning" (SSPC-SP10) followed by three 4 to 6 mil coats of an NSF Certified epoxy lining.

4) Caulk all crevices in the tank such as roof lap seams.

5) Anticipate the need for minor structural repairs (welding, grinding, etc.)

6) Consider retrofitting the tank piping to include flexible couplings and the relocation of tank bottom connections to the lower shell.

P.O. Box 801357, Santa Clarita, CA 91380
Phone: 877.274.2422 (toll free)
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www.CSIServices.biz

Page	1	of	1
Date	08/10/23	Thursday	
CSI Job No.	223084		
Completed By	Metcalf		

Field Water Tank Dive Inspection Report

Tank Name:	Paloma	Dive Supervisor:	Steven Metcalf
Tank Owner/Client:	CPUD	Dive Leader:	Anthony Jackson
Client Contact:	Ashley Smith	Dive Tender	Steven Metclaf Jr.

Scope Maintenance Inspection

Site Information

Item	Description
Cross Street	Paloma Rd
Tank Location	Paloma Rd Valley Springs CA
GPS Coordinates	38.26022 -120.74796
Nearest Structures	None
Surrounding Site	Gravel

Item		Notes
Perimeter Fencing	Yes	No Comments
Site secured on arrival	Yes	No Comments
Overhead Power Lines	No	None
Antenna on Tank	No	None
Roof Accessible	Yes	No Comments

Interior Structural Characteristics

Item	Data	
Roof Structure	Rafters and Center Column	
Column Design	Pipe	
Upper Center Column	Dollar Plate	
Column Base Design	Free Plate with Clips	
Connections	Welded	
Overflow Design	Stubs	
Inlet Interior Design	Roof Stub	
Lining Type/Original	Epoxy	Yes

Item	Data			
Outlet Design	Floor Stub			
No. Interior Ladder	Yes	One		
CP System/Type	No	None		
Water Depth	21			
Water Agitator	No	None		
Barrier Walls	No			
No. of Columns	One Column			
Caulking	Roof	No	Columns	No

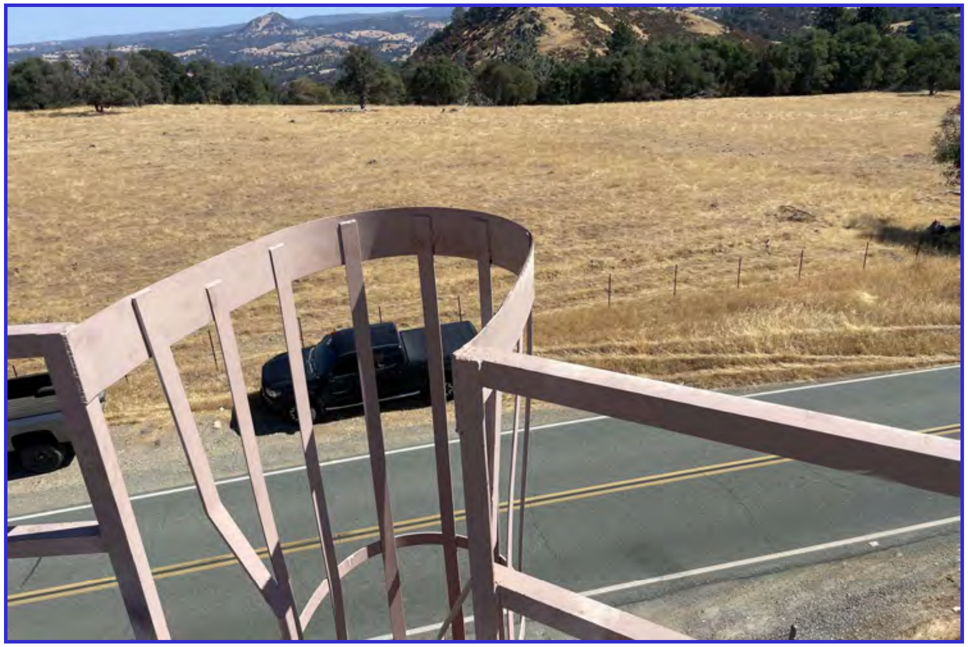
Exterior Structural Characteristics

Item	Data	
Capacity (gallons)	125,000	
Diameter (feet)	30	
Height (feet)	24	
Erection Year	Unknown	
Contract No.	Unknown	
Tank Type	Welded Steel	
Tank Profile	on grade	
Tank Geometry	Cylinder	
Number of Courses	Three	
Height of Each Course	8 Ft	
Roof Design	Pitched Roof with Nuckle	
No. Shell Manways	Two Shell Manways	
Type of Manways	Round	
Manway Cover Design	Bolted Circle	
Diameter of Manways	20 in	
No. Roof Hatches/Location	One	Near Edge
Hatch Design	Square Shoe Box	
Size of Roof Hatch	24 in	
No. Roof Vents/Location	One	Center
Roof Vent Design	Elbow	
Construction Co.	Unknown	

Item	Data	
Center Roof Vent Size	4 in	
Roof Vent Sealed	Yes	Satisfactory
Roof Rail System	Yes	No Comments
Roof Rail Satisfactory	Yes	No Comments
Rail Location	Top of Ladder	
No. & Type Roof Access	One	Ladder
Exterior Vandal Deterrent	Yes	
Ext Ladder Satisfactory	One	Yes
Ext Ladder Fall Prevent	Yes	
Roof Tie-Off Present	Yes	
Tank Piping	Floor Inlet and Outlet	
Inlet Diameter	In Ground	
Outlet Diameter	In Ground	
Flexible Pipe Coupling	In Ground	
Overflow Pipe Diameter	3 In	
Overflow Exterior Design	3 in	
Drain Location	Floor	
Tank Foundation	Concrete Ring Wall	
Water Level Indicator	Yes	
Tank Type	Potable	
Lining Type/Original	Polyurethane	No

Miscellaneous Notes

EXTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection



EXTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -001

EXTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -002

EXTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -003

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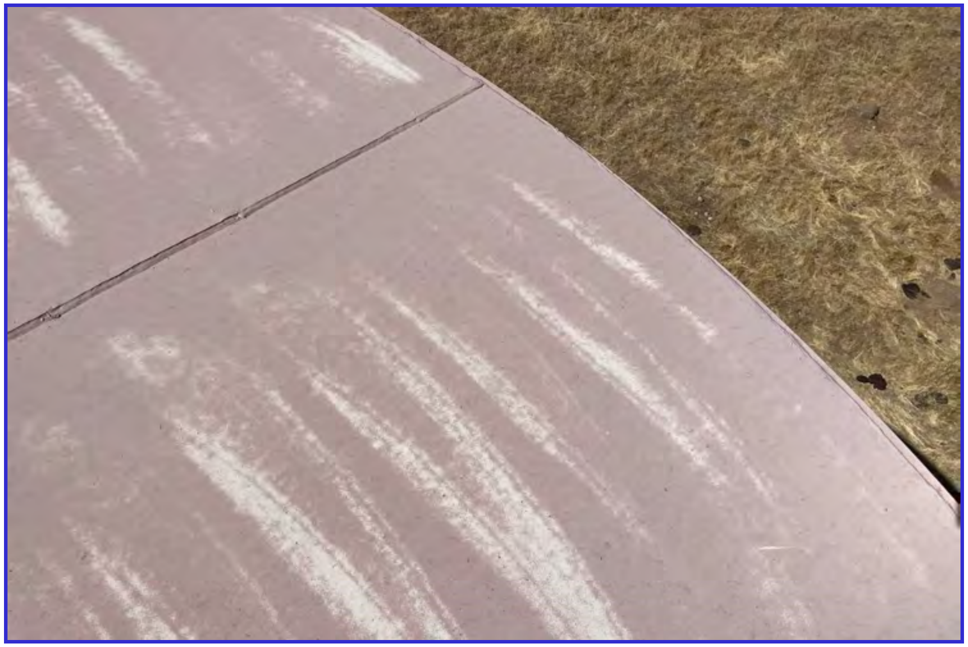

EXTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -015

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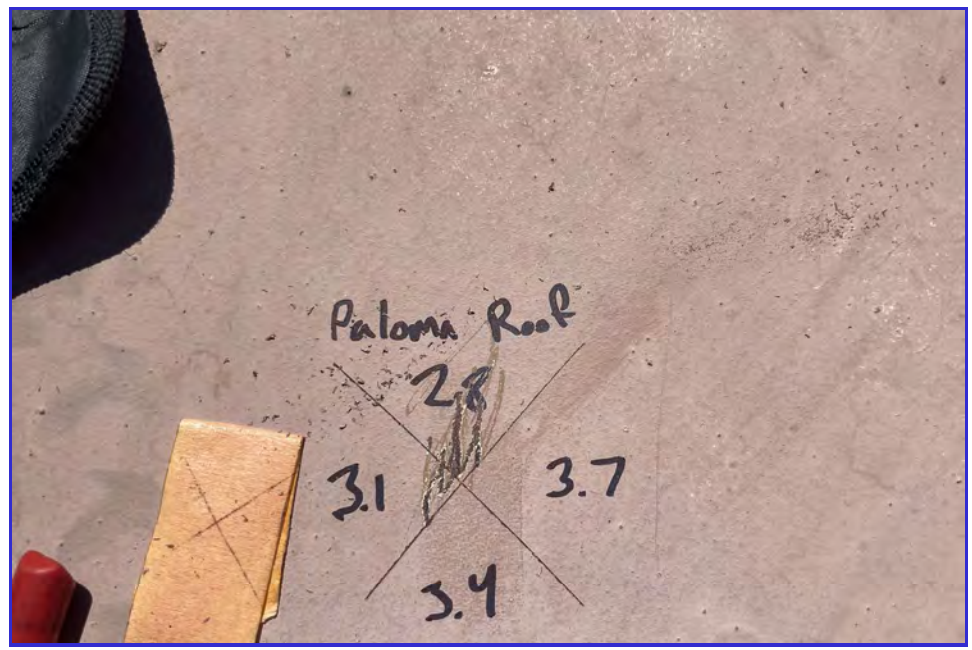

EXTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -035


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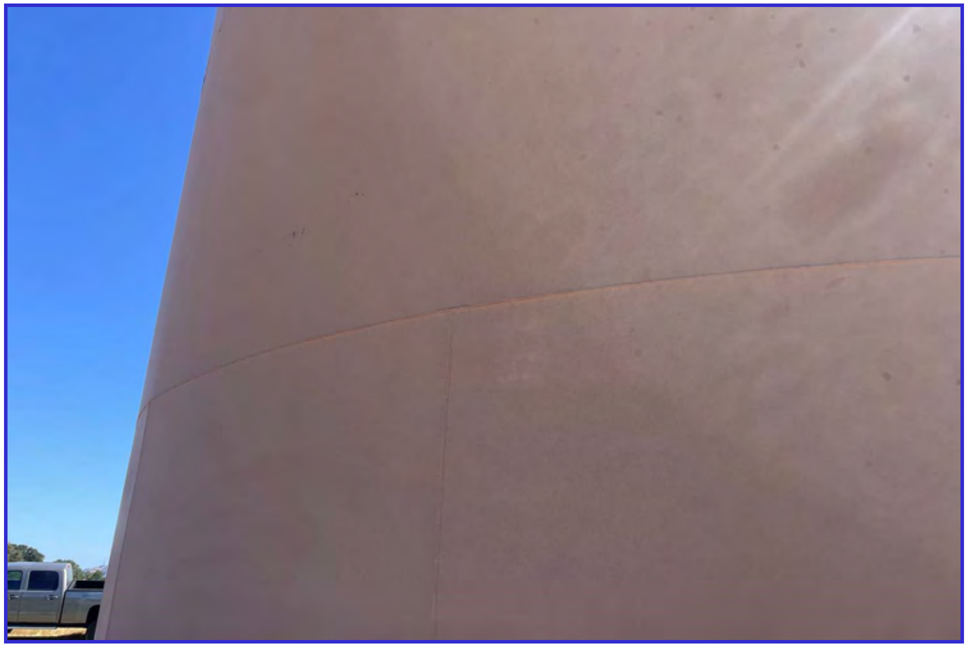

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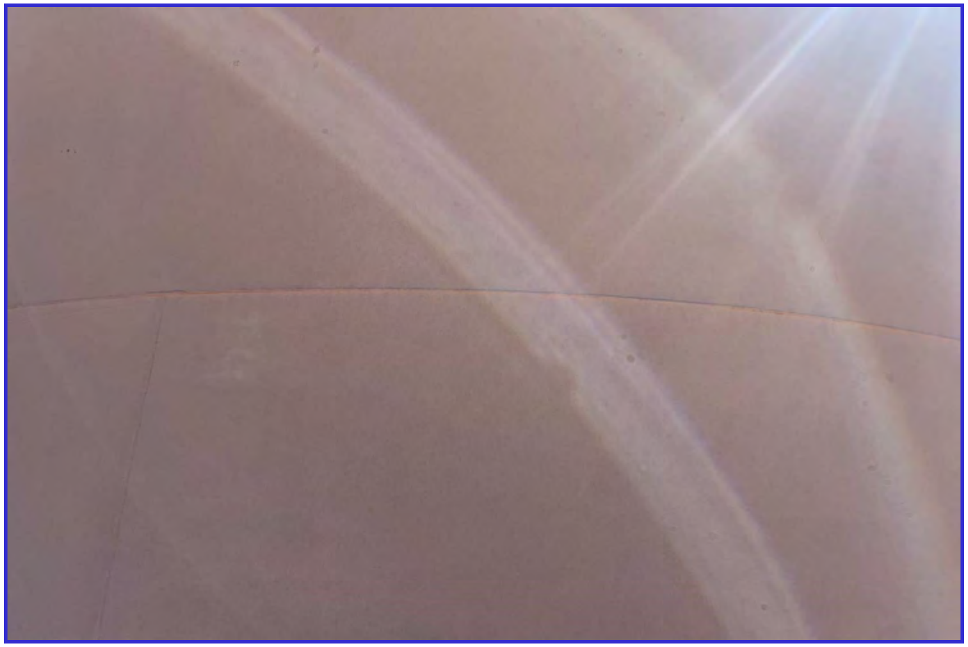

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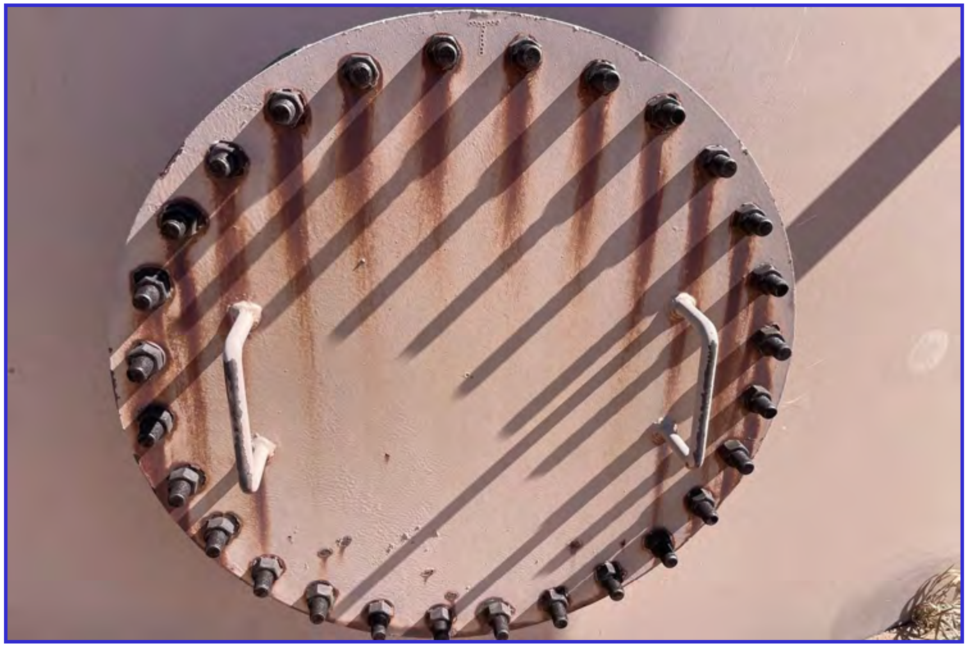

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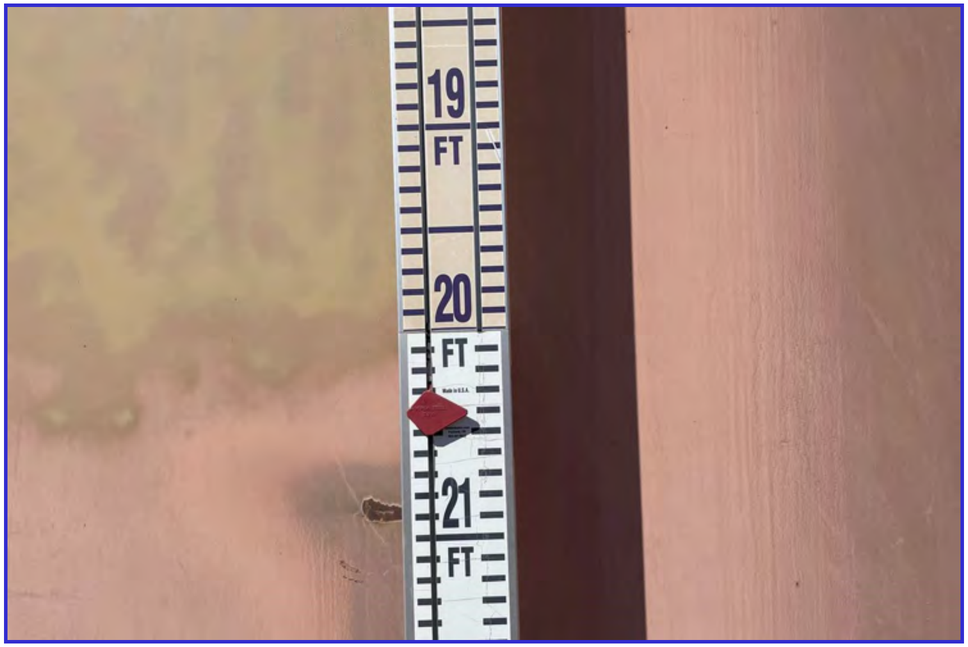

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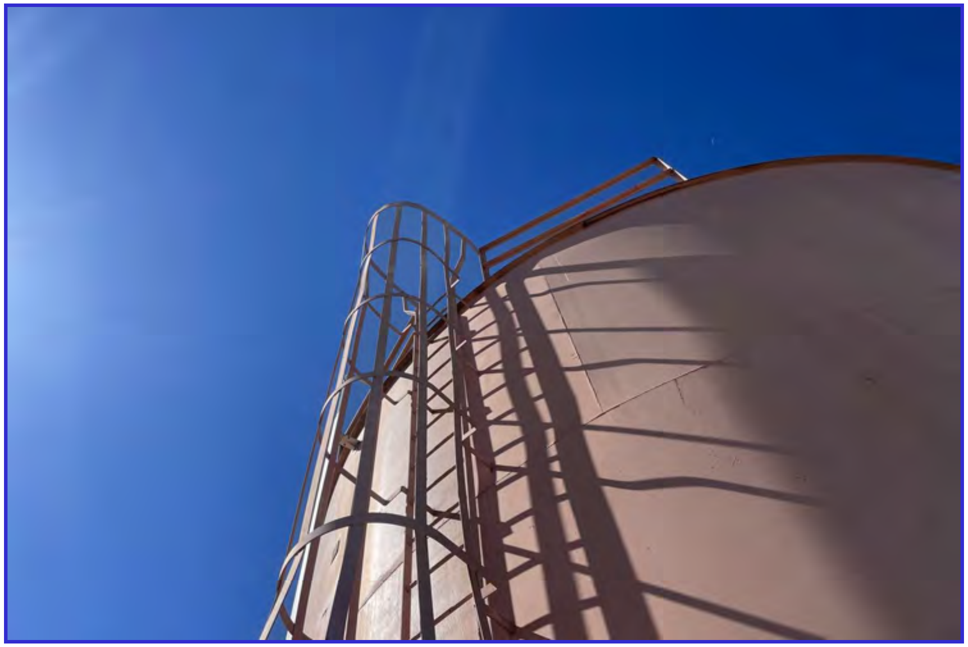

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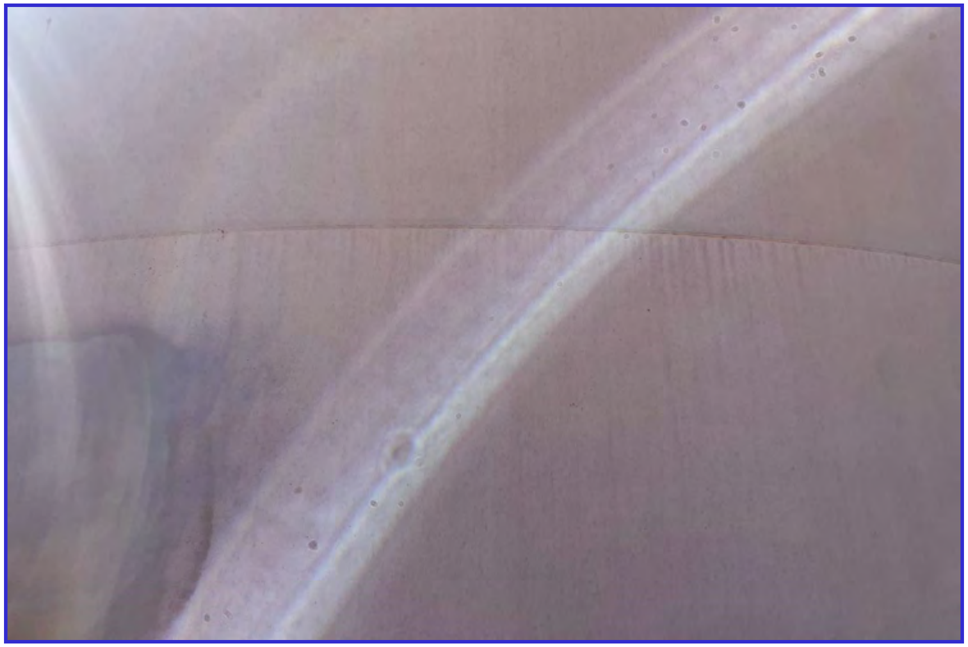

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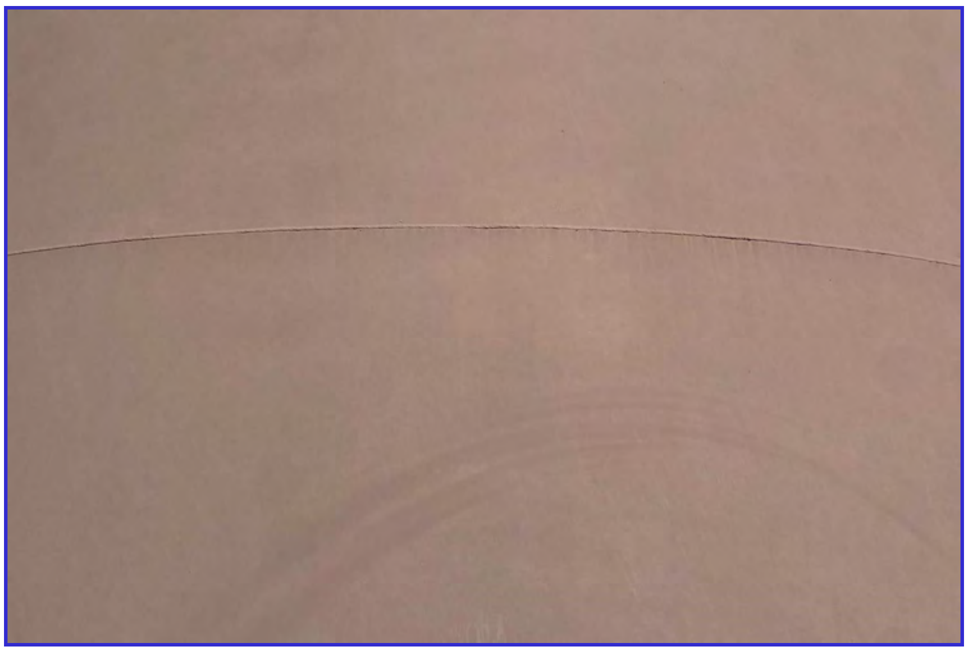

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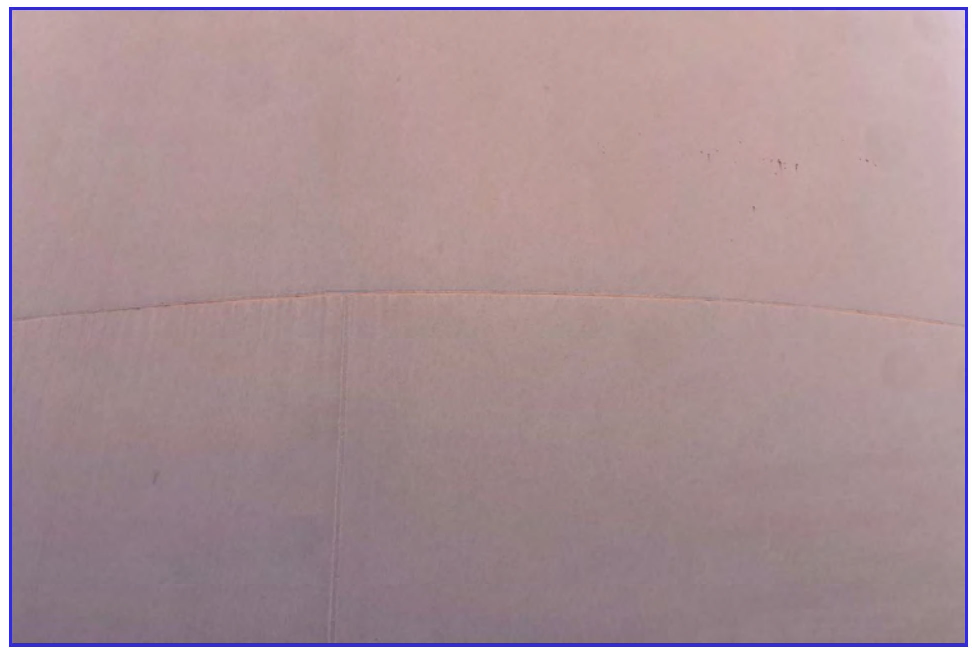

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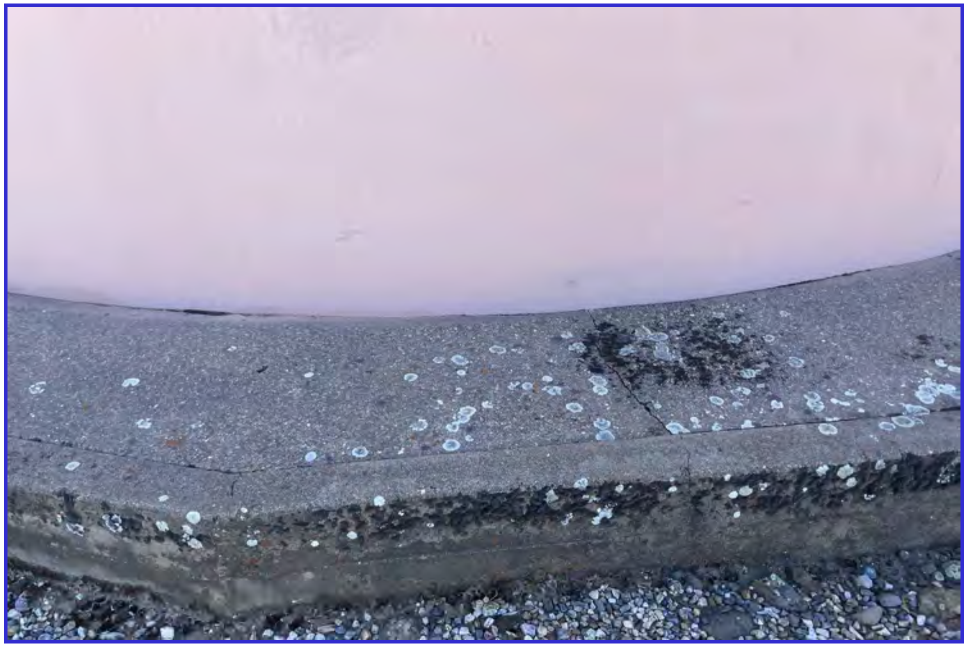

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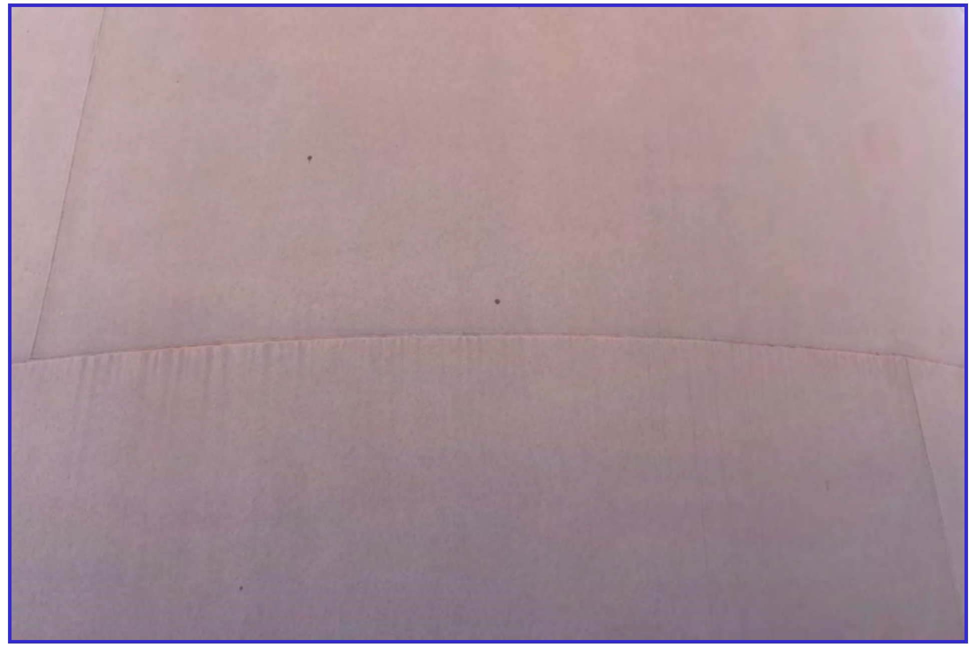

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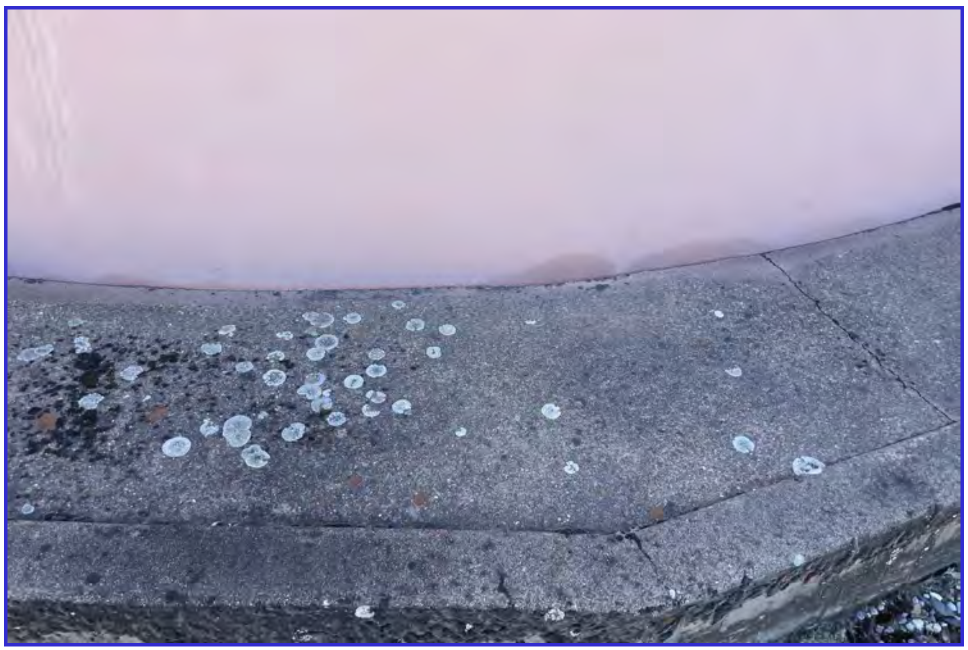

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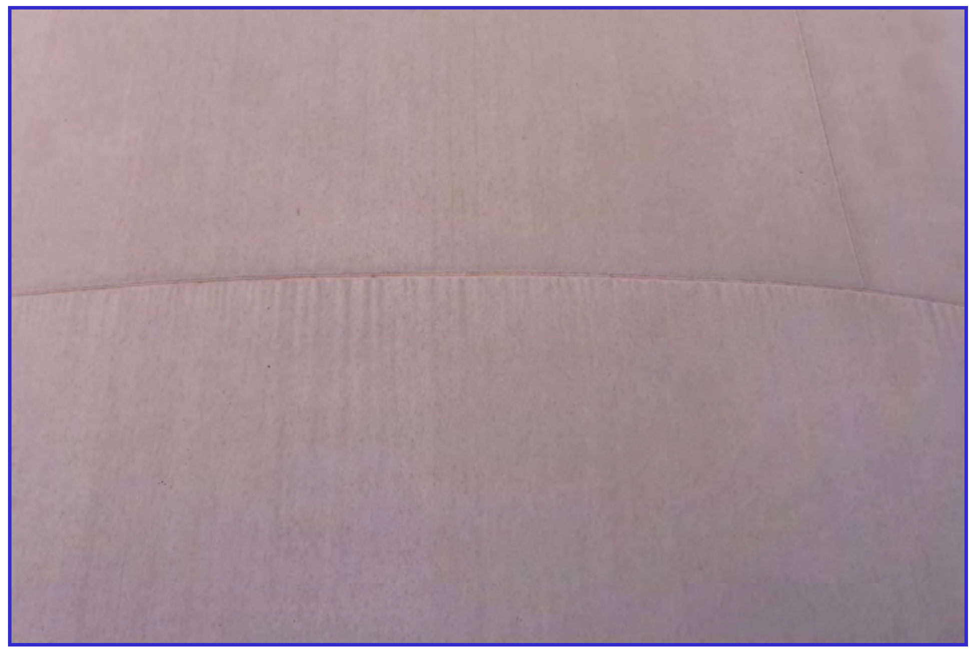

EXTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -083

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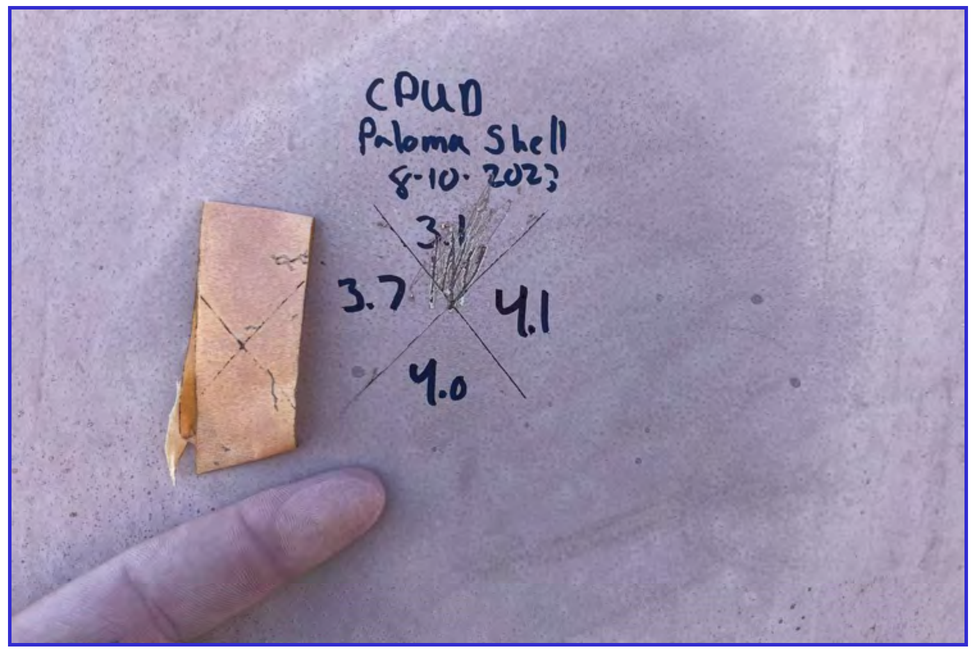
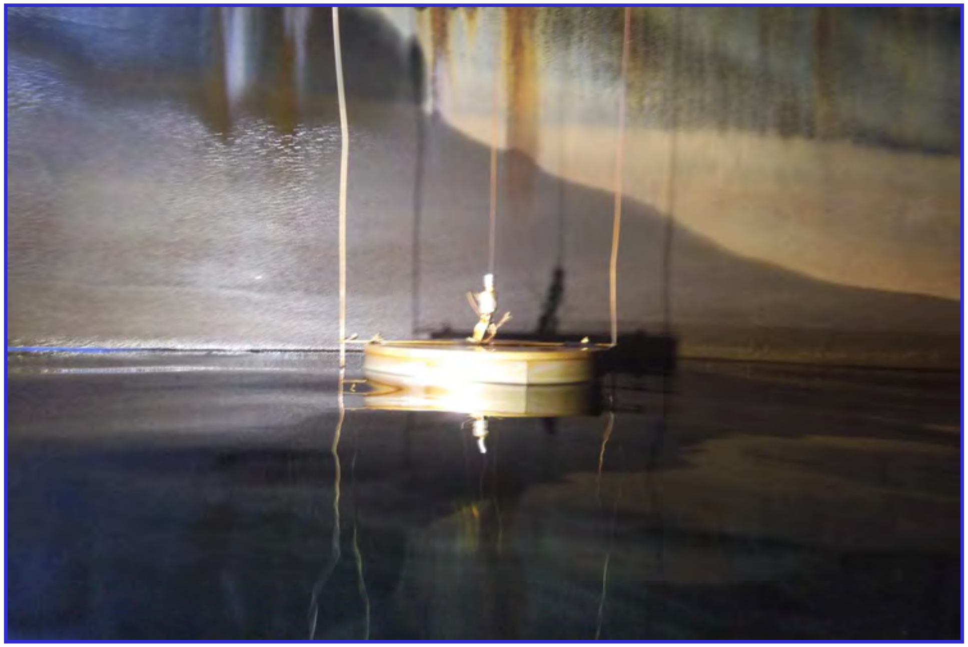


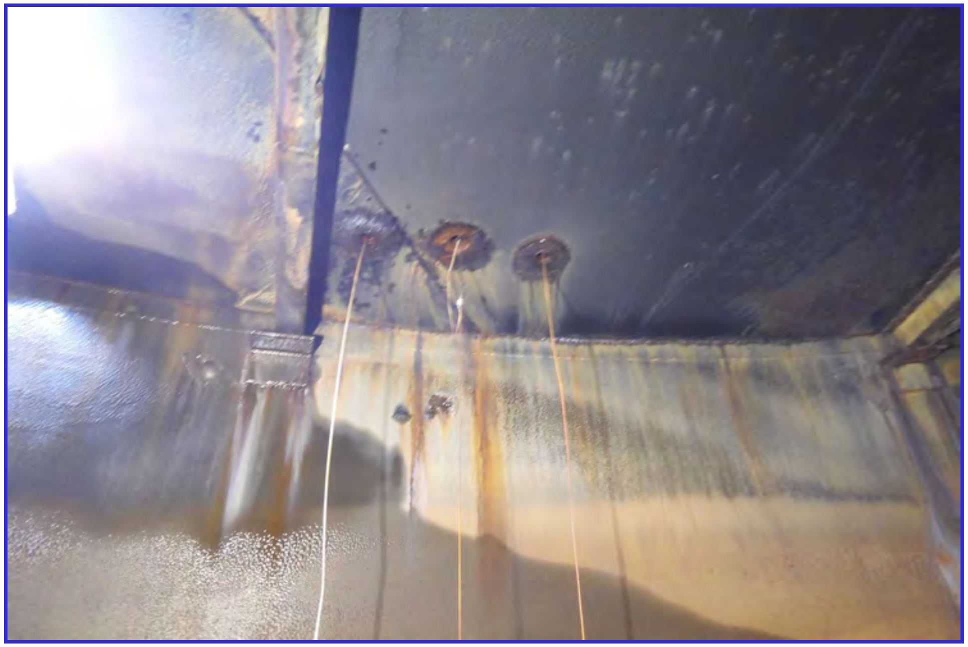
EXTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -087

INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection

INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -001

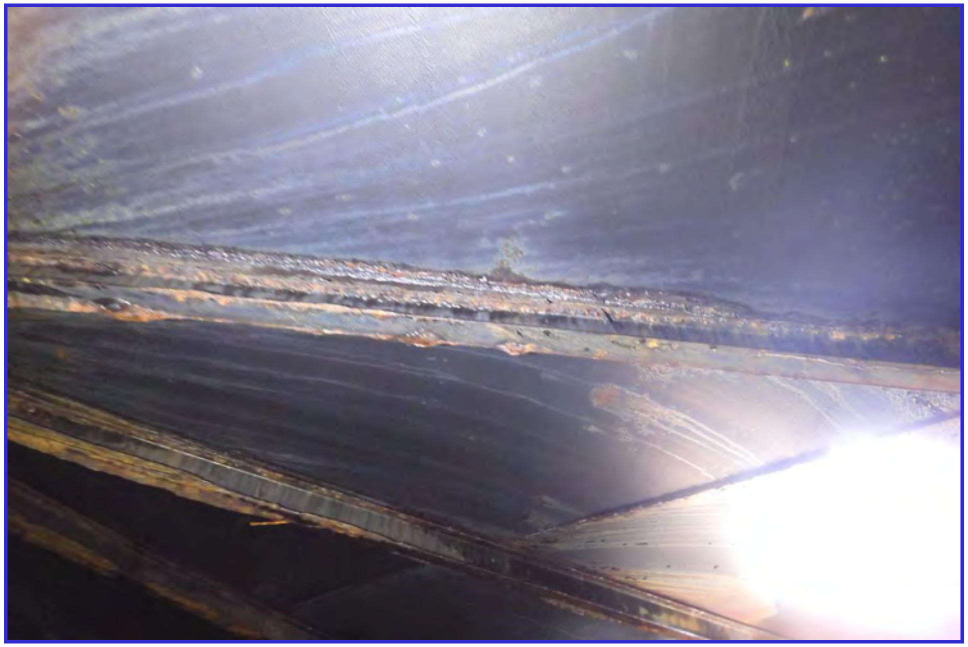


INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -002



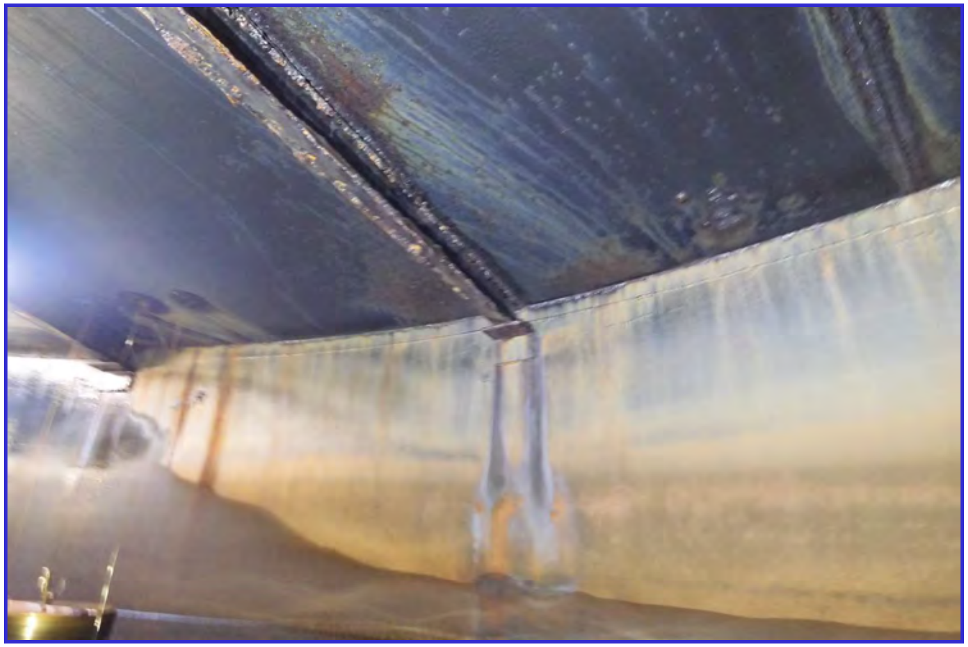
INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -003

INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -004

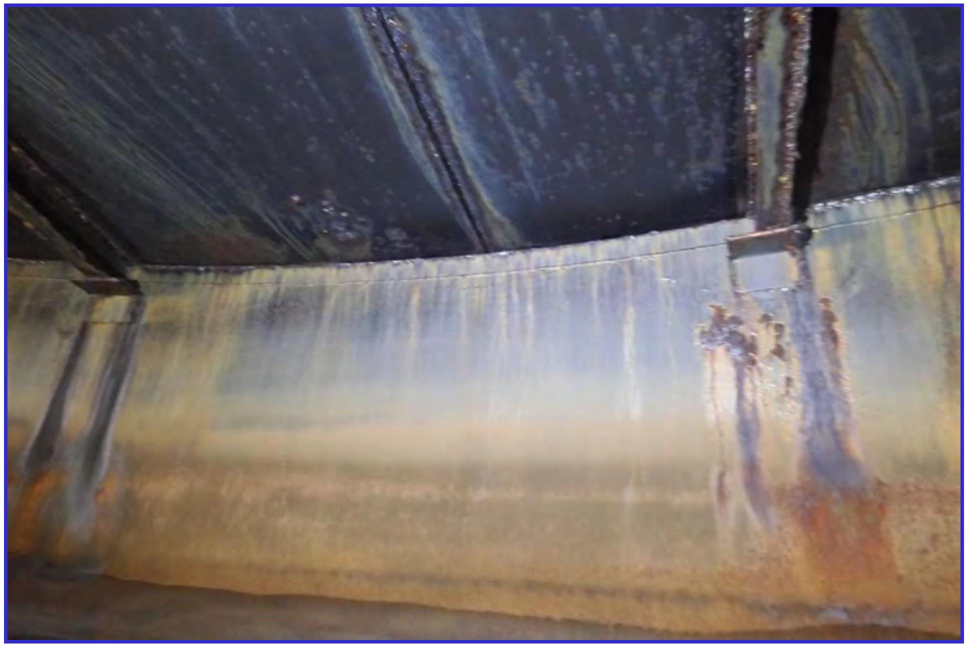


INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -005

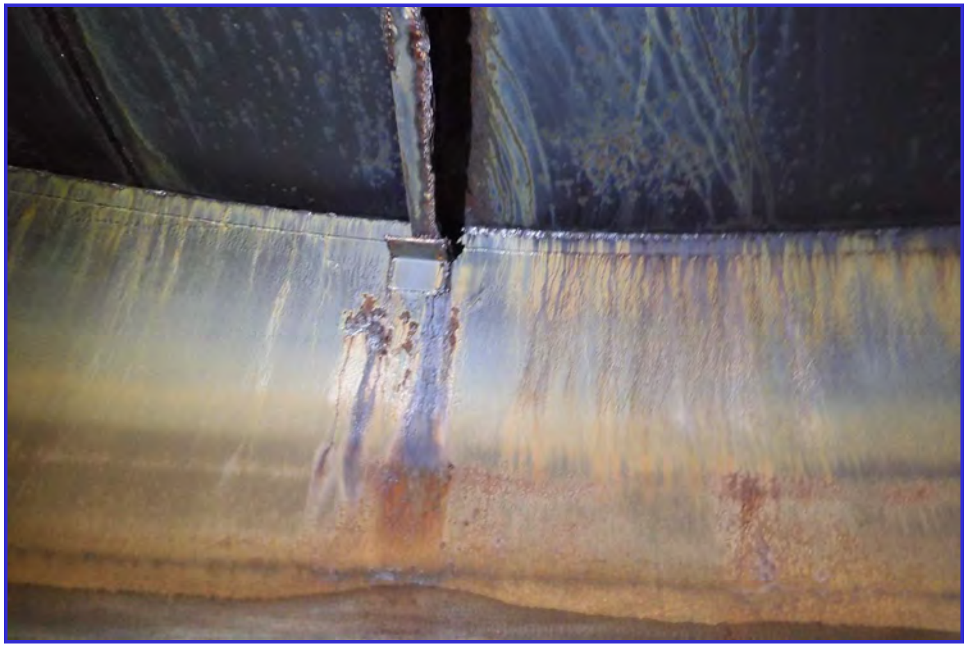
INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -006



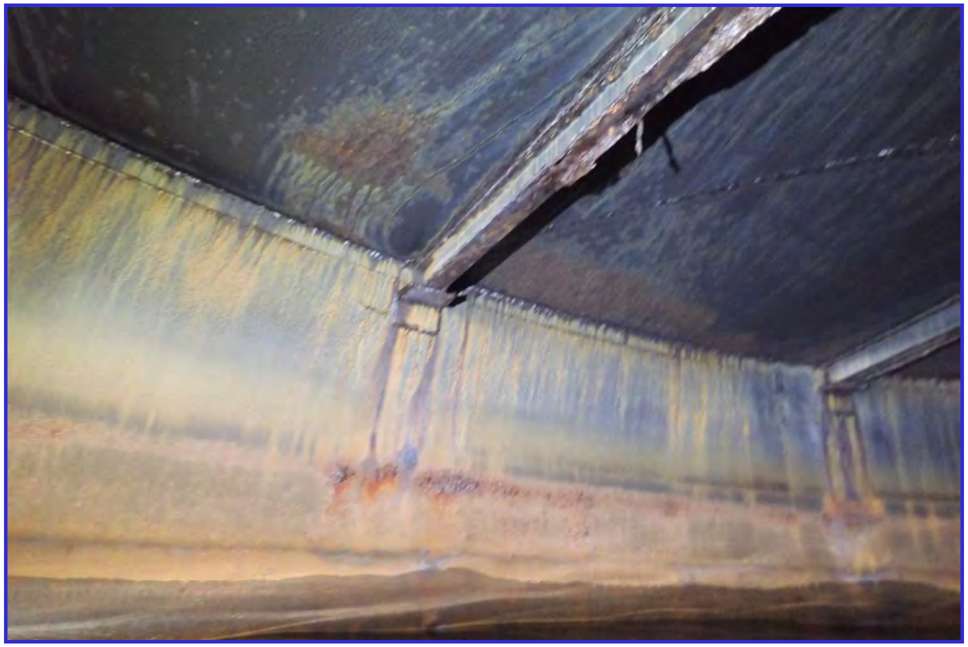
INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -007



INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -008



INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -009



INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -010

INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -011

INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -012

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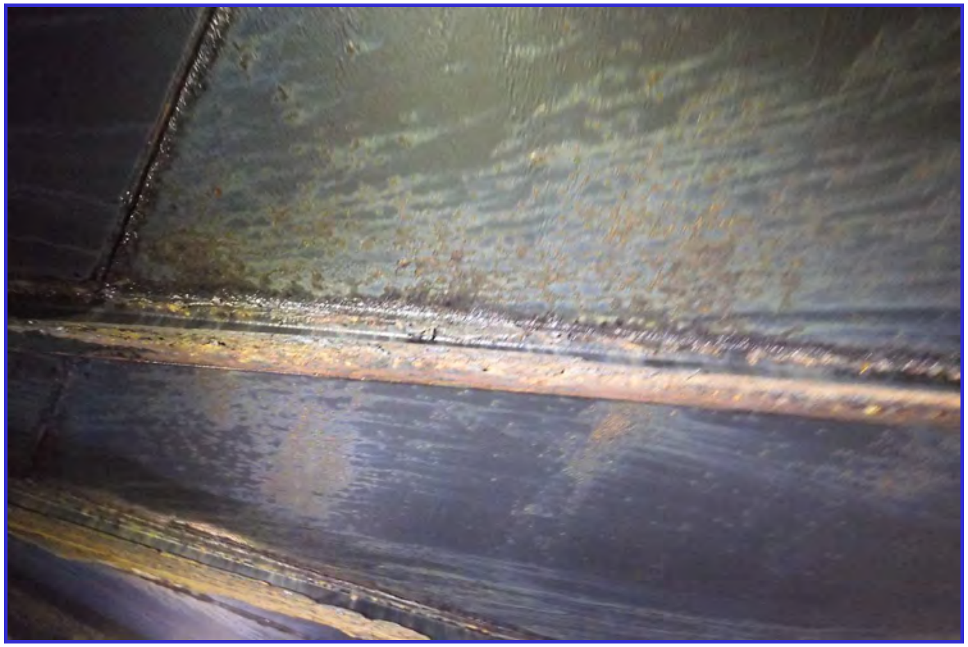
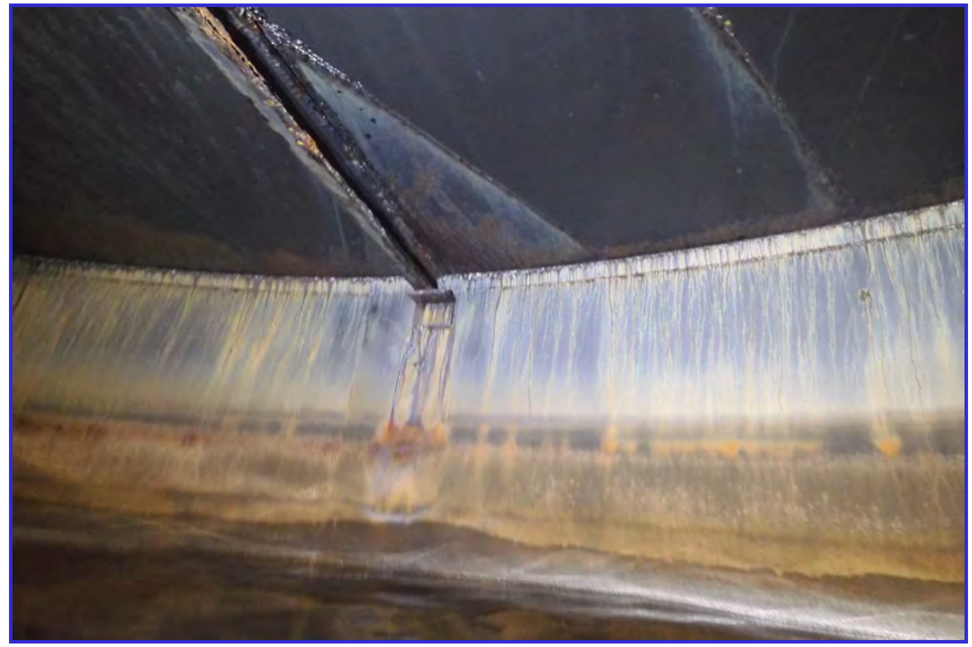
INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -014

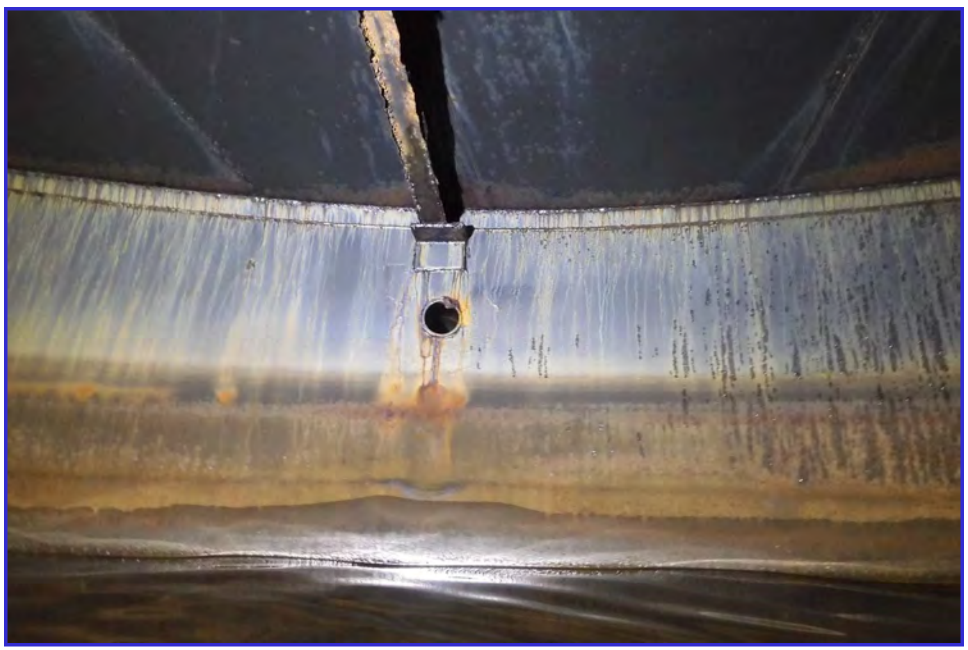


INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -015

INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -016



INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -017



INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -018

INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -019

INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -020

INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -021

INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -022

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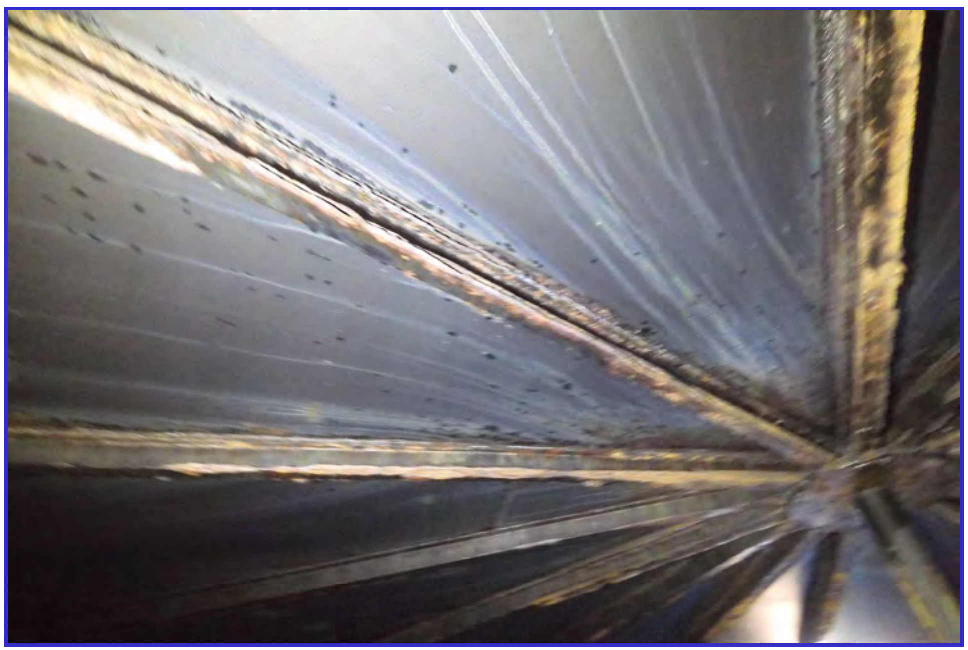
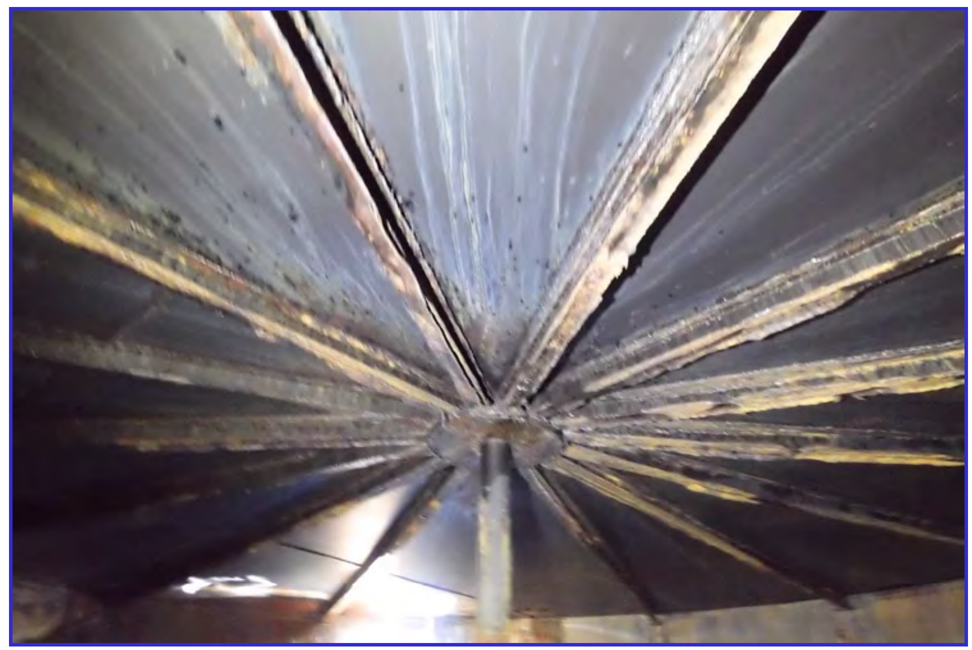
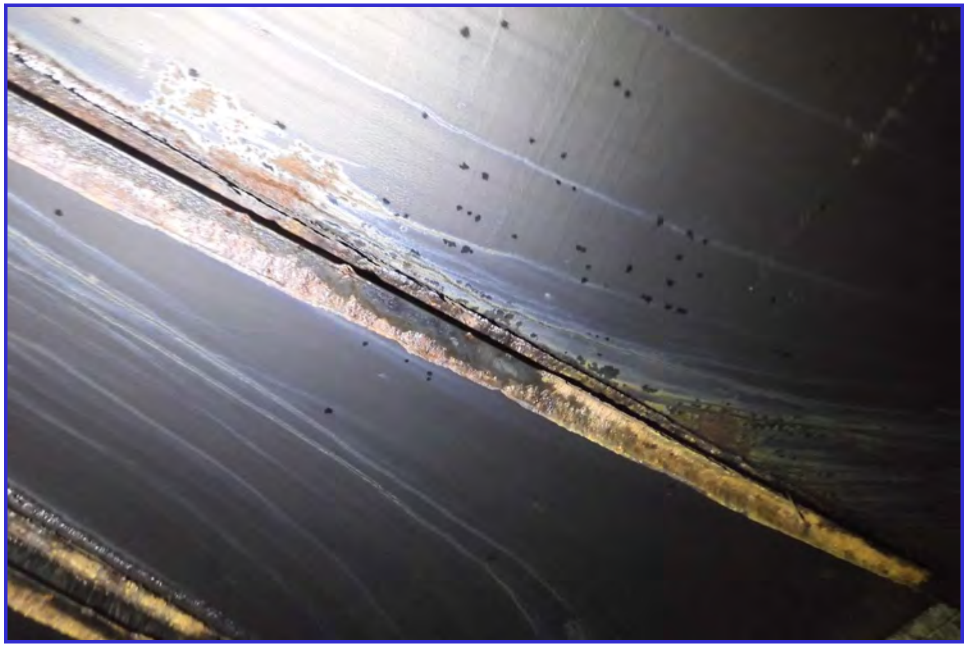
INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -025



INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -026



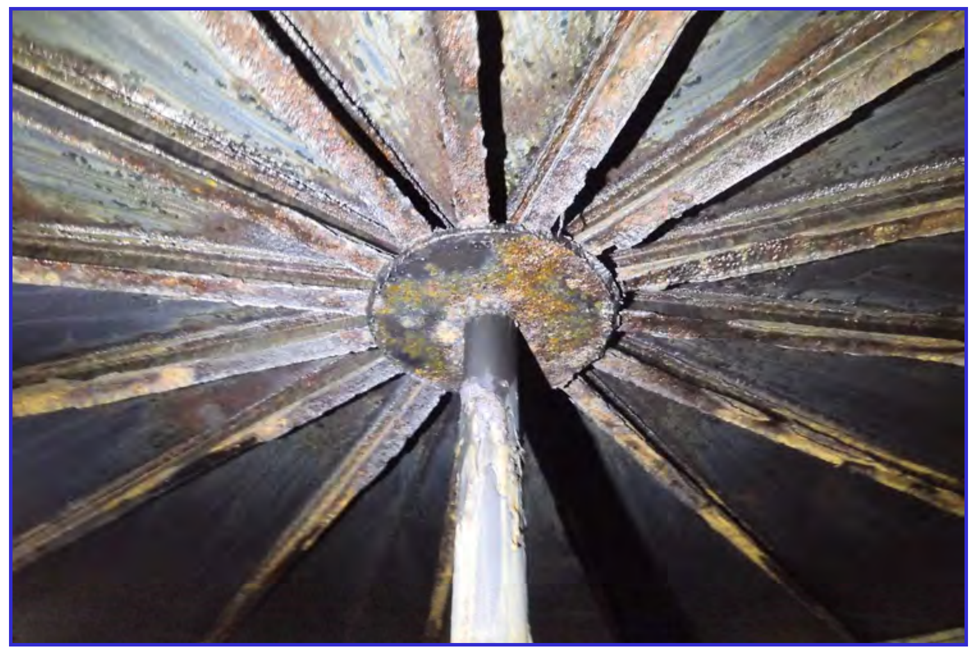
INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -027



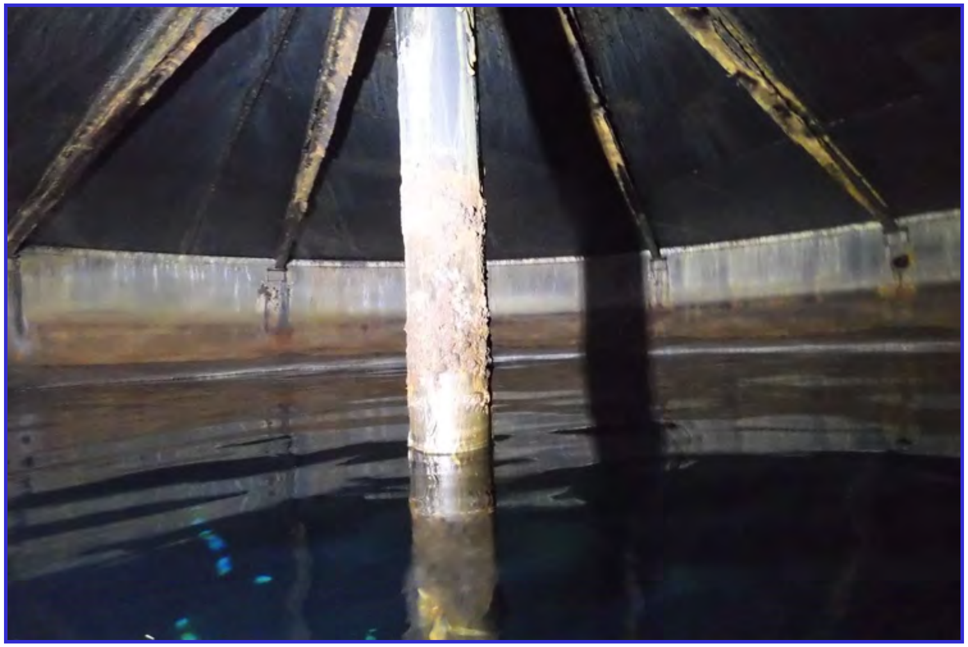
INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -028

INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -029

INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -030

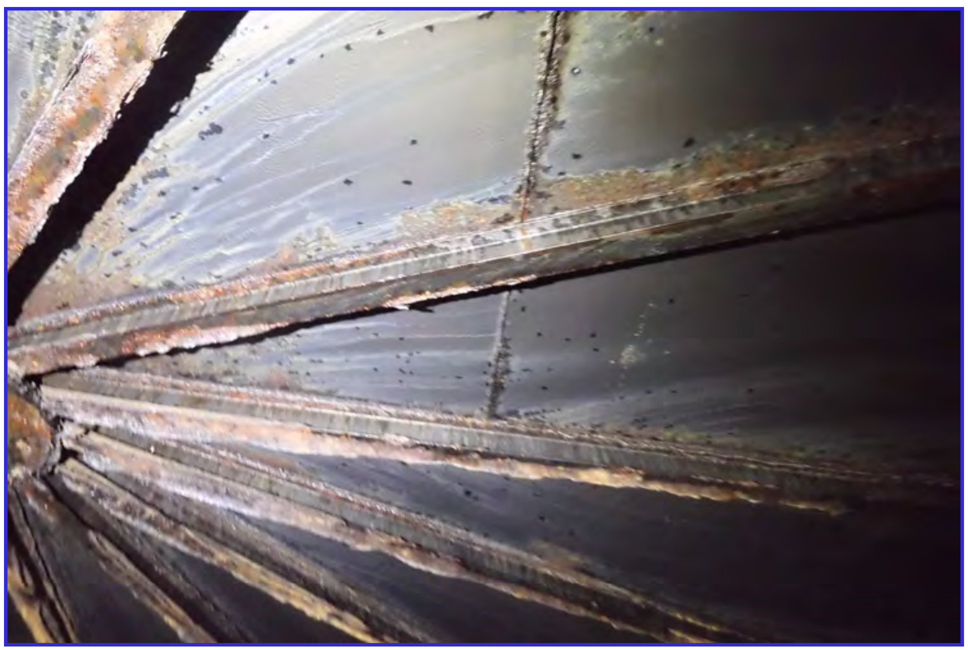


INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -031



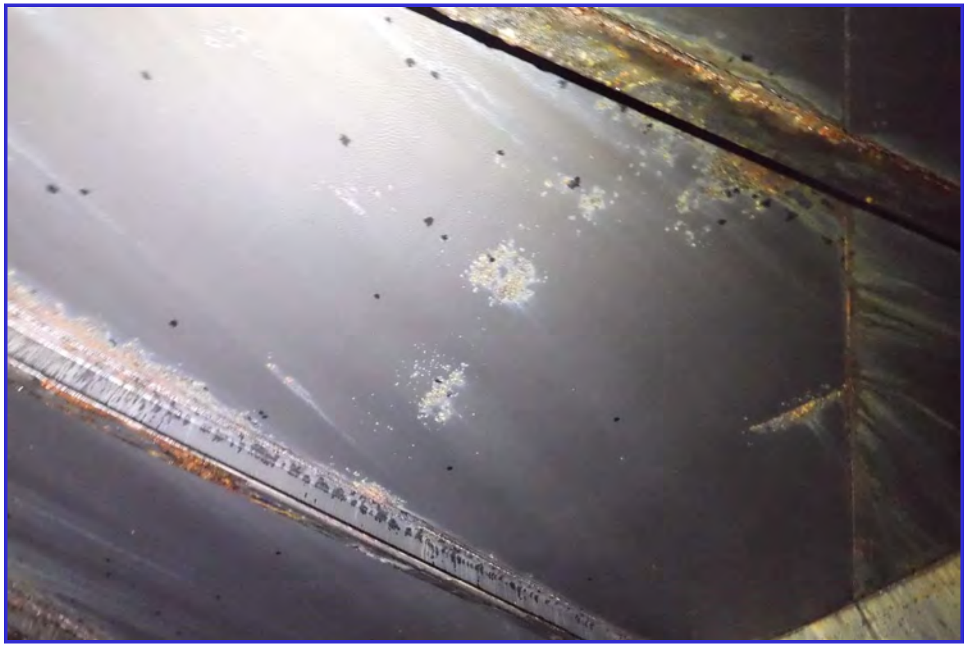
INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -032

INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -033

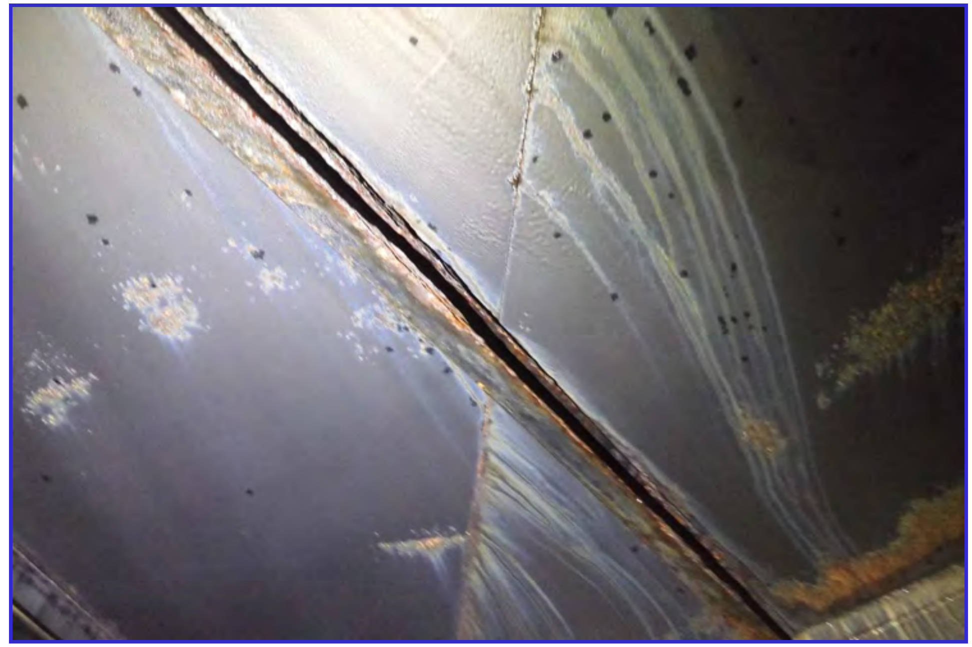


INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -034

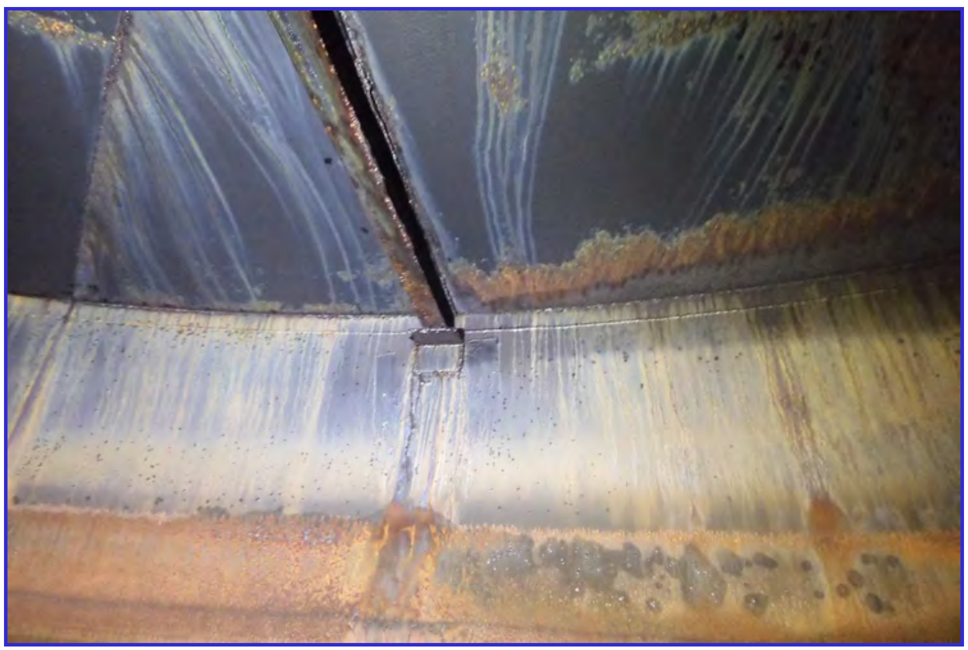
INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -035



INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -036



INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -037



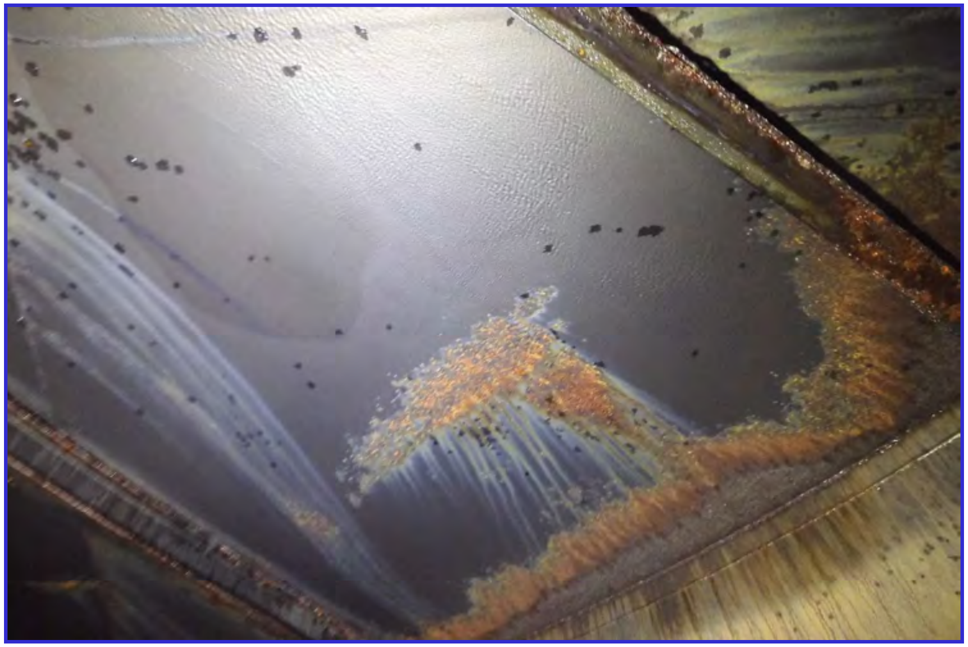
INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -038

INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -039

INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -040

INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -041

INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -042

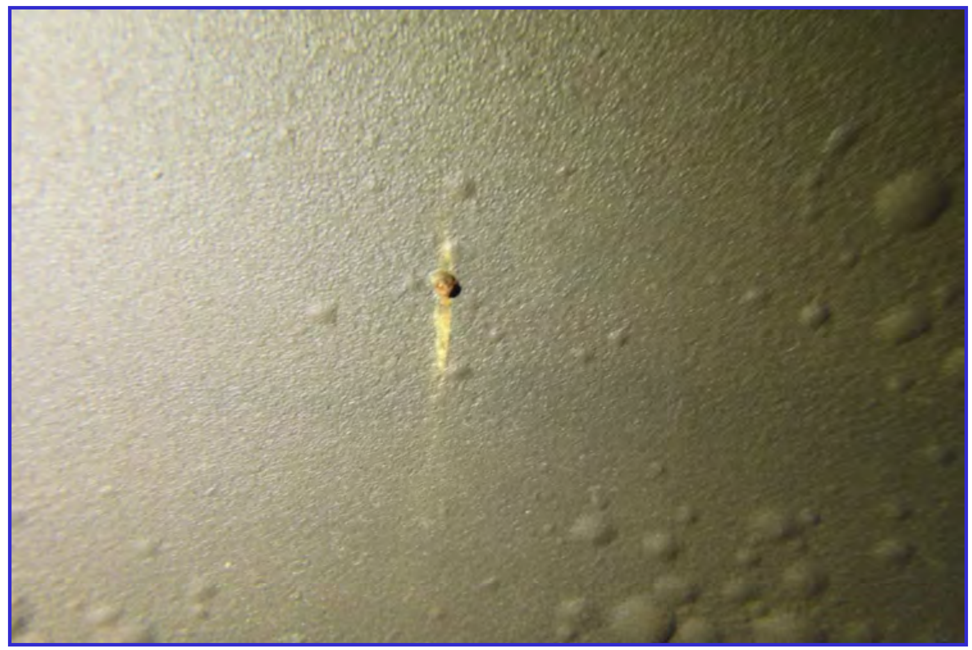


INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -043

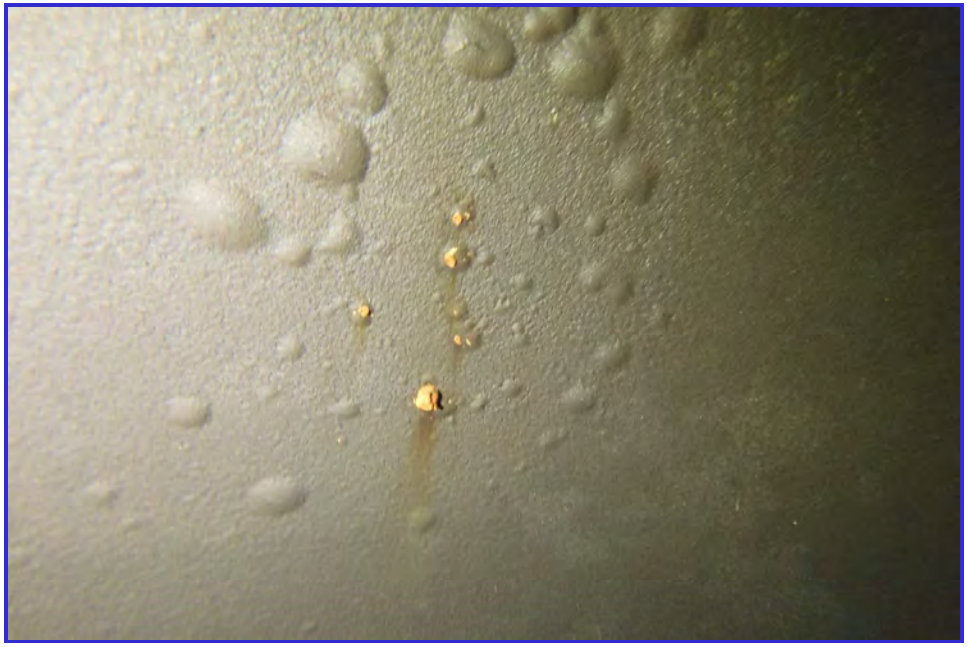
INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -044

INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -045

INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -046



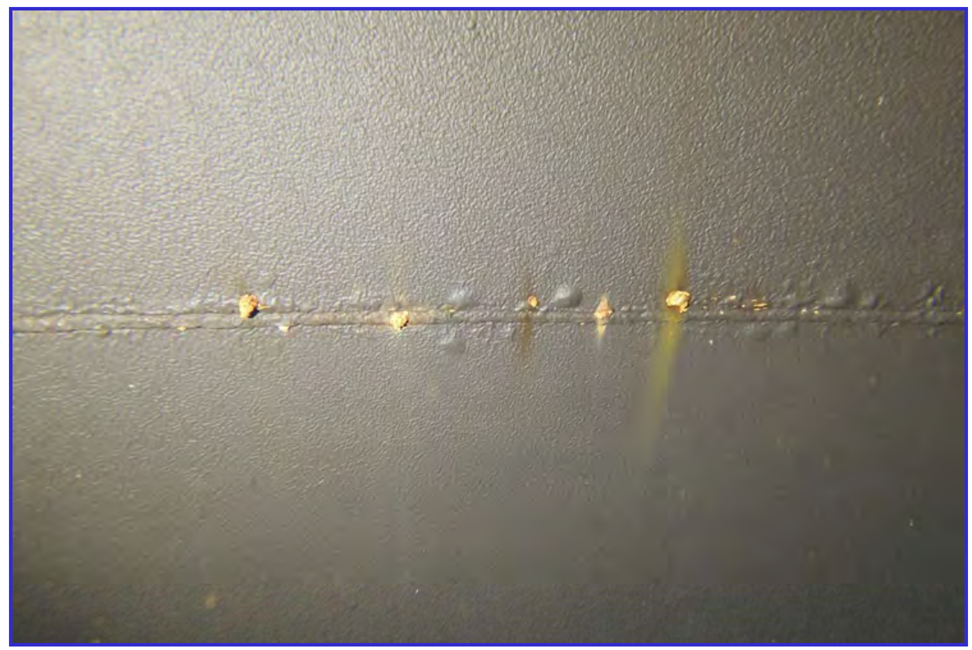
INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -047



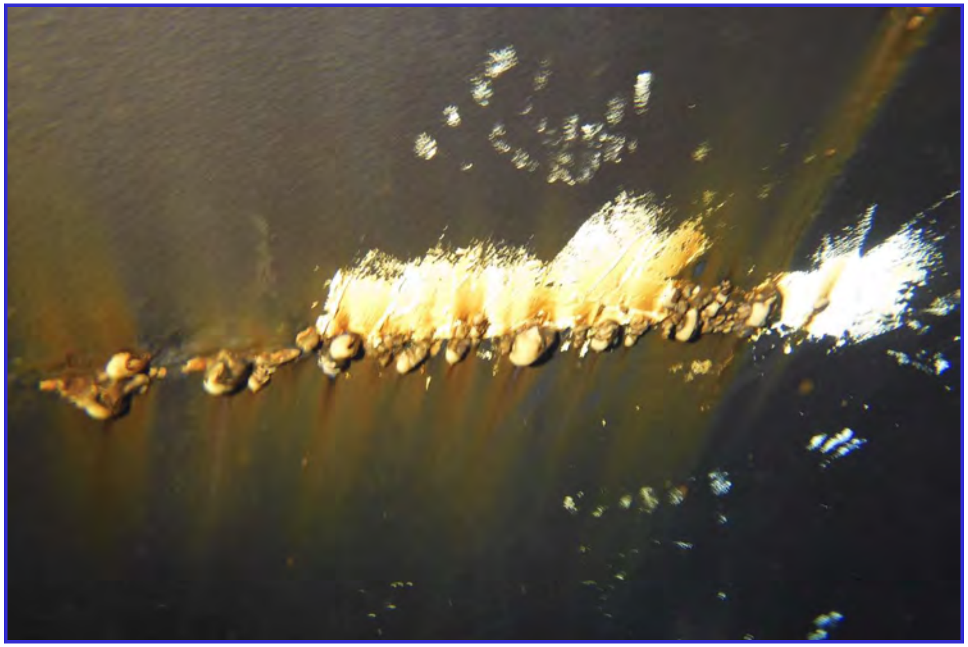
INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -048

INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -049

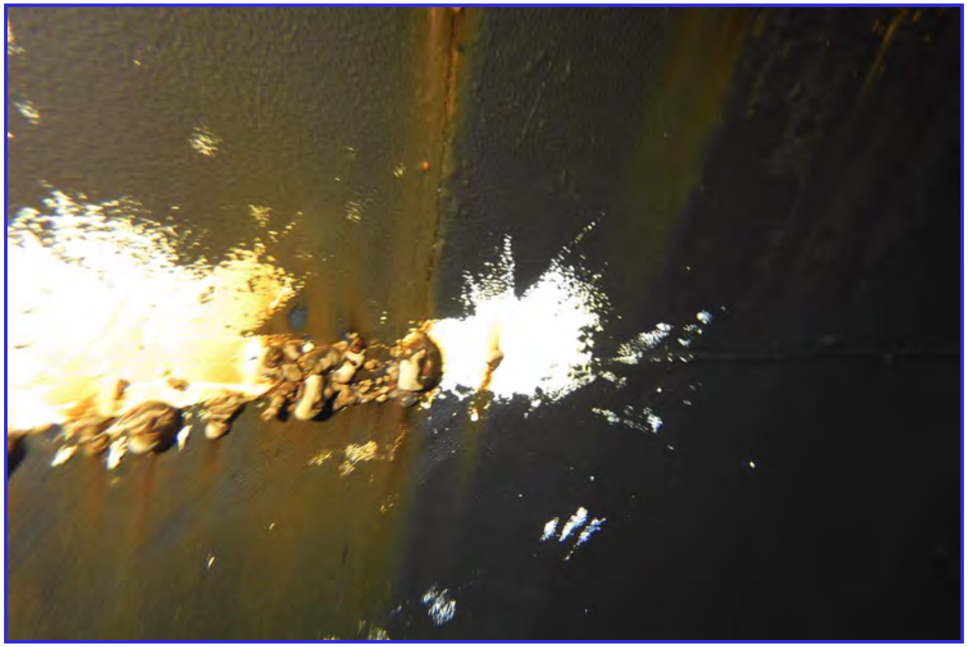
INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -050



INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -051



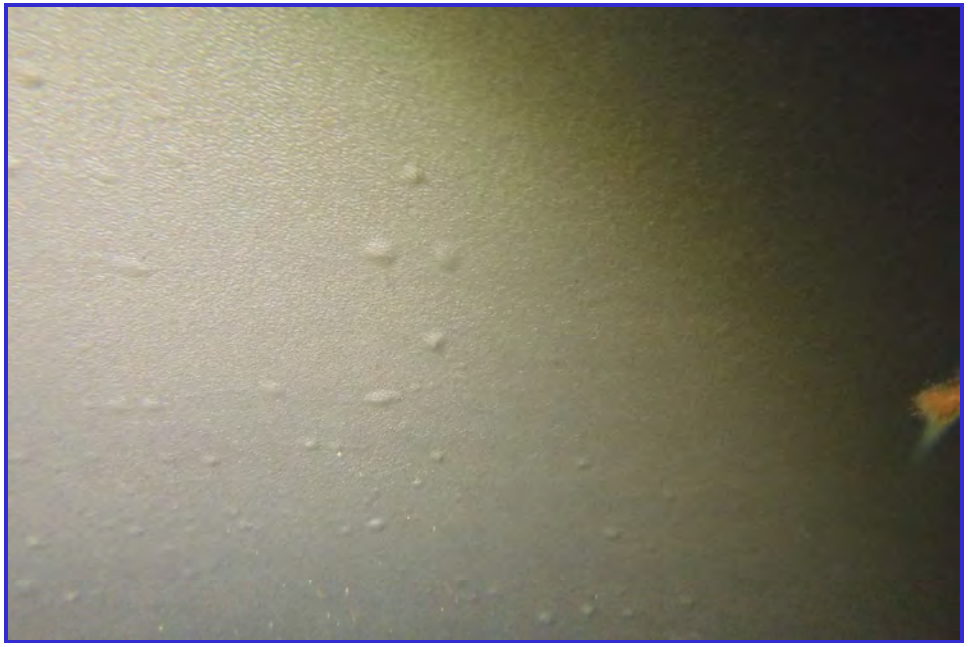
INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -052



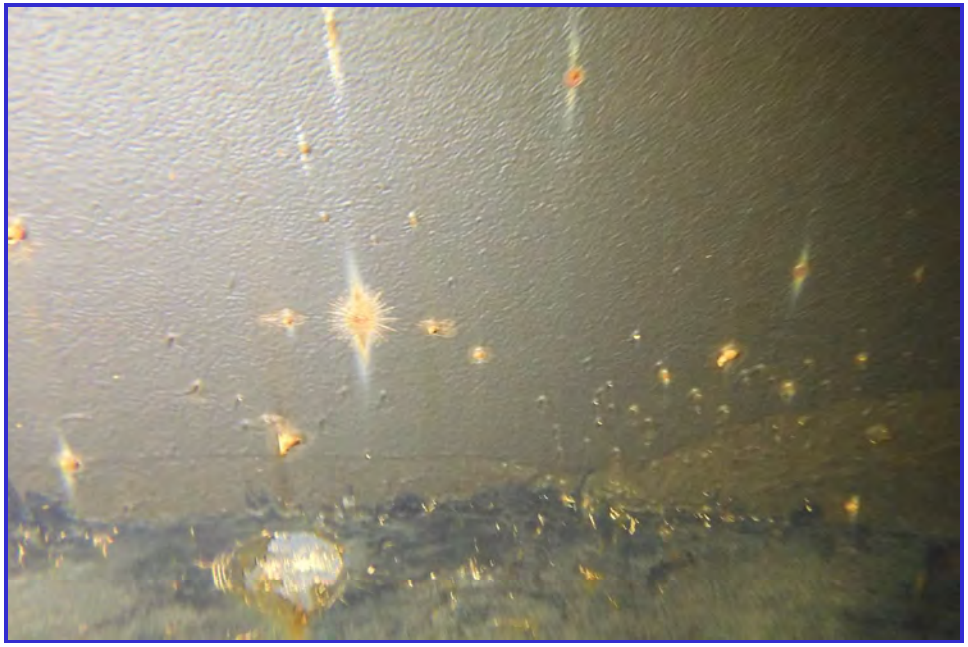
INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -053

INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -054

INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -055



INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -056

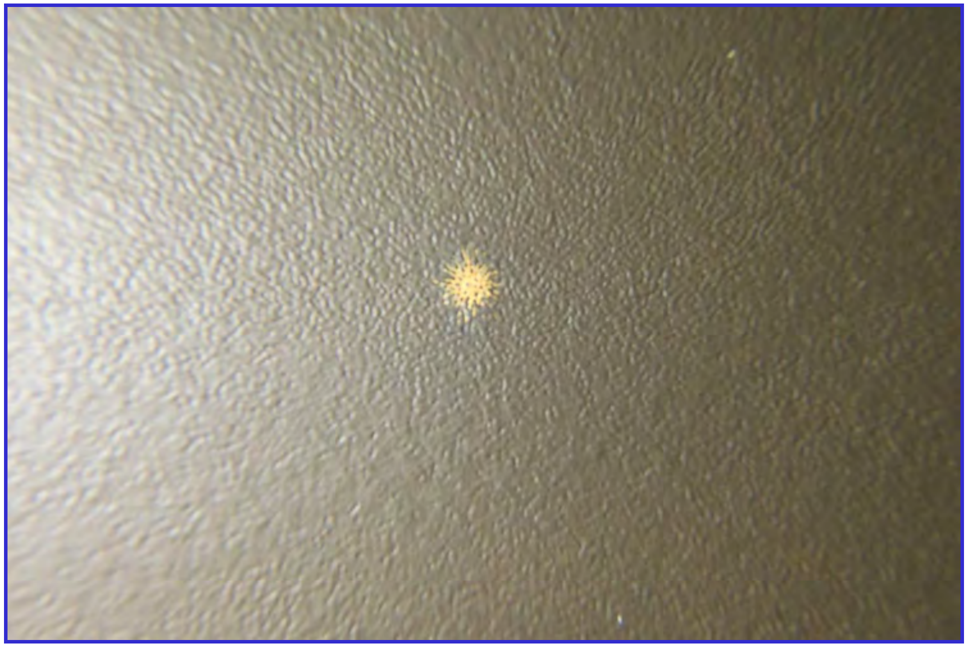


INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -057

INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -058

INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -059

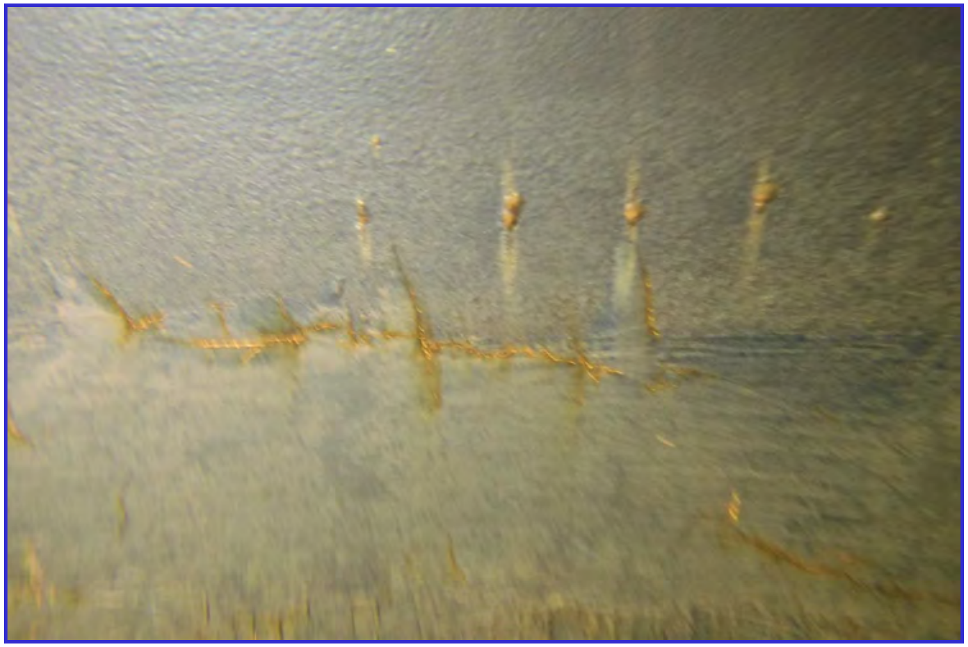
INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -060



INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -061

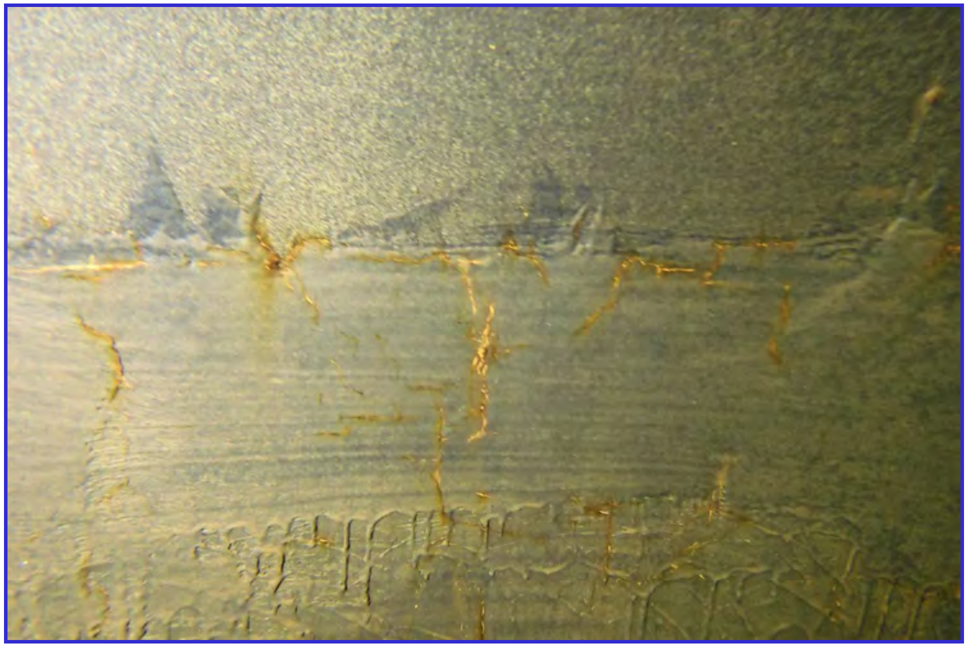
INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -062

INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -063

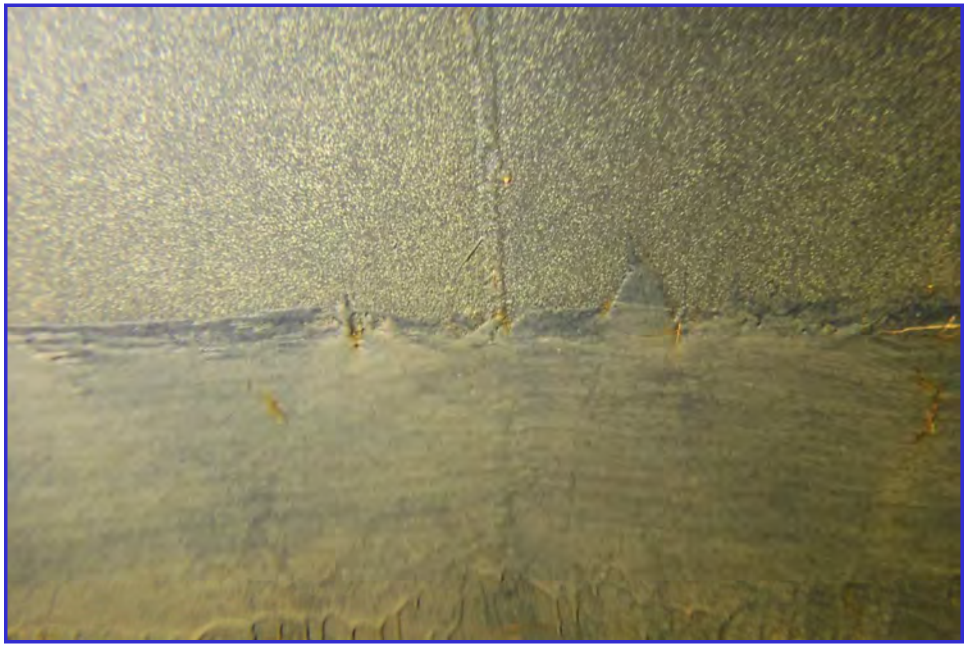


INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -064

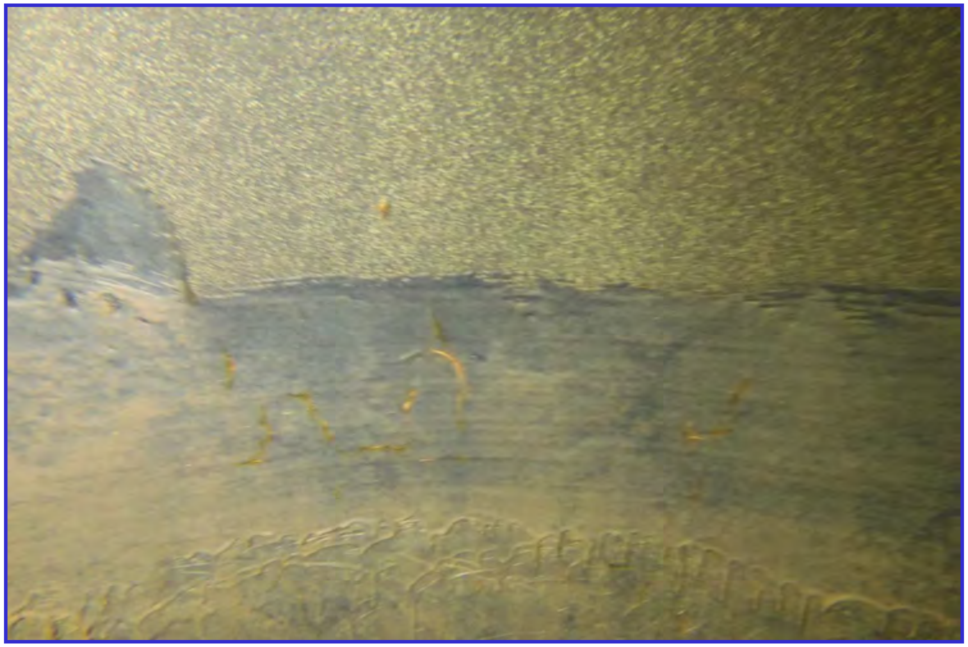
INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -065



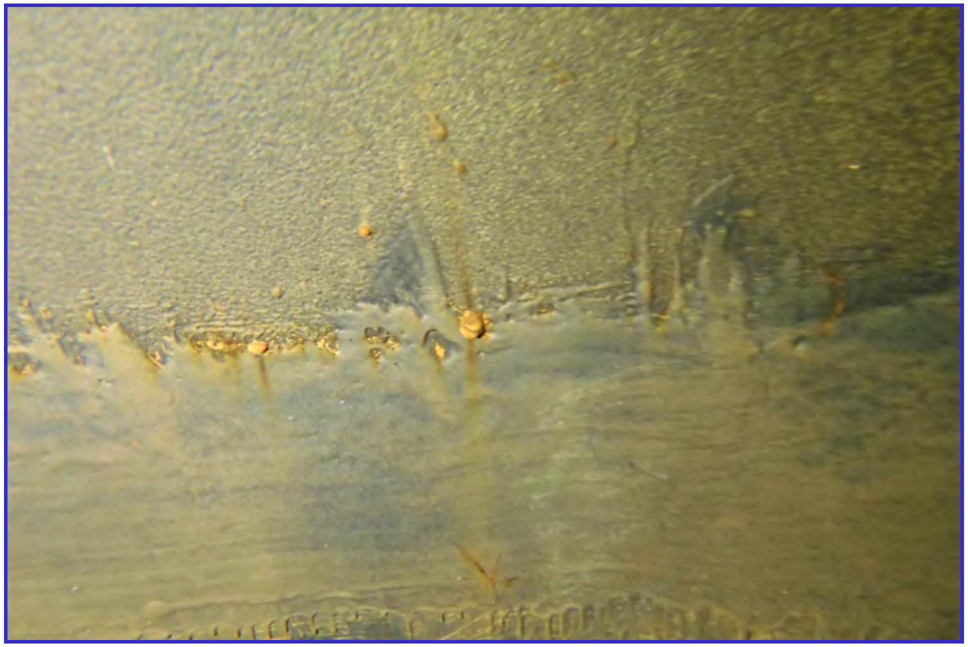
INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -066



INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -067

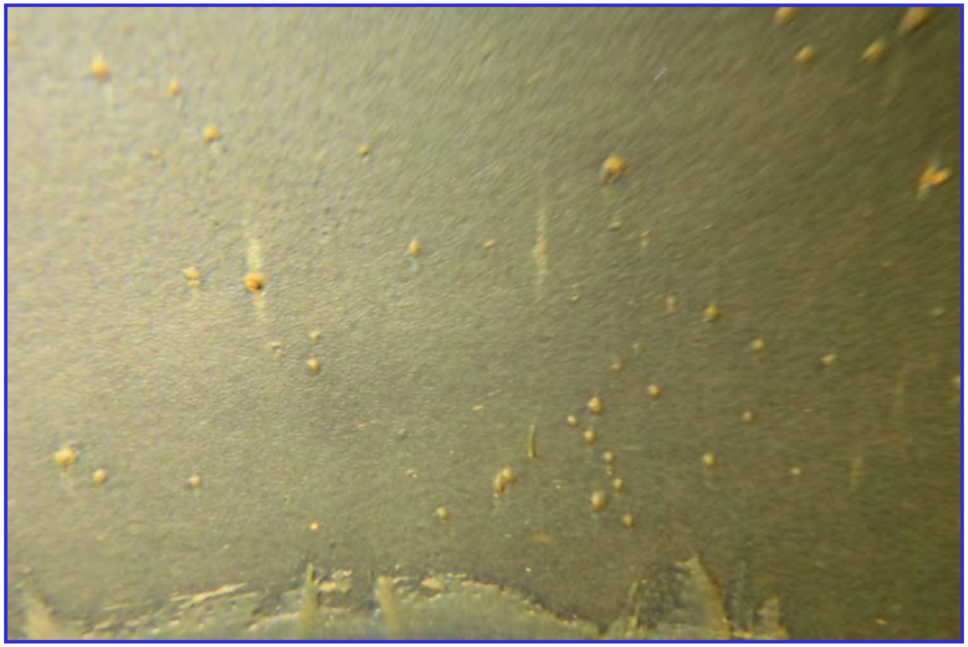


INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -068

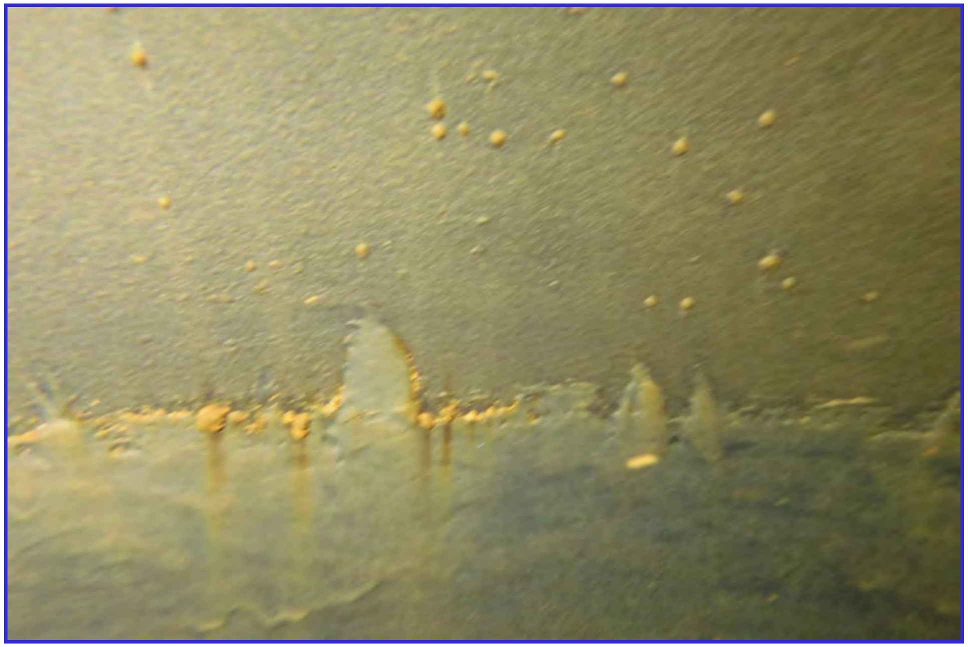


INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -069

INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -070

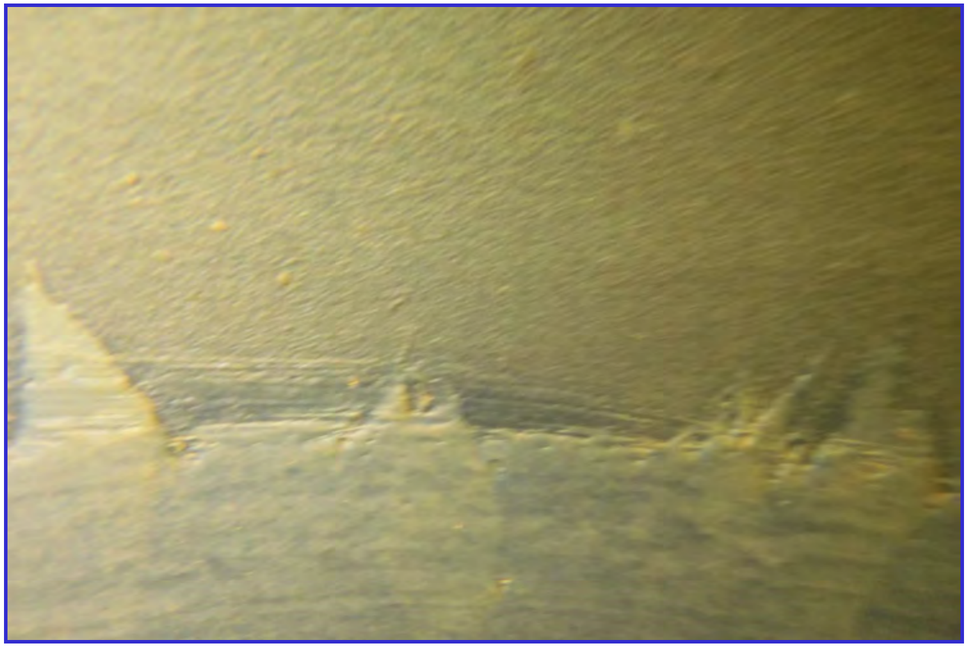


INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -071

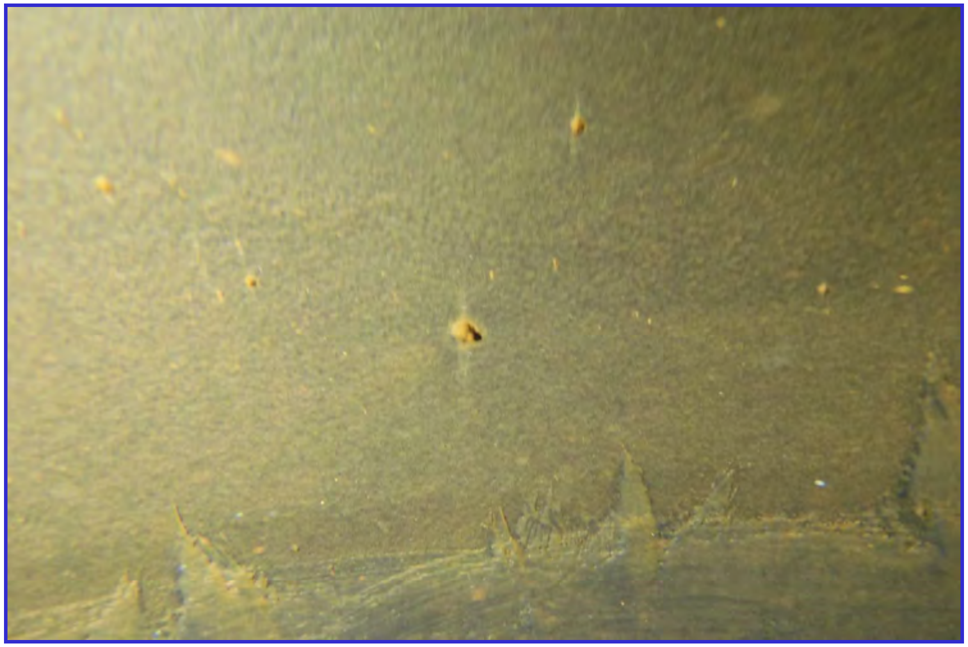


INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -072

INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -073

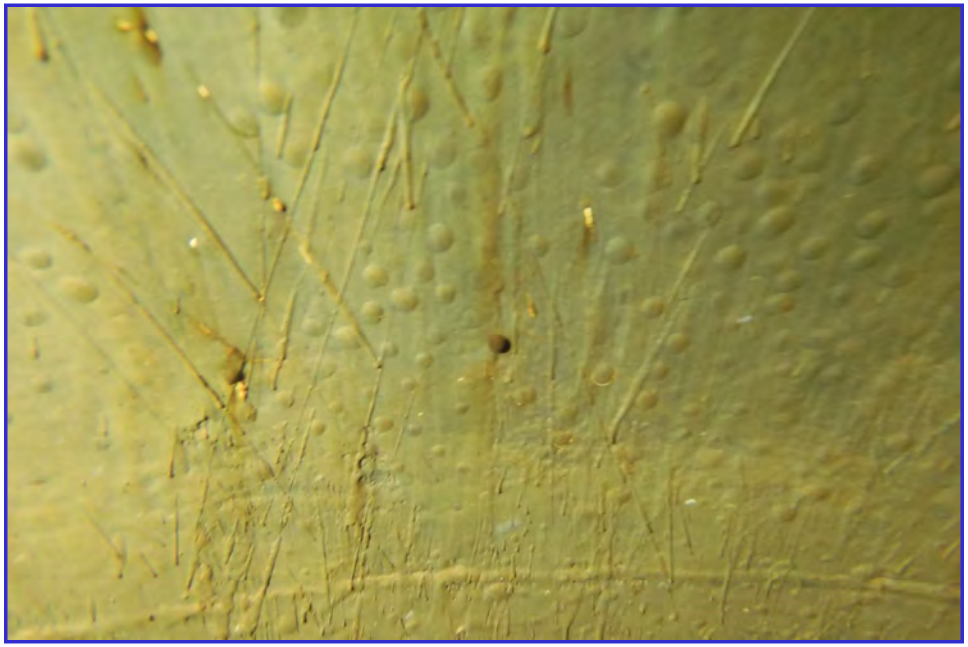


INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -074

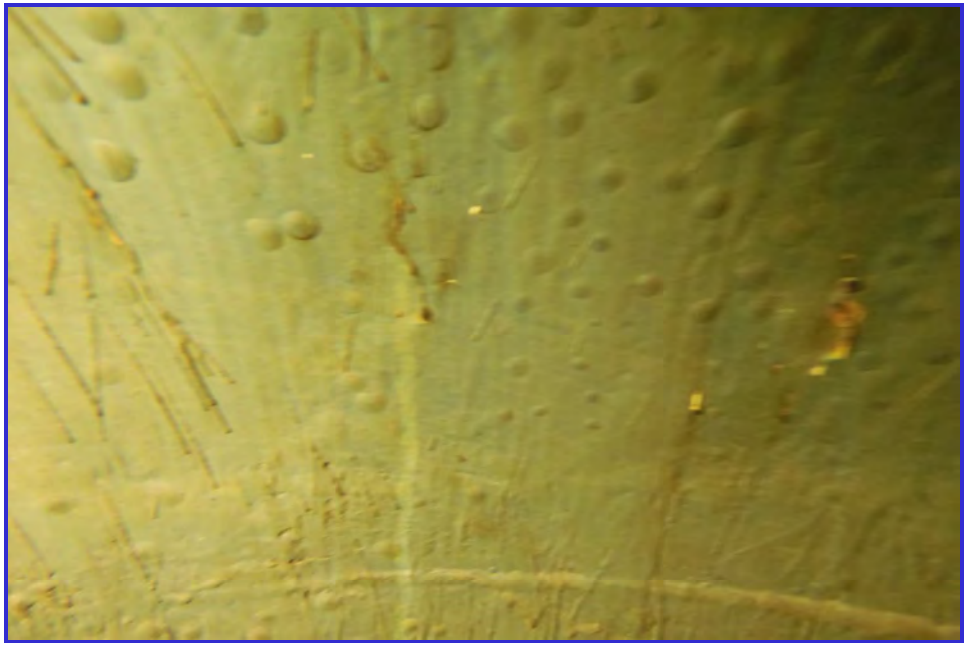


INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -075

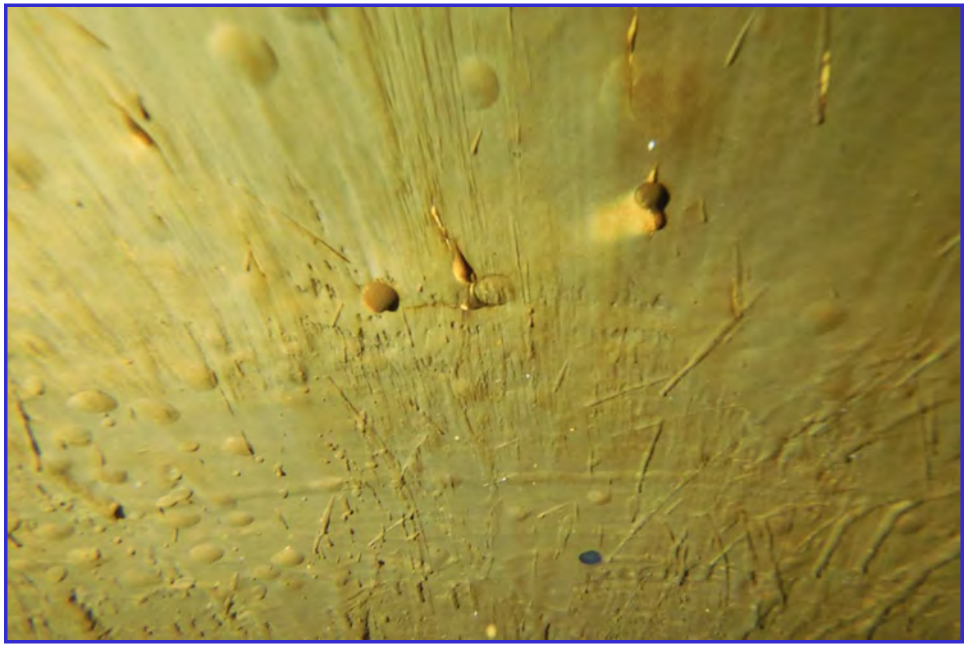
INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -076



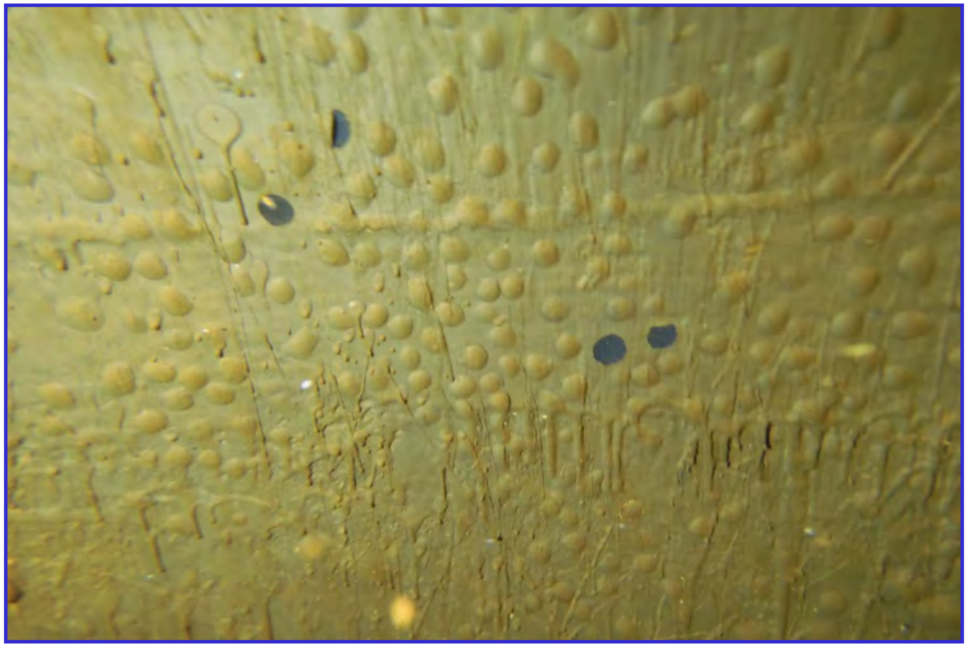
INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -077



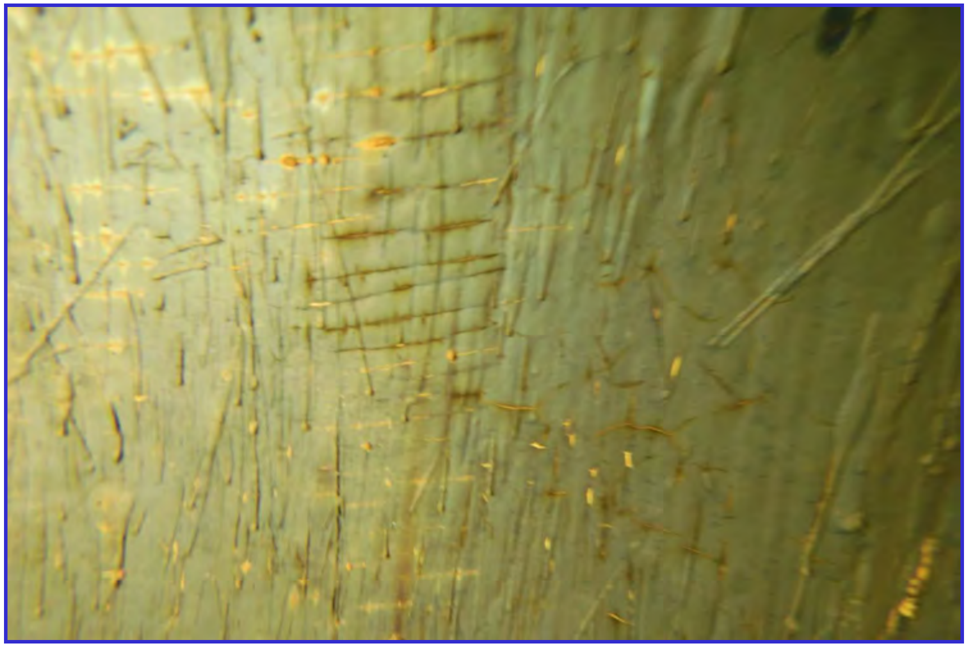
INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -078



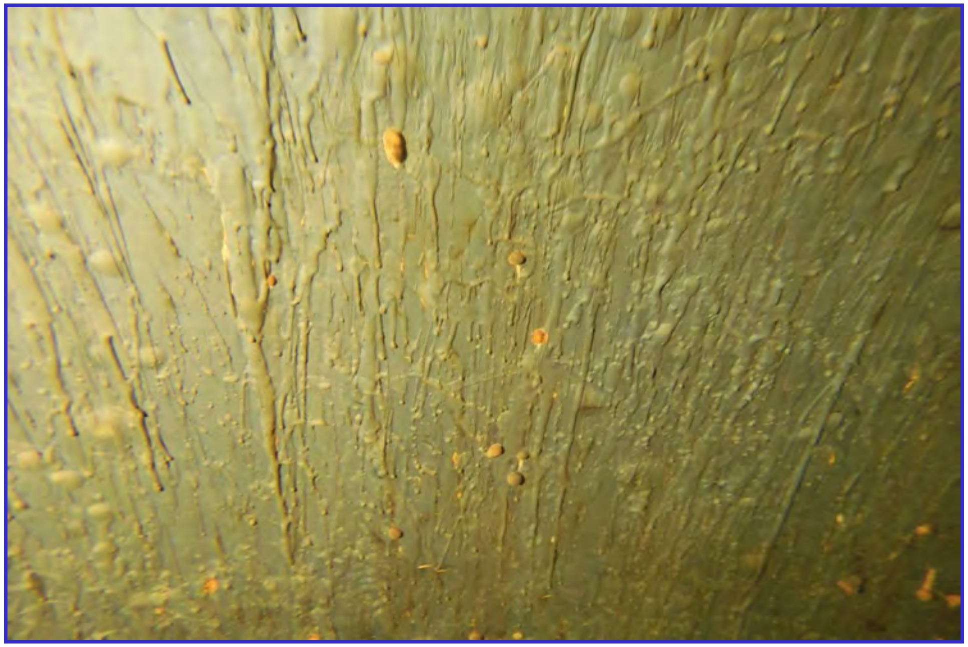
INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -079



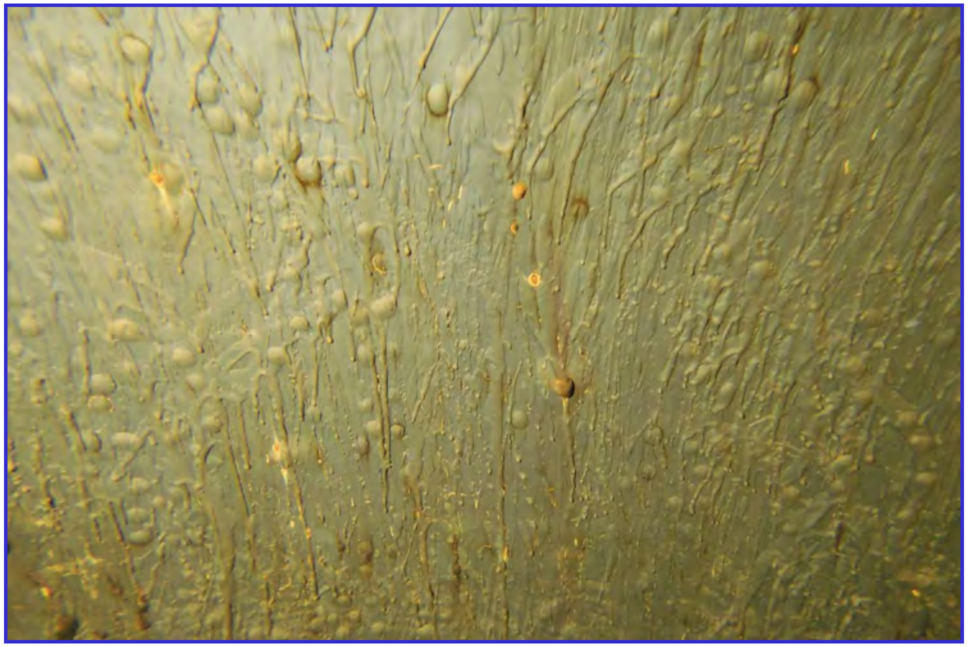
INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -080



INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -081



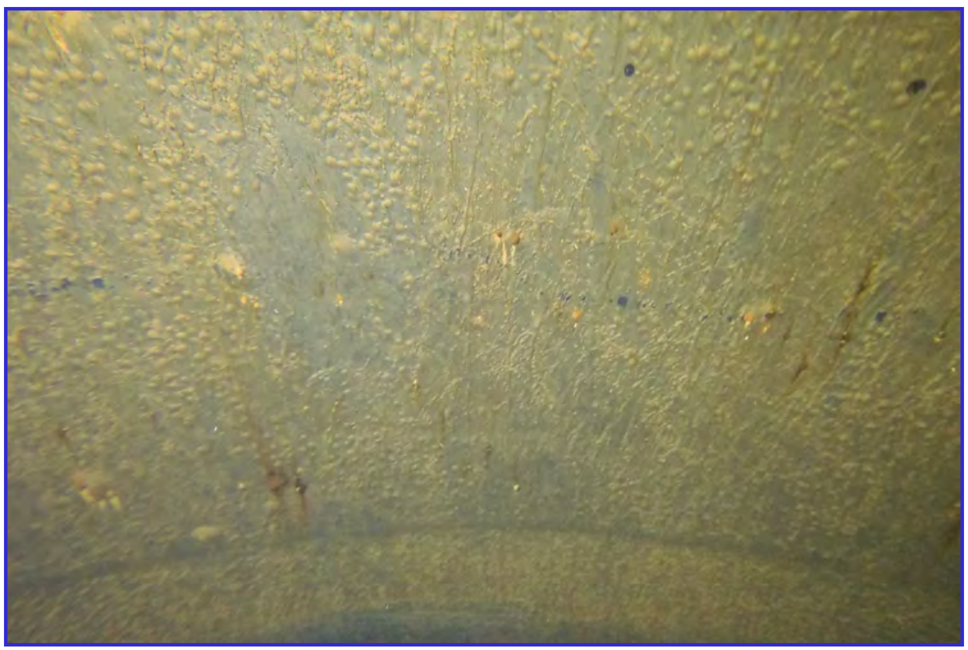
INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -082



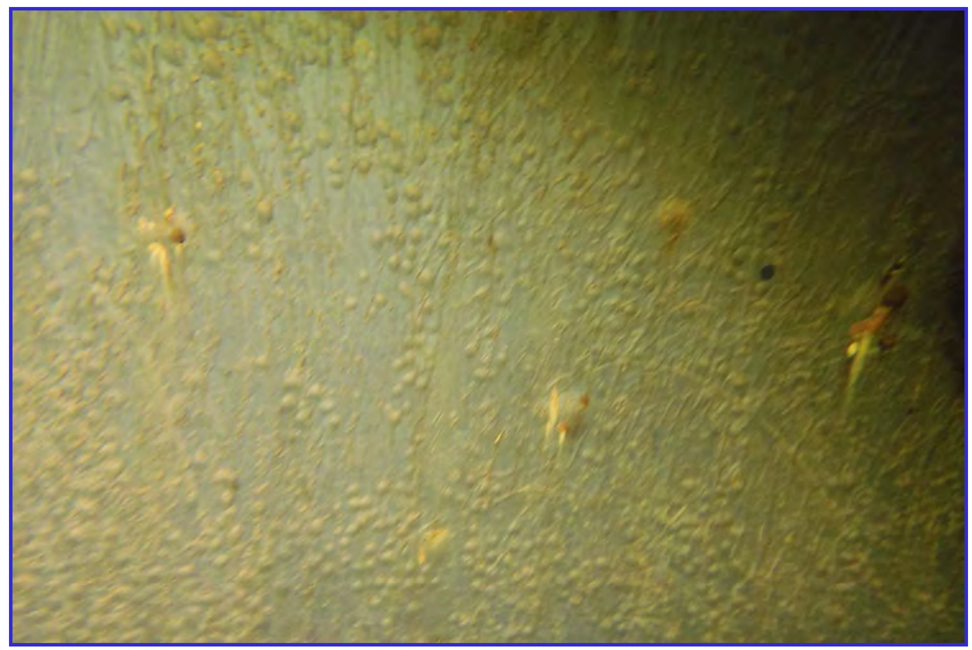
INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -083

INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -084

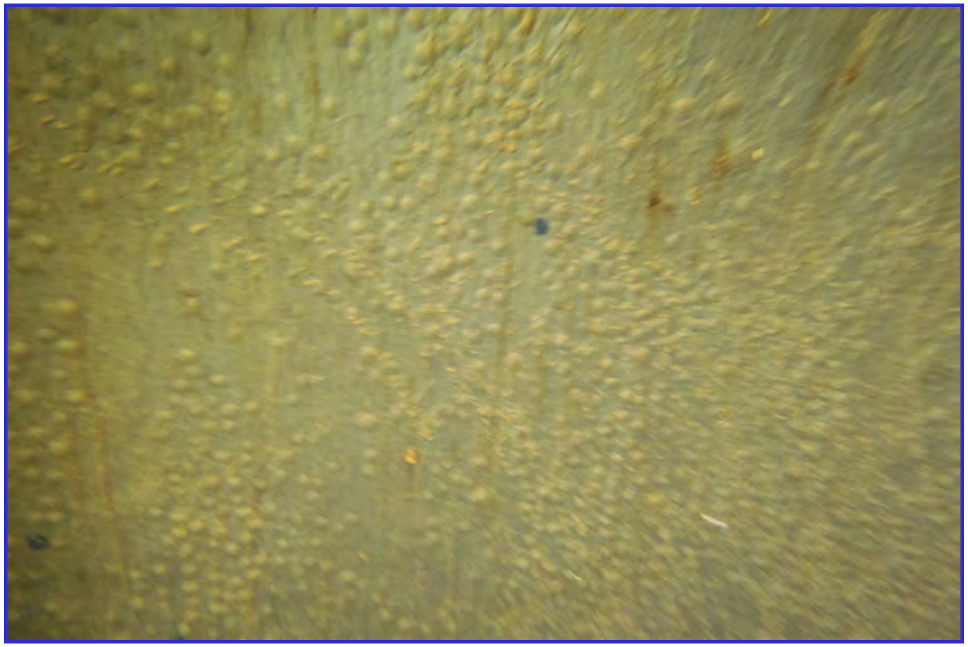
INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -085



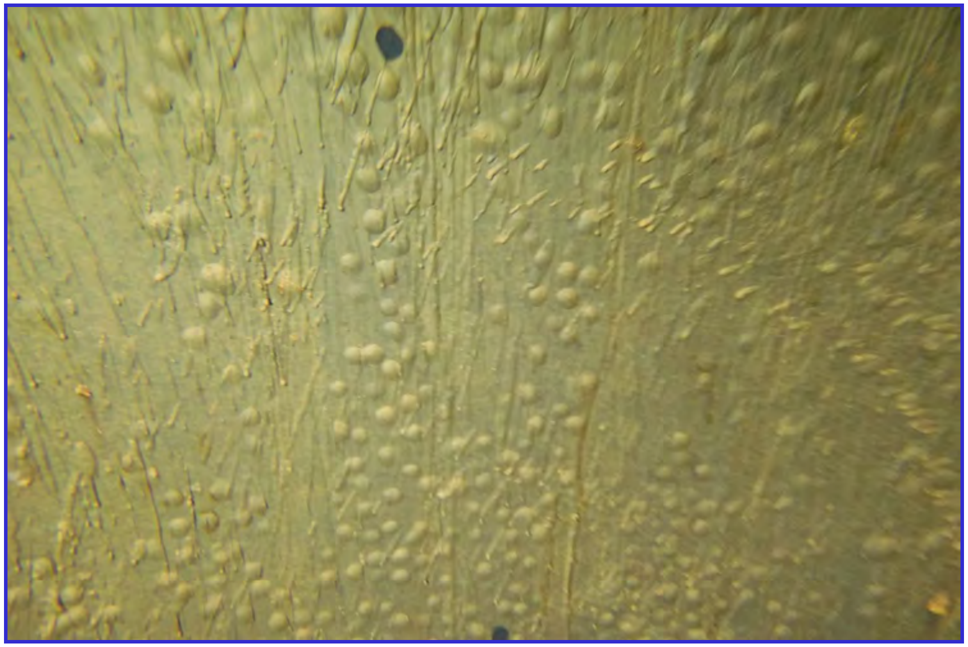
INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -086



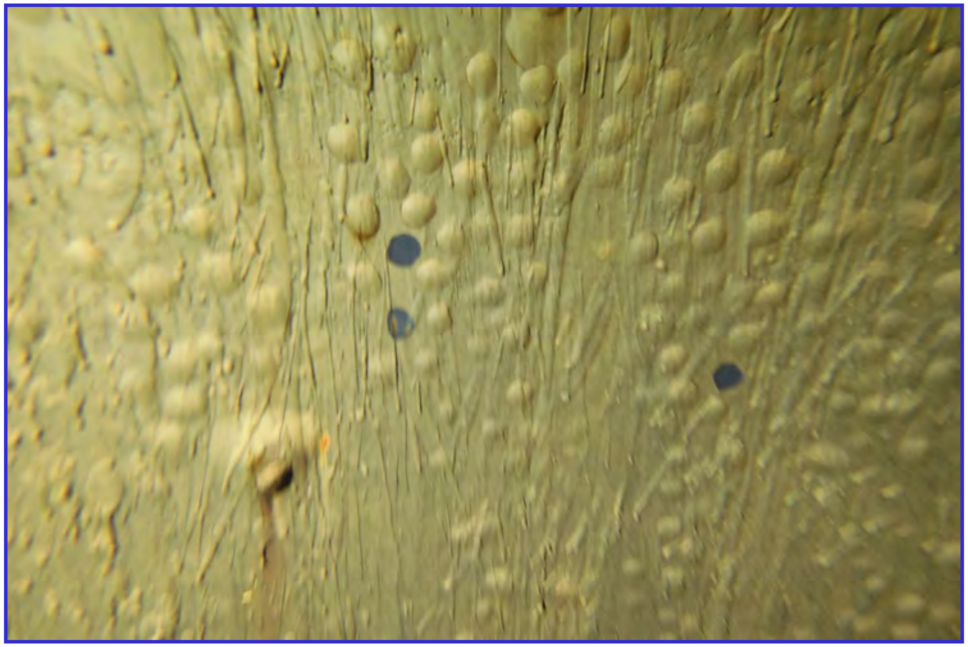
INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -087



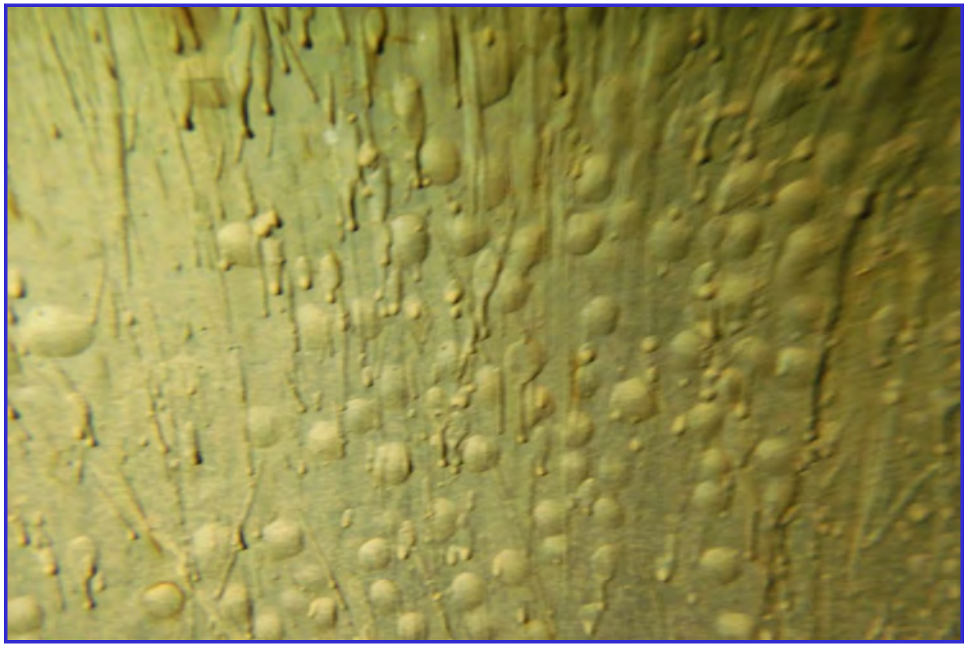
INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -088



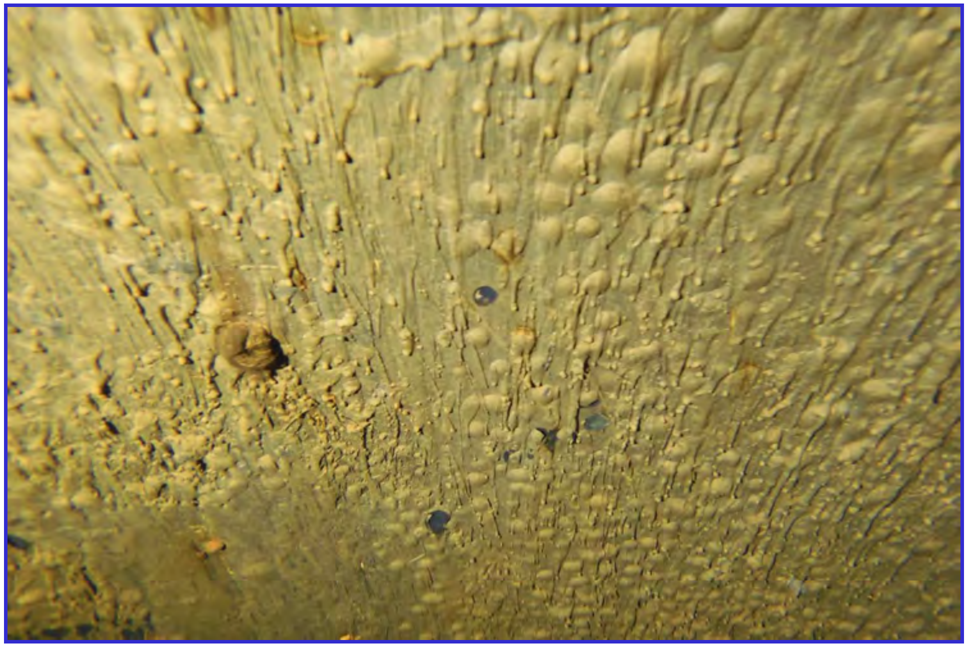
INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -089



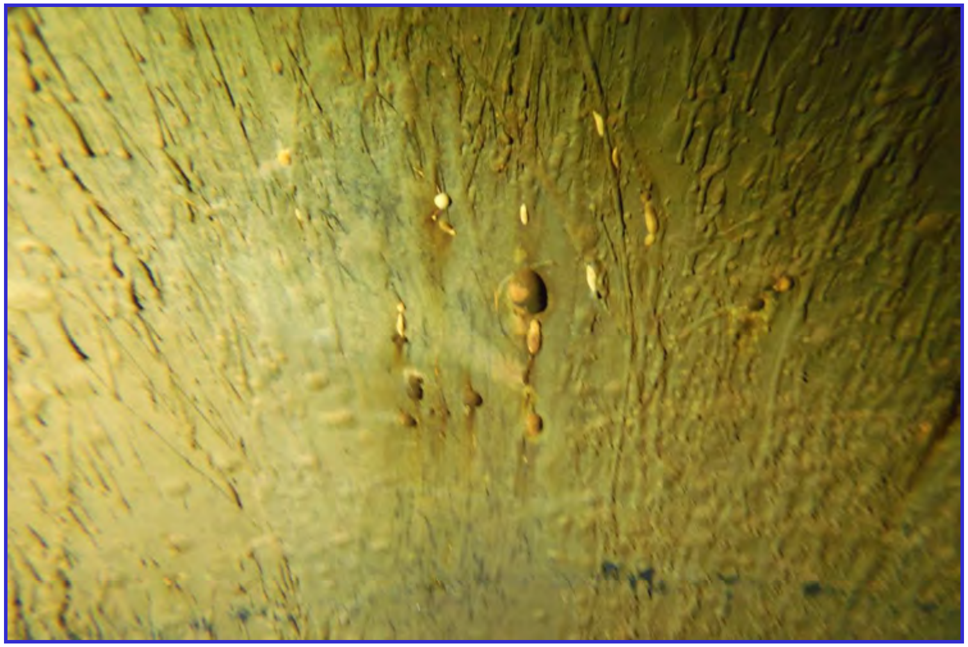
INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -090



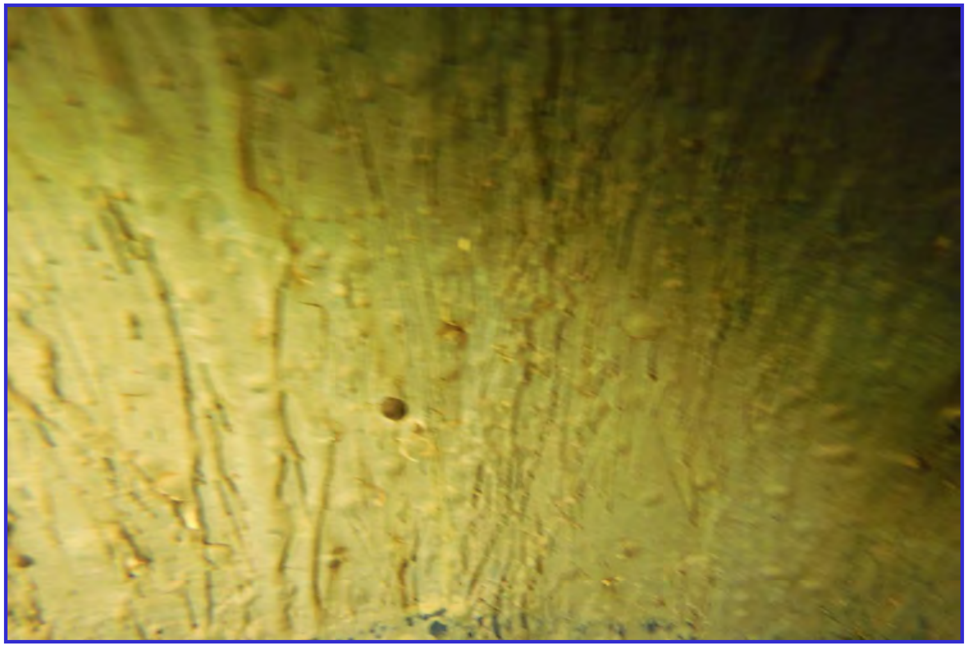
INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -091



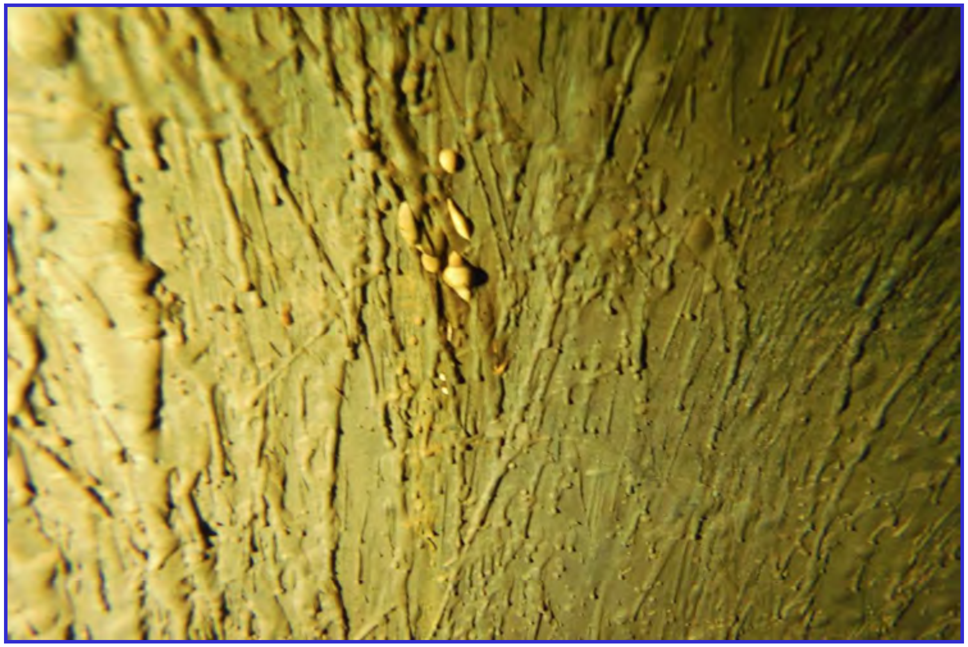
INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -092



INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -093

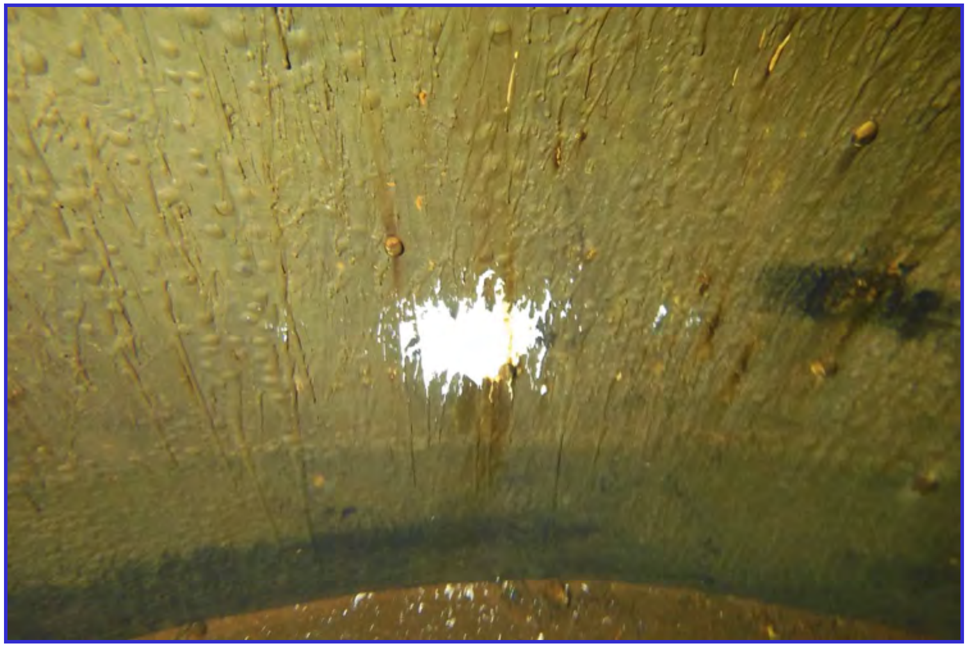


INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -094

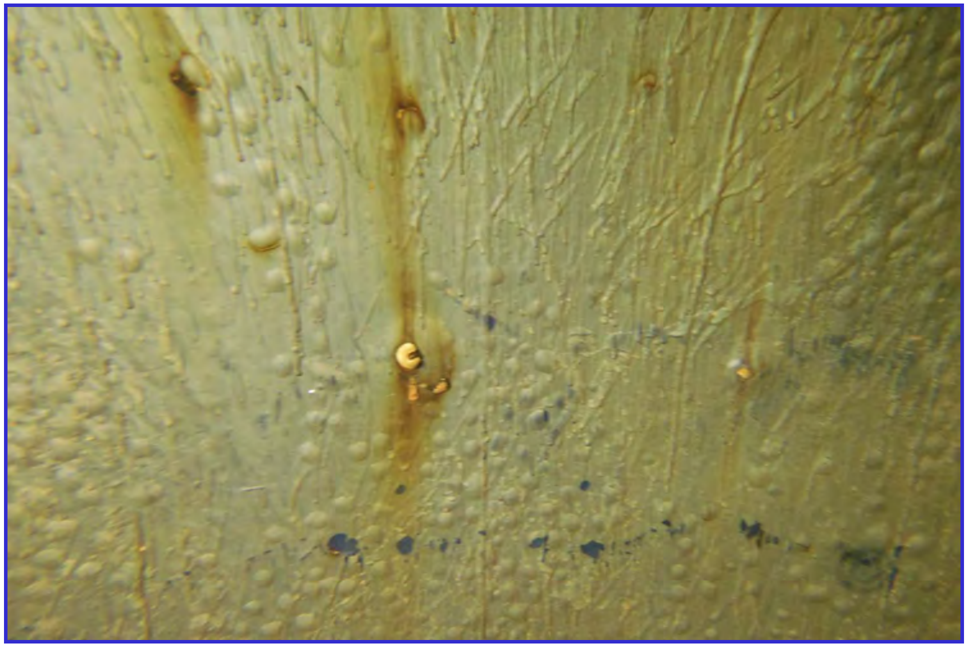


INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -095

INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -096



INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -097



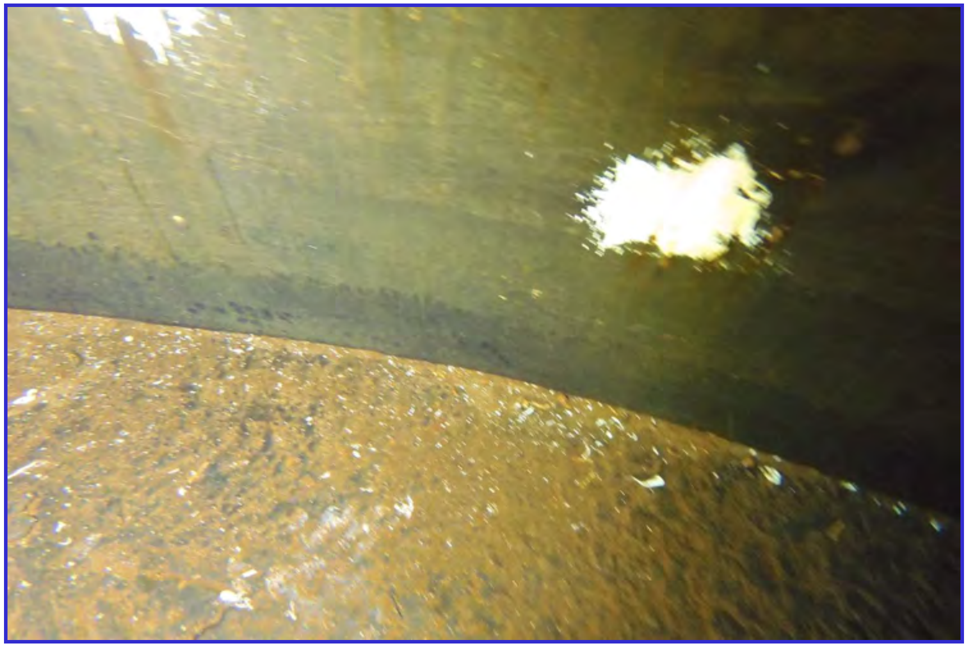
INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -098

INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -099

INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -100

INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -101

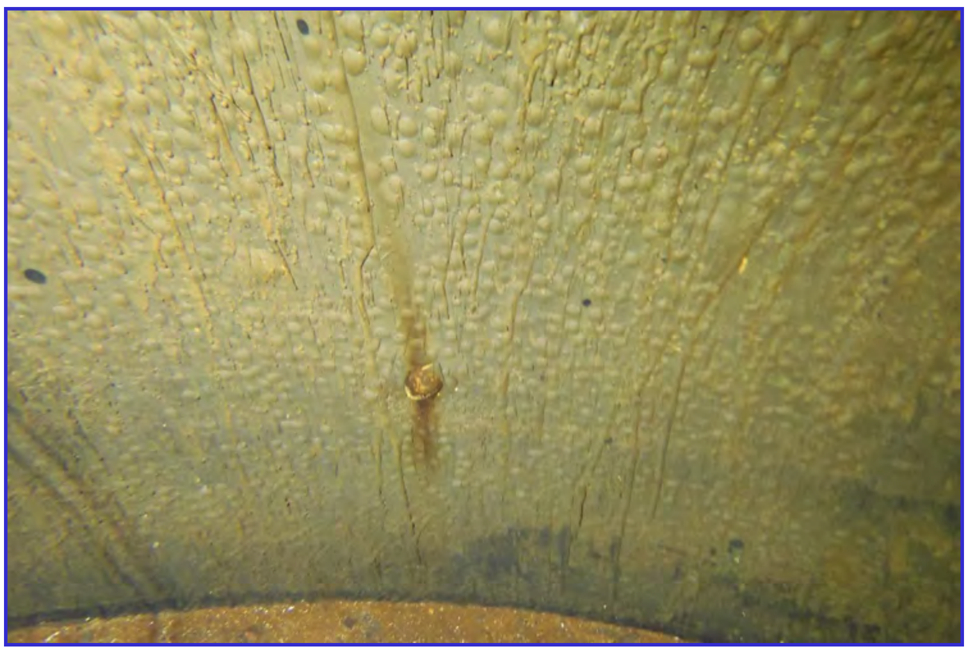
INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -102



INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -103

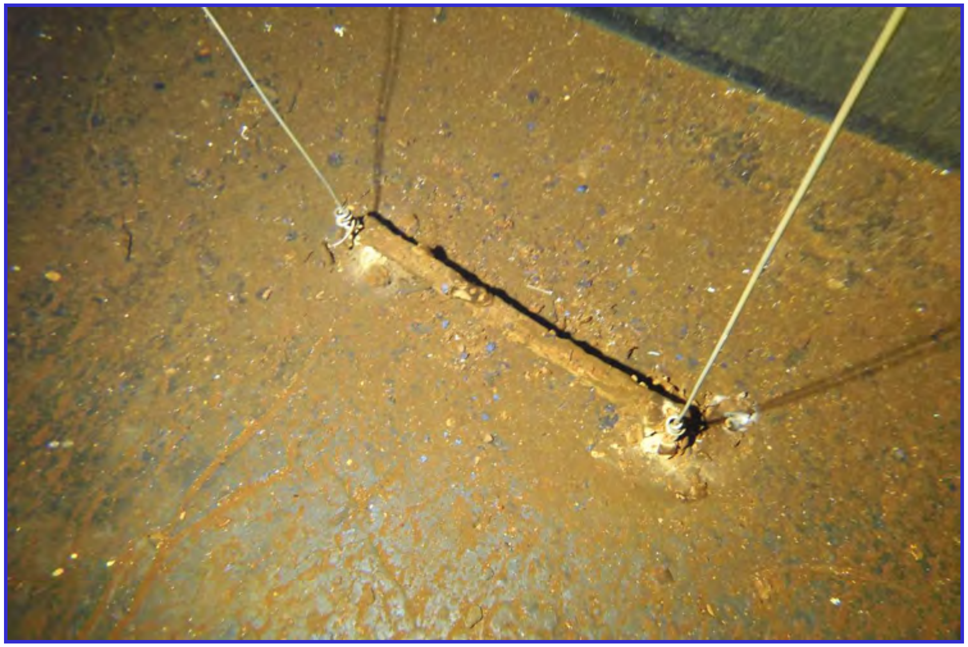
INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -104

INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -105



INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -106

INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -107

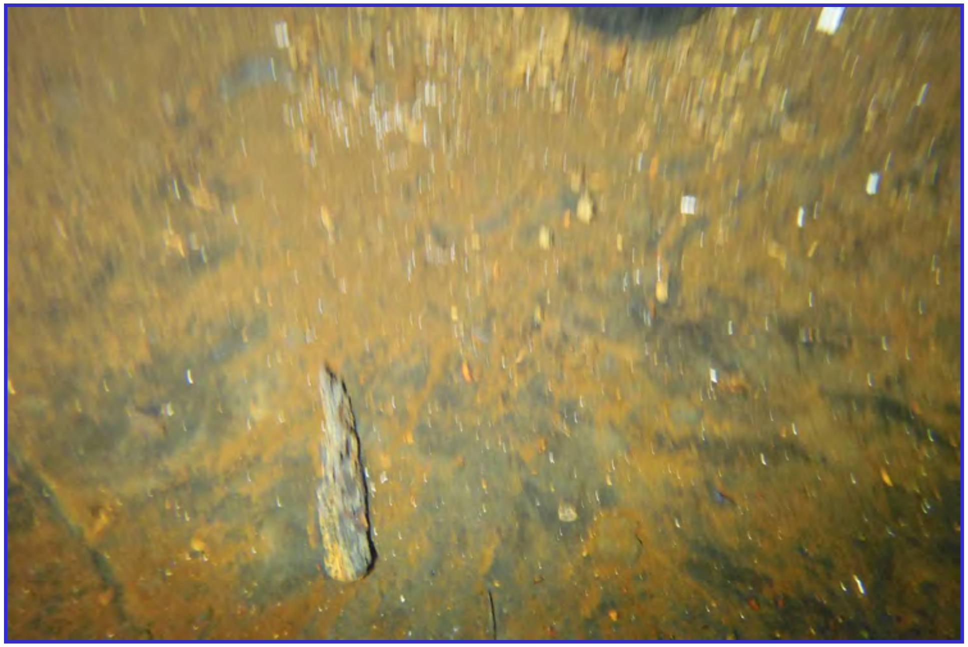


INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -108

INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -109

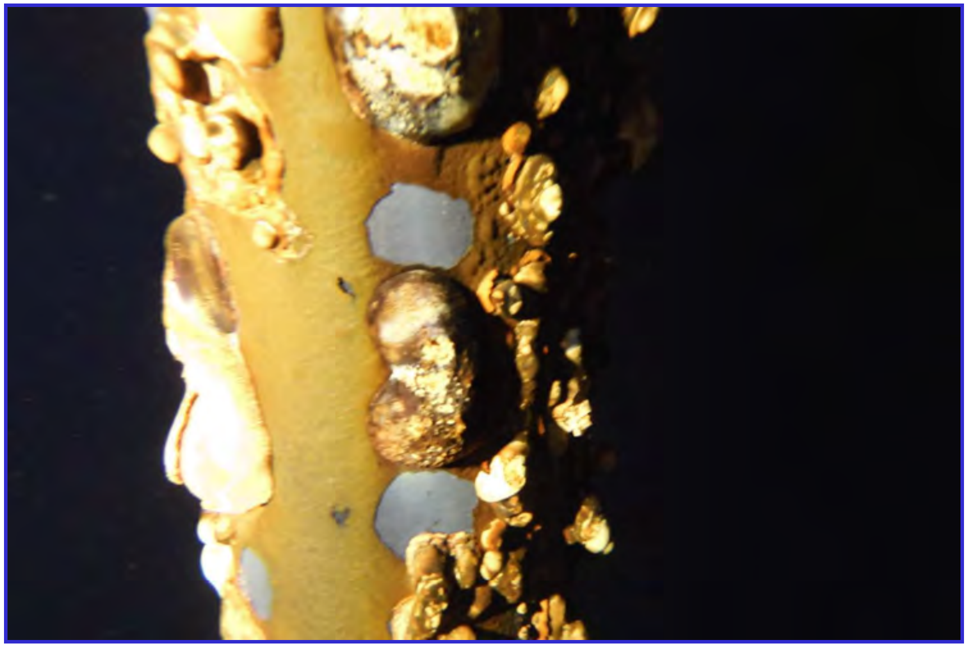
INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -110

INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -111

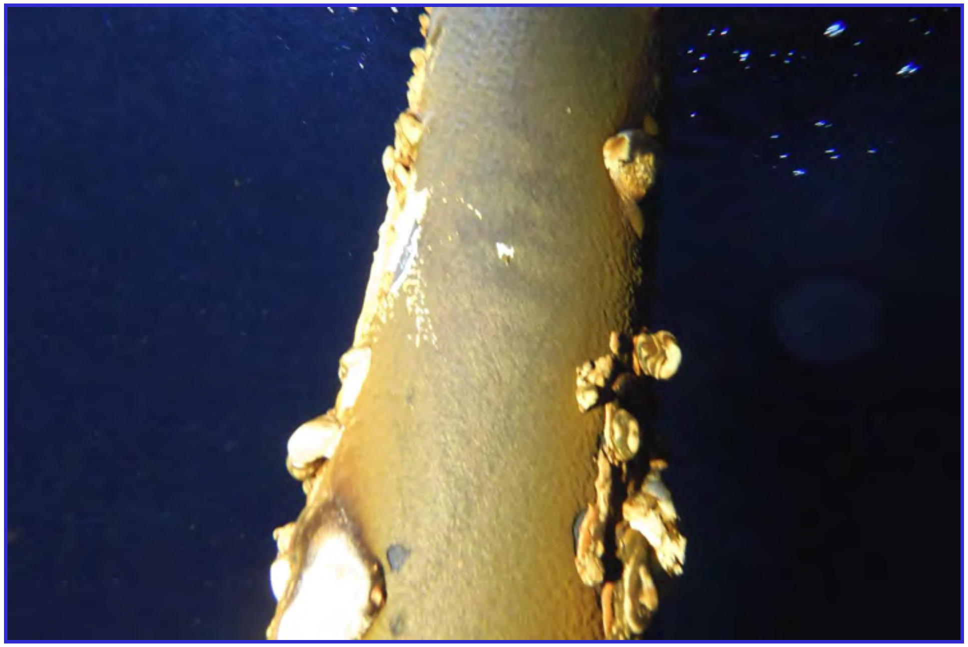


INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -112

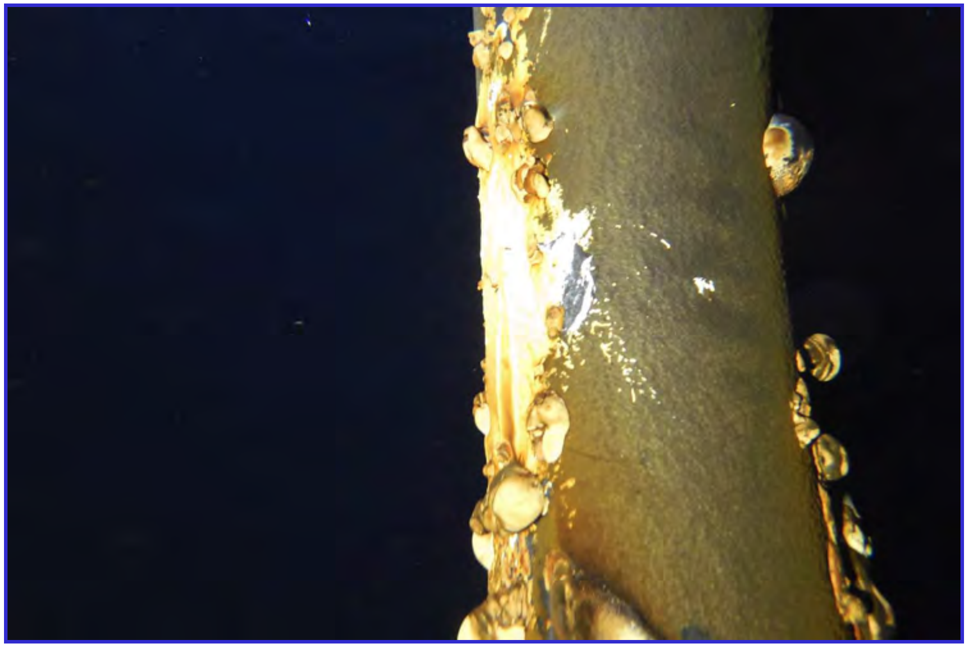
INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -113



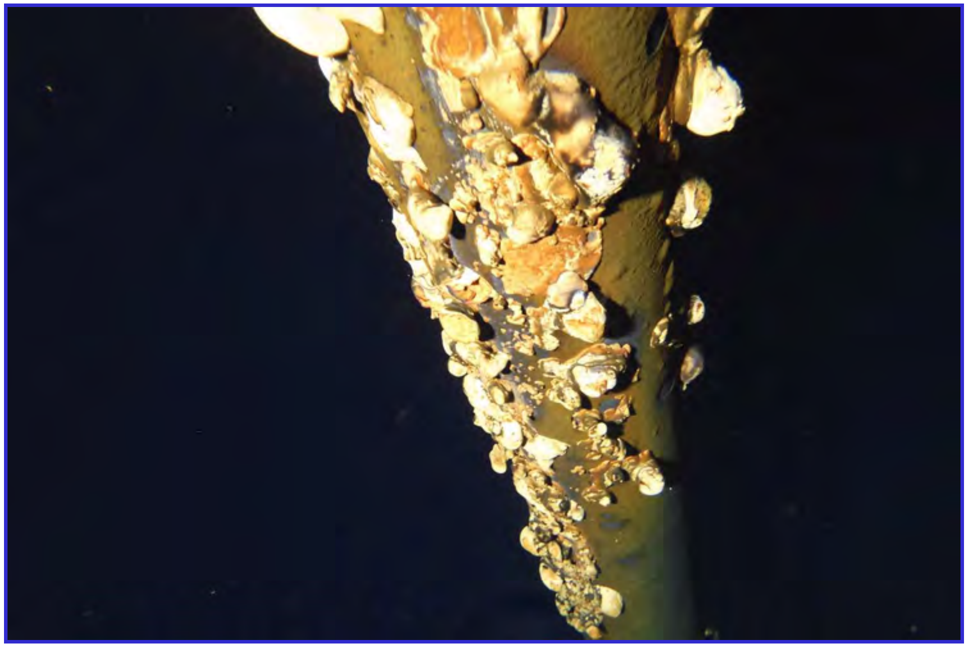
INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -114



INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -115



INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -116



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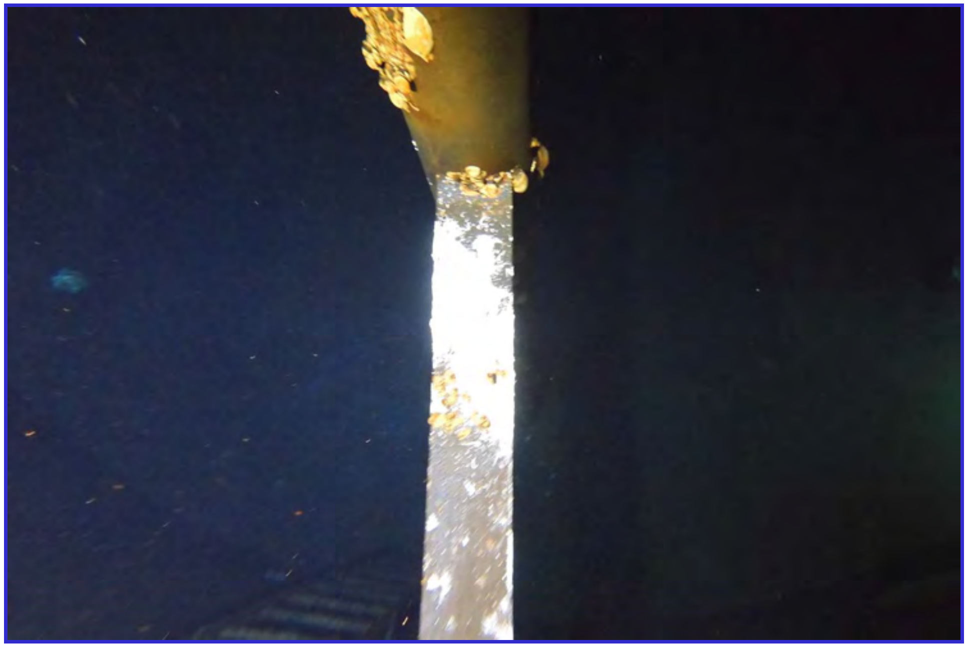

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INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -119

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INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -121

INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -122

INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -123

INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -124

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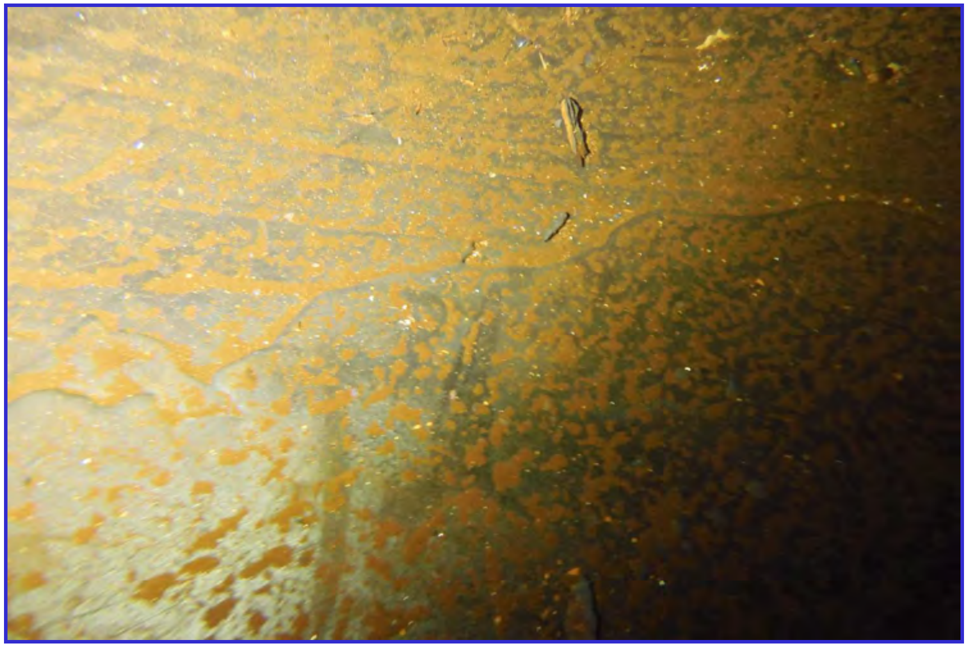
INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -127



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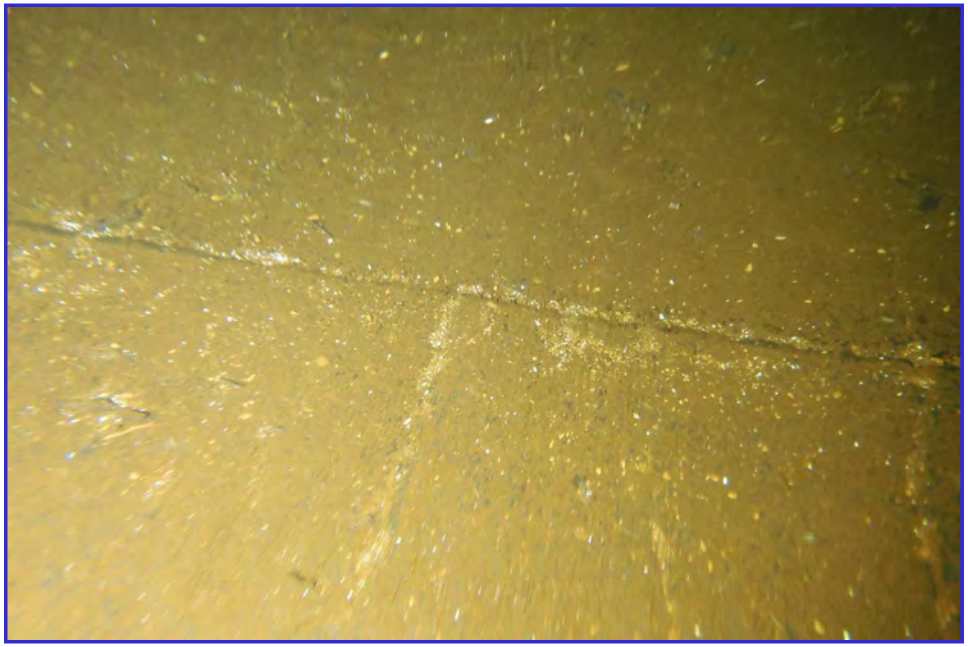

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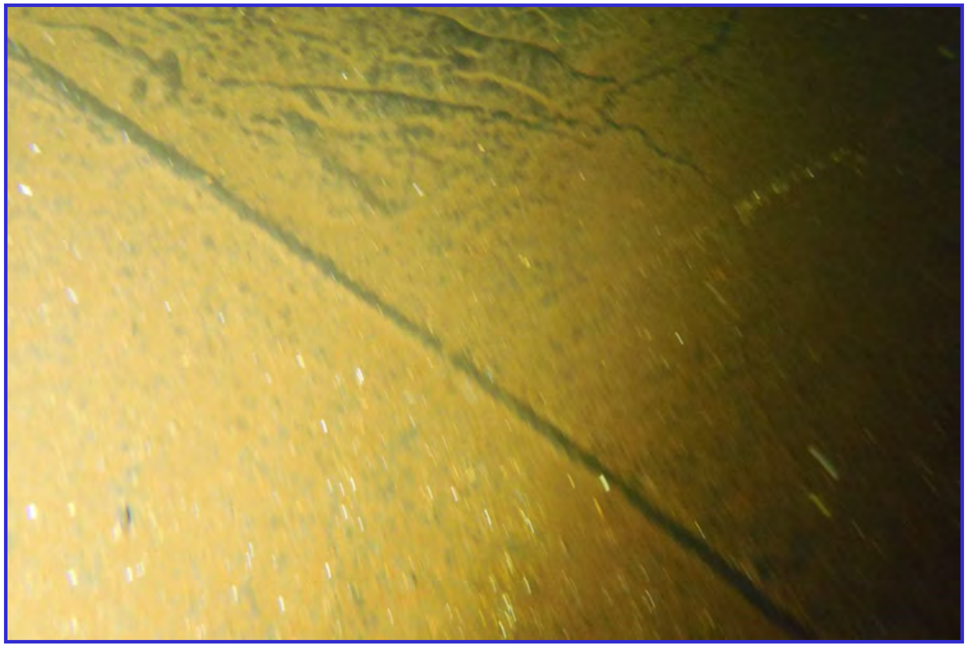

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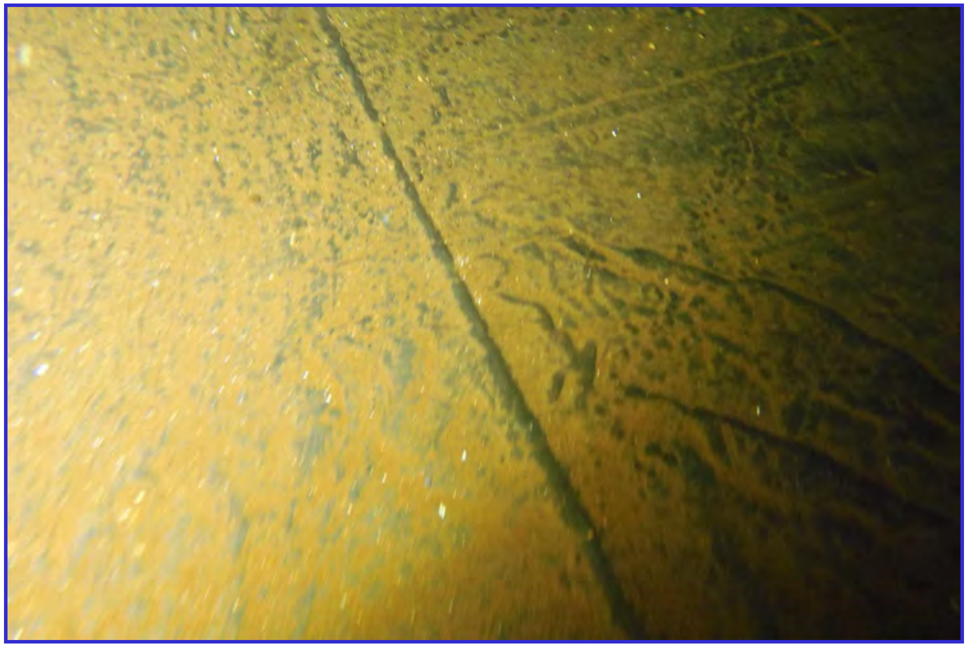

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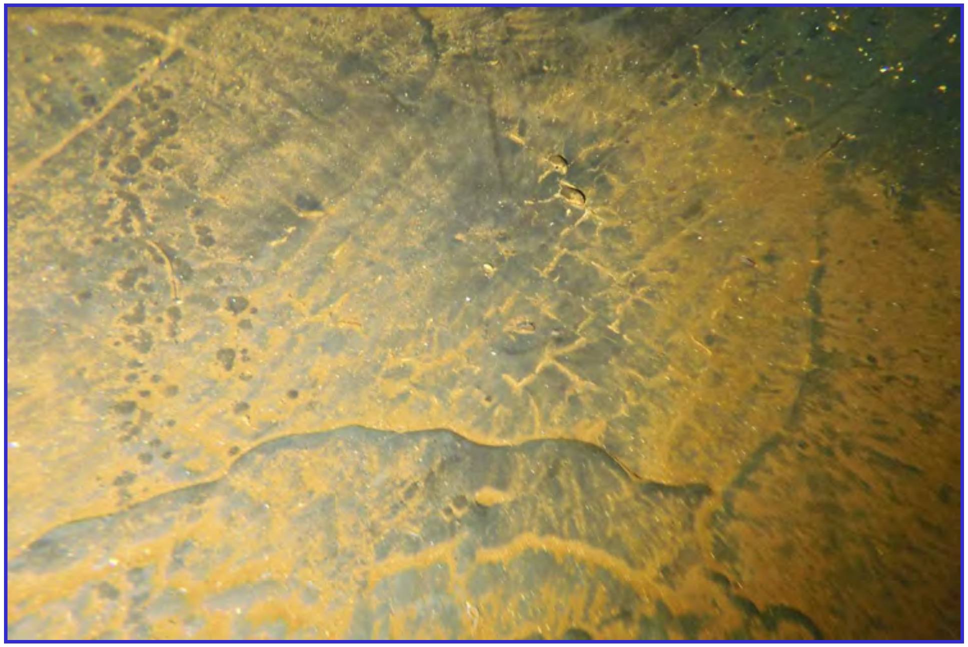

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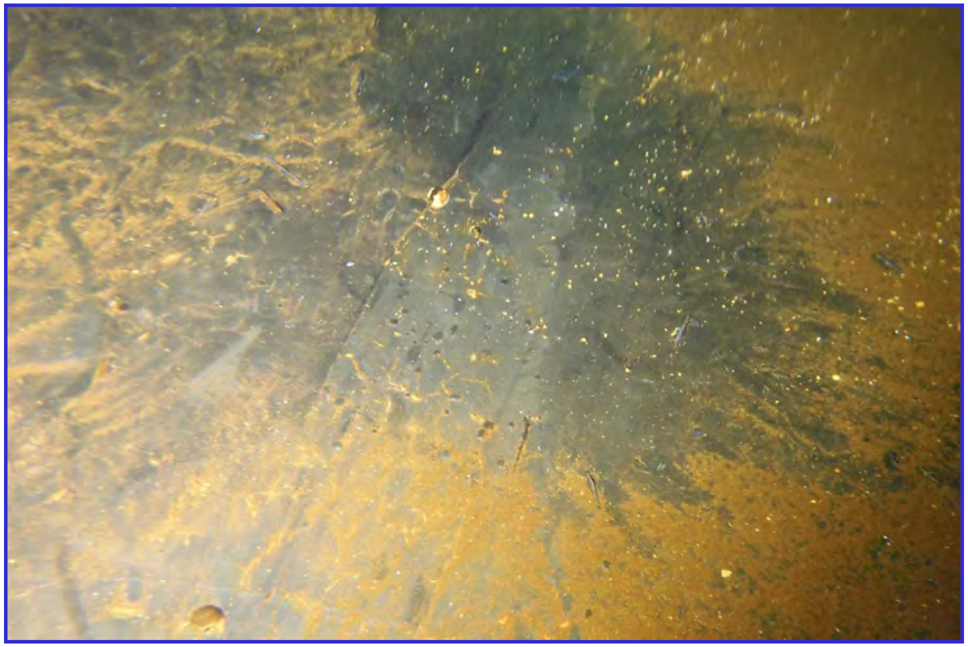

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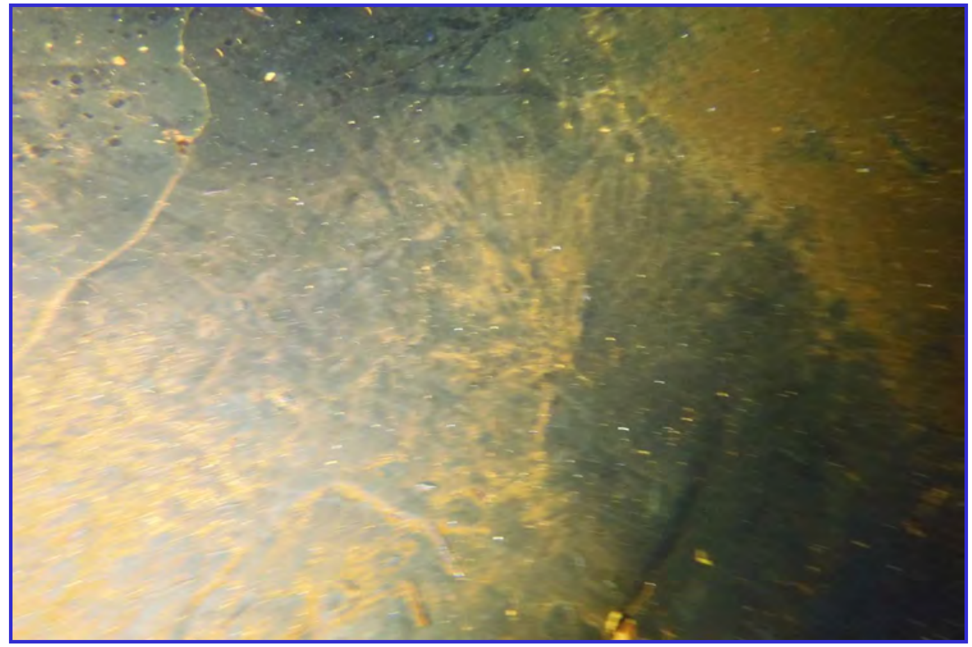

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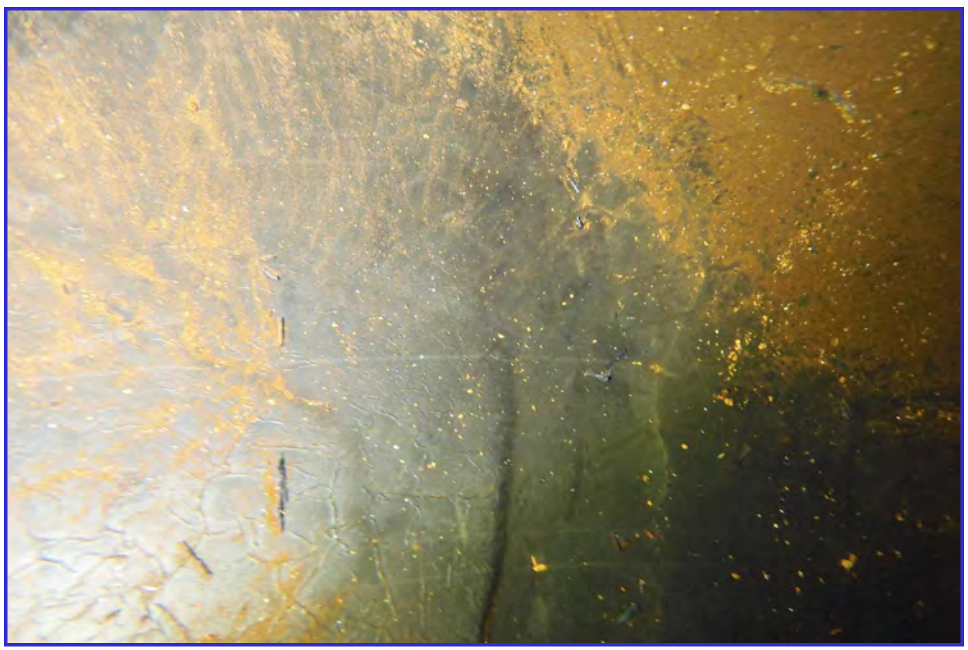

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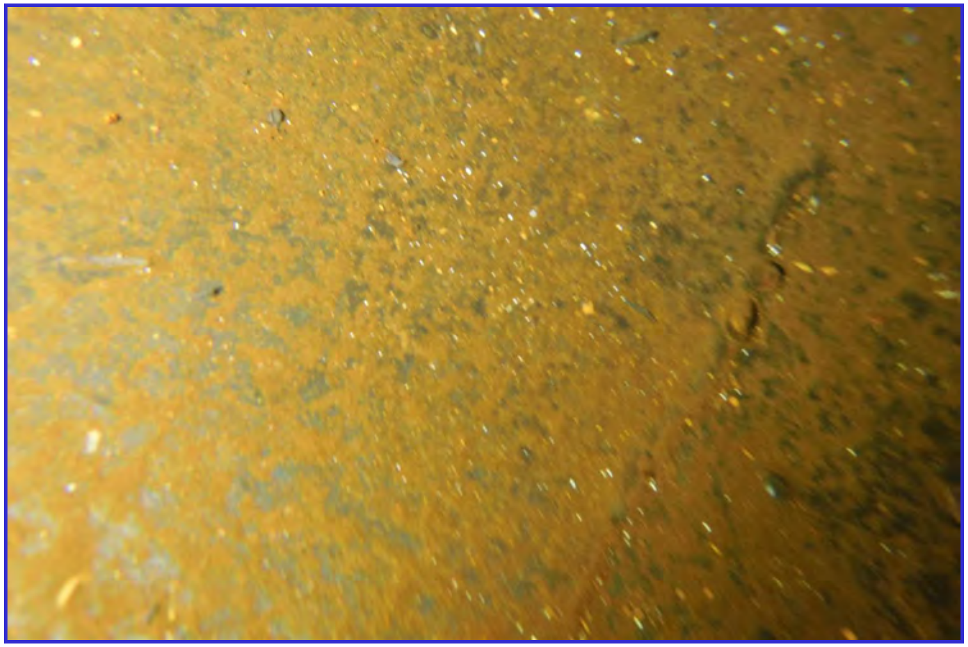
INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -139

INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -140

INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -141

INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -142

INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -143



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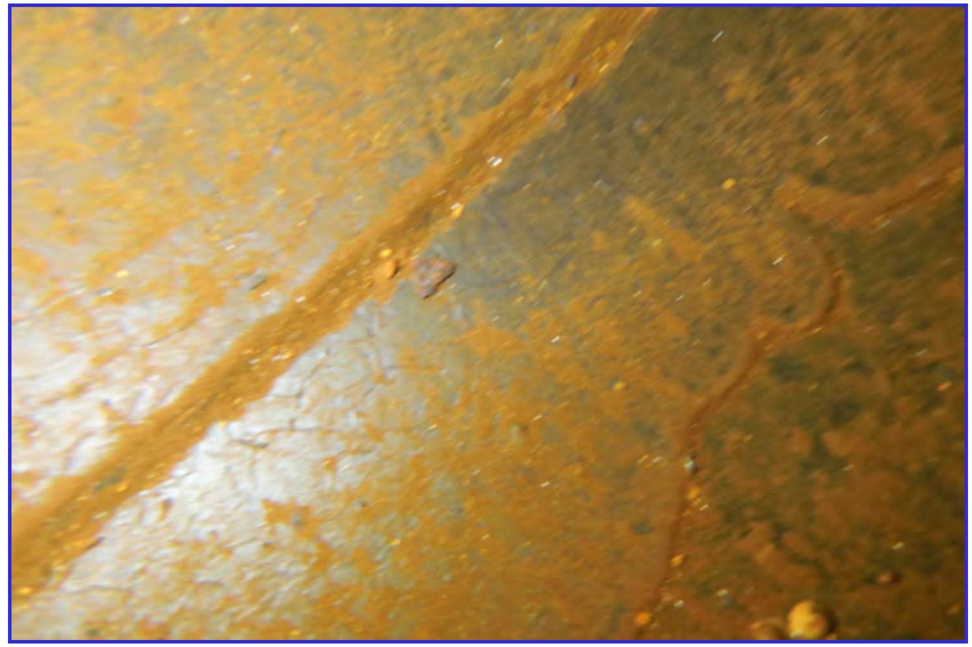

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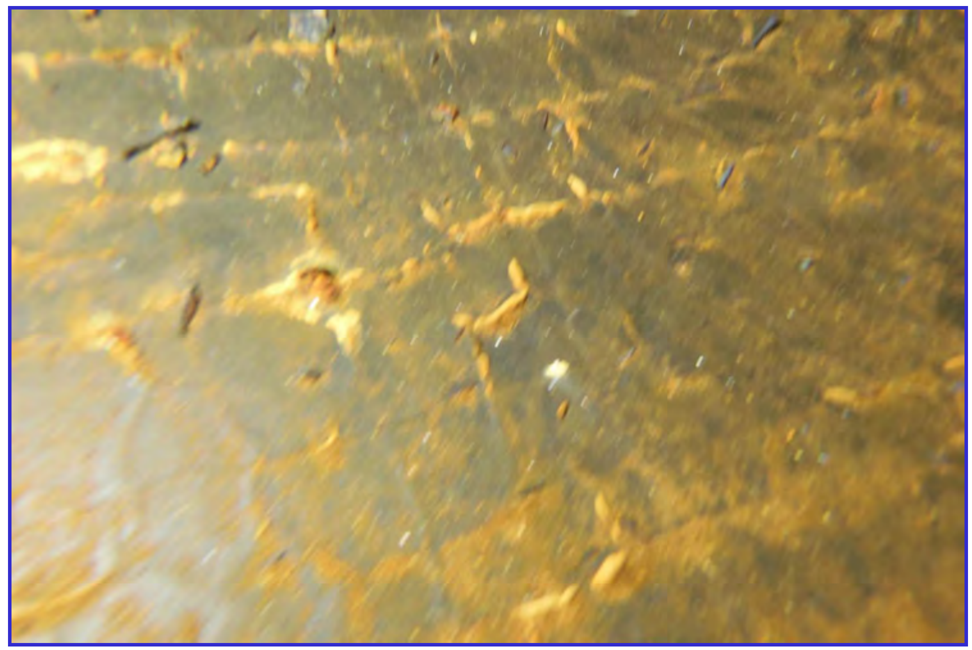
INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -146

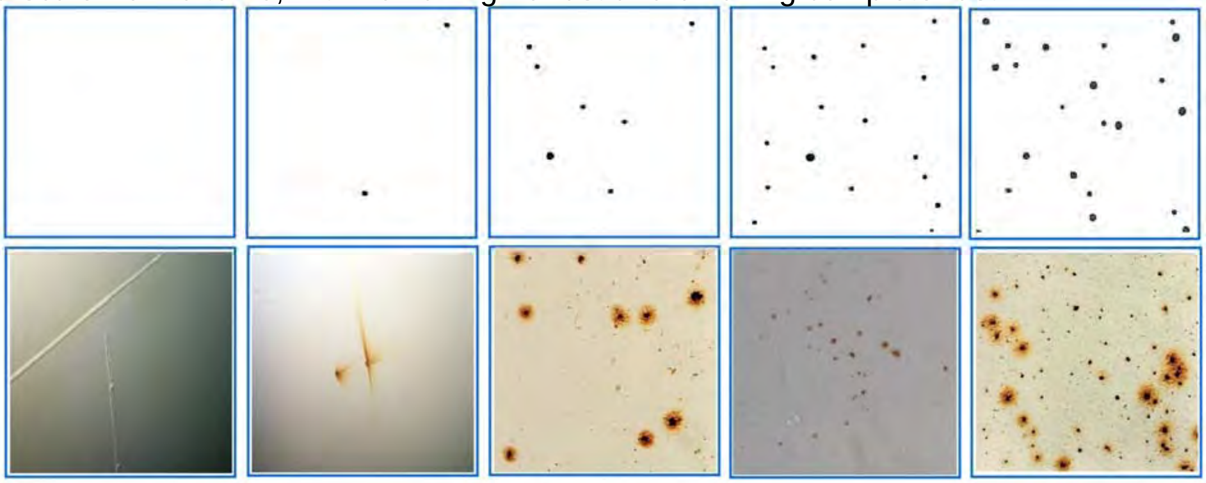


INTERIOR - CPUD - Paloma Reservoir - Maintenance Inspection -147

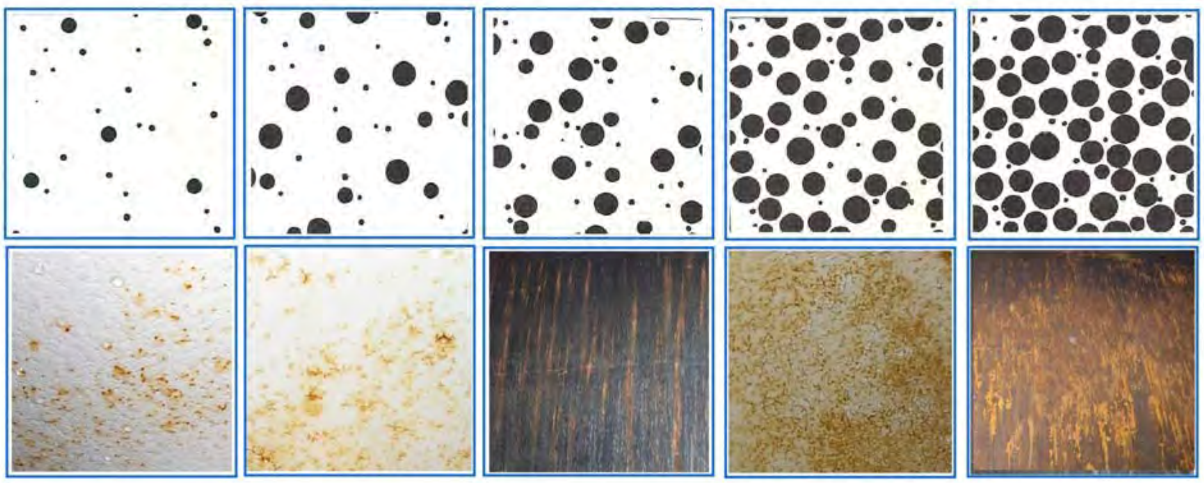
Chart 1 - Condition Rating The table below gives a basic description of the four different categories that CSI Services, Inc. uses to provide a general depiction of the condition of each defined area of a structure. The categories are Poor, Fair, Good, or Excellent. The development of these categories is based on historical knowledge and experience of various paint and lining systems over given periods of time in certain service environments. Basically, the rating is determined based on what should be expected of the paint or lining system at that point in its life cycle. As a result, different determinations are made for maintenance inspection versus warranty inspections. A detailed description of each rating with relative consideration addressed follows:

Rating	General Description of Conditions	
	Maintenance Inspection	Warranty Inspection
Poor	This condition is usually prioritized for rework in the short-term. Typically, these surfaces have considerably more coating defects and/or corrosion than what is expected for the age of the system.	This condition identifies an area with wholesale coating defects or corrosion concerns that will typically require significant removal and replacement of the coatings in the area.
Fair	Typically, these surfaces have a level of coating defects and/or corrosion that is slightly worse than what should be expected for the age of the system. This condition is placed on a short-term monitoring schedule.	This condition identifies an area with partial coating defects or corrosion concerns that will require significant rework.
Good	This condition is rated for areas without any considerable coating defects or corrosion. These surfaces are in a condition that is typical for the age of the coating system.	This condition identifies areas with coating defects or corrosion that is typically seen in one-year warranty inspections. Typically, only minor spot repairs are required.
Excellent	This condition is for areas without any considerable coating defects or corrosion. Typically, these surfaces are in a condition that is better than expected for the age of the system.	This condition identified areas that typically are in perfect condition and require no repair work.

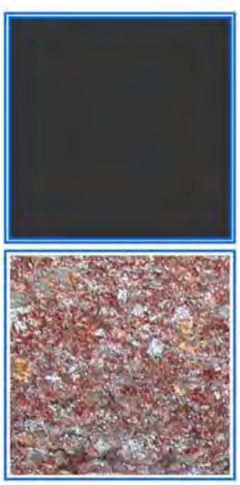
Chart 2 -Rust Grade The black and white figures below depict the standards referenced in ASTM D610 "Standard Test Method for Evaluating Degree of Rusting on Painted Surfaces." Below each standard is a photographic depiction of each level of corrosion, as used by CSI Services, Inc. The standards depict the percentage of rust on a scale from 0 to 10, with 10 having no rust and 0 having complete rust.



Rust Grade 10 Rust Grade 9 Rust Grade 8 Rust Grade 7 Rust Grade 6



Rust Grade 5 Rust Grade 4 Rust Grade 3 Rust Grade 2 Rust Grade 1



Rust Grade 0

Rust Grade	Description
10	No rusting or less than 0.01% of surface rusted
9	Minute rusting, less than 0.03% of surface rusted
8	Few isolated rust spots, less than 0.1% of surface rusted
7	Less than 0.3% of surface rusted
6	Excessive rust spots, but less than1% of surface rusted
5	Rusting to the extent of 3% of surface rusted
4	Rusting to the extent of 10% of surface rusted
3	Approximately one-sixth of the surface rusted
2	Approximately one-third of the surface rusted
1	Approximately one-half of the surface rusted
0	Approximately 100% of the surface rusted

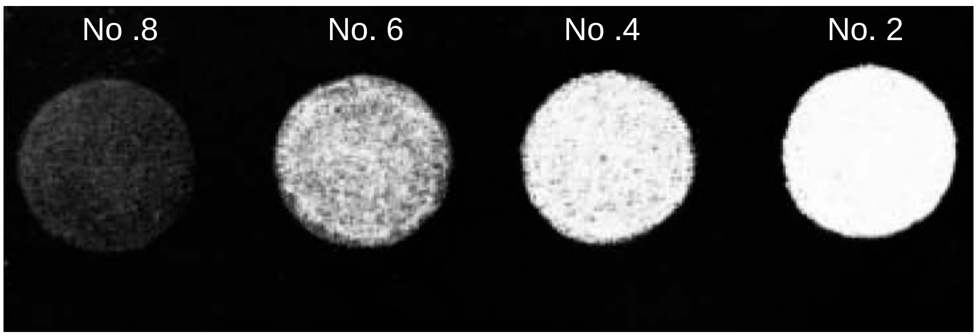
Chart 3 - Corrosion Grade The figure below depicts the photographic standards referenced by CSI Services, Inc. in the determination of the characteristics and stages of corrosion progression. This standard is used to better quantify the level of corrosion once it has progressed to Rust Grades 3, 2, 1, or 0 (see Chart 2). When applicable, CSI classifies an area as one or more of the five different Corrosion Grades. Corrosion Grades 1 through 5 are described below:

Grade	Description	Photo Examples
1	Light Rust - This condition involves relatively light colored rust that does not have any significant metal loss.	 
2	Dark Rust -This condition involves relatively dark colored, thicker rust that is progressing towards the next phase, significant metal loss.	 
3	Pitting - This condition involves isolated or widespread deep spot corrosion (pitting).	
4	Scale - Also known as lamellar or exfoliation corrosion. The edges of the affected area are leaf like and resemble the separated pages of a wetted book.	 
5	Structural Loss - This condition involves metal loss or failure where components will require structural consideration	 

The photos depicted are examples and were not taken on this project.

Chart 4 - Chalking The figure below depicts the photographic standards referenced in ASTM D4214 “Standard Test Method for Evaluating the Degree of Chalking of Exterior Paint Films,” Method D659, Method C. Generally speaking, chalking is the degradation of a paint’s binder leaving behind loose pigments as the binder reacts with the environment, primarily ultraviolet light and oxygen. Evaluating chalking is a means to measure the performance of a coating system and its life cycle projection. It is also important to quantify for consideration of future overcoating options. This test uses these pictorial standards to quantify the amount of chalking present on paint films. The depictions below represent the mount of colored chalk removed onto a cloth during the test. The scale ranges from 2 to 8 with the rating 2 having the most chalk.

Light Colored Paints



Dark Colored Paints

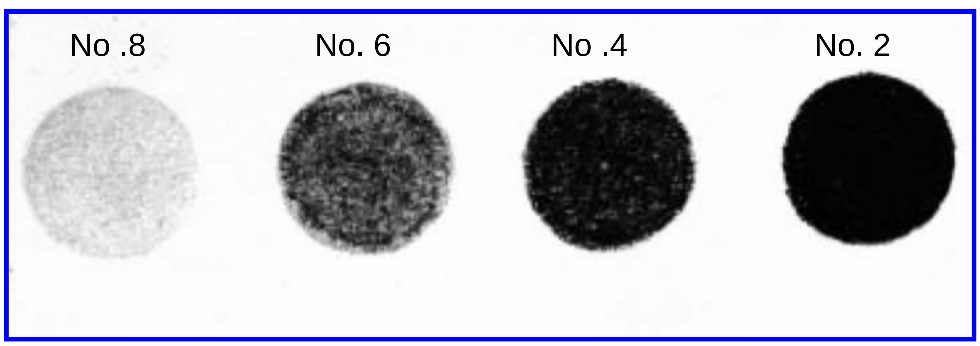
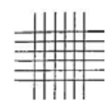
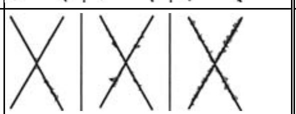
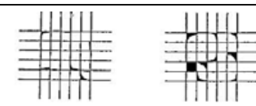
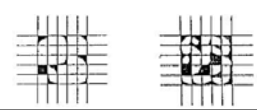
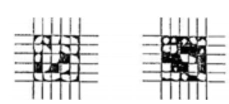
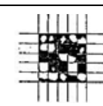
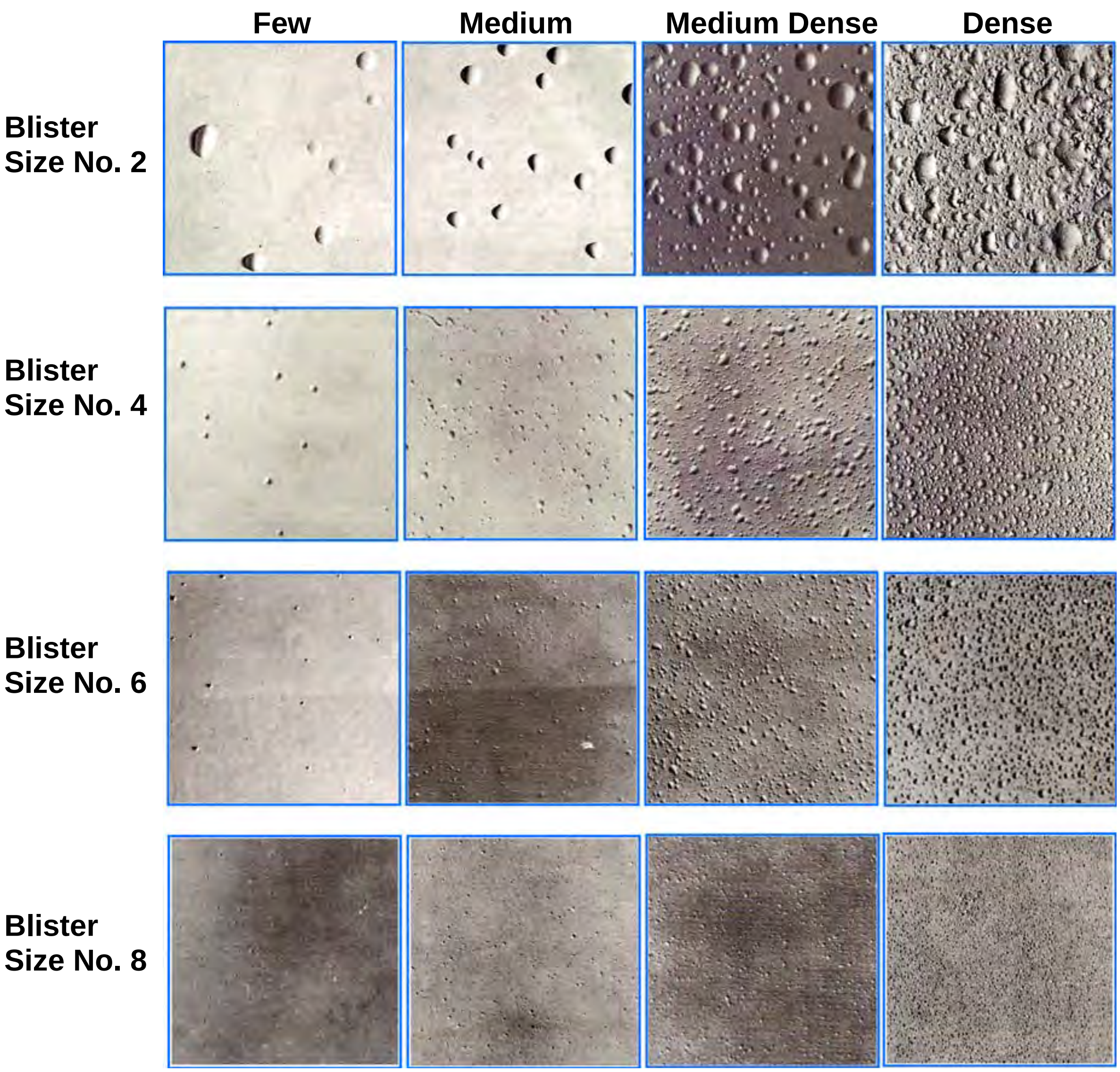


Chart 5 - Adhesion Rating The figures below depict the photographic standards and criteria referenced in ASTM D3359 “Standard Test Method for Evaluating Adhesion by Tape Test” and ASTM D6677 “Standard Test Method for Evaluating Adhesion by Knife.” Both Standards are used to assess the condition of a paint system for life-cycle projections. It is also used to evaluate an existing paint system’s ability to withstand the added stress that any overcoating strategies can create. Depending upon the thickness of the paint system, ASTM D3359 has two different test methods. The rating criteria for both standards follow:

ASTM D3359					
Method A			Method B		
Rating	**Observation**	**Surface of X-cut from which flaking/peeling has occurred**	**Rating**	**Percent Area Removed**	**Surface of cross-cut area from which flaking has occurred for six parallel cuts and adhesion range by percent**
5A	No peeling or removal	None	5B	0% none	
4A	Trace peeling or removal along incisions or their intersection		4B	Less than 5%	
3A	Jagged Removal along incisions up to 1/16” on either side		3B	5 – 15%	
2A	Jagged removal along most of incisions up to 1/8” on either side		2B	15 – 35%	
1A	Removal from most of the area of the X under the tape		1B	35-65%	
0A	Removal beyond the area of the X		0B	Greater than 65%	

ASTM D6677	
Rating	Description
10	Fragments no larger than $\frac{1}{32}$” x $\frac{1}{32}$” can be removed with difficulty
8	Chips up to $\frac{1}{8}$” x $\frac{1}{8}$” can be removed with difficulty
6	Chips up to $\frac{1}{4}$” x $\frac{1}{4}$” can be removed with slight difficulty
4	Chips larger than $\frac{1}{4}$” x $\frac{1}{4}$” can be removed with slight pressure
2	Once coating removal is initiated by knife, it can be peeled at least $\frac{1}{4}$”
0	Coating can be peeled easily to length greater than $\frac{1}{4}$”

Chart 6 – Blistering Rating The figure below depicts the photographic standards referenced in ASTM D714 “Standard Test Method for Evaluating Degree of Blistering of Paints”. This test uses these pictorial standards to quantify both the size and density of blisters that may develop in linings. Although the standard uses a blister size scale of 0 to 10 this chart uses the most common sizes of blisters found in the field. The standard does not use a reference for the size of each of the blisters depicted. CSI used this scale as a means for further quantification by qualifying the largest blister depicted as being 1 inch in width (Blister Size No. 2) and the smallest blister being 1/32 of an inch in width (Blister Size No. 8).



P. O. Box 801357
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www.CSIServices.biz

Providing Quality Technical Services to the Coating Industry

November 19, 2023 ***Via Email:*** asmith@pbieng.com

Ashley Smith, PE
Peterson Brustad Inc.
80 Blue Ravine Road, Suite 280
Folsom, CA 95630

Office: 916.608.2212
Cell: 530.200.6309

Subject: **Final Report - Maintenance Inspection**

Re: **CPUD – Railroad Flat Tank**

Dear Ashley:

Please find attached the final report for the evaluation that was completed on the above referenced tank. Also attached is our invoice.

Thank you for your business and please let me know if you have any questions or comments about our findings. I can always be reached by cell at 951.609.6991 or by e-mail at rgordon@csiservices.biz.

Sincerely,
CSI Services, Inc.

N. Randy Gordon, PCS
Technical Services Manager

P. O. Box 801357, Santa Clarita, CA 91380 877.274.2422

Final Report
Maintenance Inspection
Railroad Flat Tank
Calaveras Public Utility District

Prepared for:
Ashley Smith, PE
Peterson Brustad Inc.
80 Blue Ravine Road, Suite 280
Folsom, CA 95630

Prepared by:
CSI Services, Inc.

N. Randy Gordon, PCS
Technical Services Manager

PROTECTIVE COATING SPECIALIST
N. RANDY GORDON
No. 2018-621-011
Exp. 12-31-26
PCS
STATE OF CALIFORNIA

November 19, 2023

Hawaiian Office: P.O. Box 671, Aiea, HI 96701
Northern California Office: P.O. Box 371, Sonoma, CA 95476
Coating Specialists and Inspection Services, Inc.
Consulting Evaluations Tank Diving Inspection

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Attachments

- Field Notes
- Exterior Photos
- Interior Photos
- CSI Chart 1 – General Description of Conditions
- CSI Chart 2 – Rust Grade Criteria
- CSI Chart 3 – Corrosion Grade Criteria
- CSI Chart 4 – Coating Chalking Criteria
- CSI Chart 5 – Coating Adhesion Criteria
- CSI Chart 6 – Coating Blistering Criteria

Introduction

Peterson Brustad Inc. authorized CSI Services, Inc. (CSI) to conduct a maintenance inspection on the Railroad Flat tank located at 1141 Ridge Rd, Mokelumne Hill, CA. This report documents the findings of the inspection and services performed.

Any recommendations have been made in accordance with the applicable requirements of American Water Works Association's Standard (AWWA) D102 "Coating Steel Water Storage Tanks," AWWA Standard M42 "Steel Water Storage Tanks," and CSI's experience with evaluating over a thousand water storage facilities. A photo summary and narrated video are also included to document the condition of the tank.

The field-work was completed on August 10, 2023 by a team primarily comprised of Anthony Jackson, Steven Metcalf and Steven Metcalf Jr. The exterior shell observations were made mostly from grade level, while the exterior of the roof was examined close-up. The interior inspection was carried out with the tank's water level at approximately 34 feet using special underwater diving equipment and techniques. Steve Metcalf was the site supervisor and Anthony Jackson was the lead diver. Mr. Randy Gordon, Technical Services Manager, reviewed the results of the field data and prepared recommendations for maintenance work. Mr. Gordon has over 30 years of experience through the evaluation of thousands of storage tanks and other structures. He is certified as an SSPC Protective Coating Specialist (PCS) and NACE/SSPC Level 3 Coating Inspector.

Summary

The paint system on the exterior was found to be in satisfactory condition on the roof and excellent condition on the shell. Most of all rust on the tank exterior is on the roof. No substantial work is required on the exterior at this time, and it would be prudent to continue spot repairs of the paint system as required.

The tank lining system was found to have isolated dark corrosion and exfoliation above the highest water level (HWL), but only a minor amount of corrosion below HWL. The lining below the HWL was found to have rust nodules and pitting especially at the floor where a few of the coating breaks were repaired during this inspection using an NSF certified underwater curing epoxy.

There is a galvanic process whereby the carbon steel elements in contact with stainless steel is forcing the carbon steel to sacrifice itself to the more noble stainless steel. An accelerated corrosion rate within a water tank is often attributed to the difference in galvanic potentials of dissimilar "directly connected" metals (i.e. stainless steel components and carbon steel tank). The maximum corrosion rate for steel in fresh water is typically no more than 30 mils per year (MPY). Depending on the mass and/or difference in potential of the dominant metal, the rate of corrosion can increase to as much as 150 MPY or more. A future repair should consider electrical isolation of dissimilar metals to dissuade the rapid corrosion we witness today.

Background

The Railroad Flat Tank is a welded steel on grade structure built in 2001. The tank is approximately 47 feet in diameter by 40 feet high providing a nominal capacity of 506,000 gallons.

The tank shell has four courses that are connected to a roof with rafters and center column. The tank has one roof vent, one 24” square roof hatch, and two 30” shell unibolt manways. There is one interior ladder and one exterior ladder. The exterior ladder has fall protection. The tank is anchored to a concrete ring wall with anchor bolts. There is no internal or external cathodic protection (CP) system associated with this tank. The tank has a water level indicator and four PVC baffle walls suspended from the roof rafters and secured to clips along the shell and floor.

It is believed that the interior linings are the original coatings applied. All of the interior steel surfaces, including the roof, shell, roof support members, tank bottom, and appurtenances are coated with an Epoxy lining. The exterior roof, shell, and appurtenances are painted with what appears to be a urethane system. The internal roof lap seams are not caulked.

Field Evaluation

The purpose of this survey was to assess the condition of the existing coatings and recommend maintenance coating work, where needed. The evaluation mainly involved visual observations, but also involved various testing procedures. Photographs and video were taken to document the field inspections, and a photo summary and narrated video is included within this report.

For survey purposes, the tank has been segmented into defined areas: exterior roof, exterior shell, interior roof, interior shell, and interior floor. The various appurtenances within each of these areas have also been evaluated. A rating system has been developed to quantify the condition of these various tank areas. Each of the rating criteria is found in the Attachments (Charts 1 through 6).

The condition of the coating systems was rated as being poor, fair, good, or excellent

(Chart 1). The extent of any rust defects identified within each of the areas was generally determined using the guidelines set forth in ASTM D610 "Standard Test Method for Evaluating the Degree of Rusting of Painted Steel Surfaces" (Chart 2). Where applicable, the characteristic or stage of corrosion was determined in accordance with CSI Corrosion Grade criteria (Chart 3). The degree of paint chalking was determined in accordance with ASTM D4214 "Standard Test Method for Evaluating the Degree of Chalking of Exterior Paint Films," Test Method D659, Method C (Chart 4). Coating adhesion was assessed in accordance with ASTM D3359 "Standard Test Method for Evaluating Adhesion by Tape Test, modified Method A and/or a modified version of ASTM D6677 "Standard Test Method for Evaluating Adhesion by Knife" (Chart 5). The modified version of ASTM D6677 was used in areas where destructive testing was not found to be practical. Any blistering that may have been present was rated in accordance with ASTM D714 "Standard Test Method for Evaluating the Degree of Blistering in Paints" (Chart 6), and the paint dry film thickness was measured with a Positector 6000FN3 Type II gage in accordance with the applicable guidelines set forth SSPC PA2. The visual observations and data collected from the various areas of the tank are found in the charts below:

Exterior

Close-up visual examination of the coating was limited to the first (lowest) shell course, upper shell areas adjacent to the ladder, and the roof. The exterior paint on the roof is in poor condition and the shell is in excellent condition with minimal chalking (ASTM D4214, No. 8). A minor amount of isolated light rust (CSI Corrosion Grade 2) was present in areas that had been vandalized or mechanically damaged from operations and at areas where paint was peeling. The amount of rust on the tank was minimal and rated a 9 (ASTM D610). The paint thickness was found to range from 5.0 to 9.0 mils, and the paint was estimated to exhibit satisfactory adhesion (ASTM D6677, 4A). Some of the specific data collected follows:

Exterior Paint			**Overall Condition**		Good							
Paint Defects	**Roof Quadrant**				**Shell Quadrant**				**Tank Support**			
	Exterior		Good		Exterior		Excellent		Exterior		Fair	
	S	**W**	**N**	**E**	**S**	**W**	**N**	**E**	**S**	**W**	**N**	**E**
Rust spots (ASTM D610)	9	9	9	9	9	9	9	9	9	9	9	9
Corrosion Grade	2	2	2	2	2	2	2	2	2	2	2	2
Rusting at crevices												
Spot peeling				Yes					Yes	Yes		
Delamination												
Cracking (ASTM D661)												
Checking (ASTM D660)												
Chemical staining												
Chalking	8	8	8	8	8	8	8	8	8	8	8	8

Interior

The roof area is defined as those surfaces above the highest water level (HWL). Close-up visual examinations were made to all areas below the waterline and all other areas were assessed from the water level. The coating on the underside of the roof plates and roof support structure is in poor condition with corrosion common to the edges of the support member flanges and roof plates. At locations where dissimilar metals are connected, exfoliation has occurred in the immediate area. Each of these locations has dark rust (CSI Corrosion Grade 2, 4). The total amount of corrosion on the roof was rated to be approximately 1 percent of the total surface (ASTM D610, 6), and there was a minimal amount of rust staining present at the upper shell course from the roof.

The lining on the shell was found to be in good condition with areas of dark rust (CSI Corrosion Grade 2), especially below the high-water level segment of the shell. There are some areas that appeared to have involved underwater patching with white epoxy, and these areas appear to be performing properly. The total amount of corrosion on the shell and was rated to be less than approximately 0.03% percent of the total surface (ASTM D610, 9).

The floor was found to be in fair condition, (ASTM D610, 7) with rusting at crevices and some rust nodules that lead to corrosion pitting that was patched during the inspection.

The data collected from the underwater inspection follows:

Interior Paint	Above Water Condition			Fair		Below Water Condition			Fair			
Paint Defects/Overall Grade	Roof Quadrant				Shell Quadrant				Floor Quadrant			
	Interior		Poor		Interior		Good		Interior		Fair	
	S	W	N	E	S	W	N	E	S	W	N	E
Rust spots (ASTM D610)	6	6	6	6	9	9	9	9	7	7	7	7
Rust areas (ASTM D610)												
Corrosion Grade	2, 4, 5	2, 4, 5	2, 4, 5	2, 4, 5	2	2	2	2	2,3	2,3	2,3	2,3
Rust staining	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor
Rusting at crevices	Yes	Yes	Yes	Yes					Yes	Yes	Yes	Yes
Spot peeling	Yes	Yes	Yes	Yes								
Delamination												
Cracking (ASTM D661)												
Blistering (ASTM 714) Size/Densit												
Pitting (Estimated Amount)												
Pitting (Estimated Deepest Mils)												

Dive Inspection Video

Click on link or cut and paste the external link: https://youtu.be/gco8B3lgk84

Discussion

The paint system on the exterior was found to be relatively thin and in good condition on the roof and excellent condition at the shell. There are no wholesale defects, and it appears the roof has been spot repaired since the last inspection in 2020. Chalking was negligible and the system appears to be performing as intended.

Chalking is the term for the powdery characteristic of an aged coating that may also have a faded finish. Chalking is a result of the natural breakdown of a paint system's binder when it is exposed to sunlight. The binder (or resin) degrades in ultraviolet light, which leaves behind the unbound pigment or chalk. Aside from a faded appearance, chalking can result in corrosion as the film weathers (thins) away through cycles of wind and rain. As the paint endures years of direct sunlight, it begins to weather away, which results in the paint no longer providing enough barrier protection from corrosion. On this basis, it is recommended that a plan for recoating the tank with an industrial paint should be completed.

Generally speaking, there are four possible approaches to maintenance coating work. The coatings can be either completely removed and replaced (repainted), spot repaired, spot repaired and overcoated, or simply overcoated. In evaluating the condition of a coating to determine the best approach there are a number of different factors to consider. The first set of factors includes the determination of the coating's ability to withstand the added stress of an additional coat(s). Attributes impacting this decision include film thickness and adhesion. If a film is too thick or has poor adhesion, the tension from the curing stresses and/or the weight of the additional paint can cause the existing system to disbond. The second set of factors to consider when determining what maintenance coating approach to take is the amount of surface area requiring repair, the overall difficulty in providing access to the structure, and whether the coating system contains heavy metals. The final factor is the condition of the substrate.

When considering whether a spot repair approach is a viable option, a good rule of thumb is that up to 10 percent of the surface area requiring repair is the point at which making spot repairs with overcoat becomes a diminishing return. With 10 percent rusting, overcoating may be an option if the adhesion is better than fair. If there is more than 10 percent rusting and the substrate is free of mill scale, overcoating may be considered an option if the adhesion is satisfactory. Once the amount of surface area exceeds this range, the cost of cleaning and coating the individual rust spots approaches (or exceeds) the total cost of removal and replacement.

On this basis, it is recommended that the tank exterior paint system be spot repaired at the next maintenance interval.

At interior surfaces, the tank lining system was found to have widespread dark corrosion above the highest water level (HWL) with lamellar and/or exfoliation corrosion common to baffle wall attachment points along with cracked and delaminated film at rafters. Corrosion was found below HWL with pitting, generally within the vicinity of dissimilar metal connections.

Exfoliation corrosion is a form of intergranular corrosion which involves selective attack of a metal at or adjacent to grain boundaries. In this process, corrosion products force metal to move away from the body of the material, giving rise to a layered, laminar appearance. Exfoliation corrosion is also known as layer corrosion or lamellar corrosion.

Isolated corrosion pits can develop within a coating system that may have only a few small breaks that were not corrected through periodic maintenance repairs. If the remaining, adjacent coating has excellent adhesion, it will inhibit undercutting corrosion. As a result, the corrosion forces will have a tendency to concentrate on the exposed bare metal, which results in pitting. Pitting can be critical in some instances. The maximum corrosion rate for steel in fresh water is typically no more than 30 mils per year (MPY). As a result, the pitting can develop into a perforation if not repaired. If a thru-hole develops within a tank bottom, the isolated issue can develop into a much larger corrosion problem. Corrosion requires oxygen to advance, and the underside of the tank bottoms are considered a dead-air space. As a result, the bottom of tank floors are typically not coated. A perforation or thru-hole with even a small trickle of water will reintroduce oxygen into the environment creating active corrosion that is difficult to identify until the steel floor plate requires replacement.

Industrial paint systems such as those applied to industrial facilities (i.e. piping, structural steel, storage tanks) typically have a life expectancy of 25 to 35 years before any spot maintenance coating repairs are required. The lining is approaching the end of its serviceable lifespan and

The supports and associated components of the baffle walls are rusting, especially within the folds of the PVC curtain where the chains and wires are corroding heavily. During the inspection, CSI reattached several of these elements to their associated floor clips to best of its ability.

It should be noted that the most advanced coating defects below the HWL were patched during this inspection using NSF certified underwater curing epoxy.

A common tank design in the past was to run tank piping up through the tank bottom. This design can help prevent piping from obstructing outside areas of the tank but can be problematic during a seismic event. During an earthquake, there is the potential for the tank bottom to move at a different rate than the below grade piping. Past seismic events have resulted in piping connections being sheared or cracked, which resulted in a loss of water capacity during times when it was most needed during the emergency. Moving tank piping to the shell to include flexible connections for inlet/outlets is a better design when considering this issue.

Recommendations

The following activities are recommended for remedial work:

Exterior:

Continue to spot repair the paint system at the next maintenance interval.

Interior:

Within the next year, remove and replace the interior lining. This work should include the following:

1) Cleaning all surfaces in accordance with SSPC's Surface Preparation Standard No. 10 "Near-White Metal Blast Cleaning" (SSPC-SP10) followed by three 4 to 6 mil coats of an NSF Certified epoxy lining.

2) Caulk all crevices in the tank such as roof lap seams.

3) Anticipate the need for structural repairs (welding, grinding, etc.)

4) Eliminate all dissimilar metal connections within the tank by electrically isolating these connections with phenolic washers, nylon inserts, neoprene or Teflon buffers.

5) Consider retrofitting the tank piping to include flexible couplings and the relocation of tank bottom connections to the lower shell.

P.O. Box 801357, Santa Clarita, CA 91380
Phone: 877.274.2422 (toll free)
Fax: 661.755.7628
www.CSIServices.biz

Field Water Tank Dive Inspection Report

Tank Name:	Railroad Flat	**Dive Supervisor:**	Steven Metcalf
Tank Owner/Client:	CPUD	**Dive Leader:**	Anthony Jackson
Client Contact:	Ashley Smith	**Dive Tender**	Steven Metcalf Jr

Scope: Maintenance Inspection

Site Information

Item	Description
Cross Street	Ridge Rd
Tank Location	1141 Ridge Rd, Mokelumne Hill CA
GPS Coordinates	38.3366 -120.5424
Nearest Structures	none
Surrounding Site	Gravel

Item		Notes
Perimeter Fencing	Yes	No Comments
Site secured on arrival	Yes	No Comments
Overhead Power Lines	No	None
Antenna on Tank	No	None
Roof Accessible	Yes	No Comments

Interior Structural Characteristics

Item	Data	
Roof Structure	rafters and center column	
Column Design	Pipe	
Upper Center Column	Dollar plate	
Column Base Design	Free plate	
Connections	welded	
Overflow Design	Funnel and pipe, lower course exit	
Inlet Interior Design	floor elbow	
Lining Type/Original	Epoxy	Yes

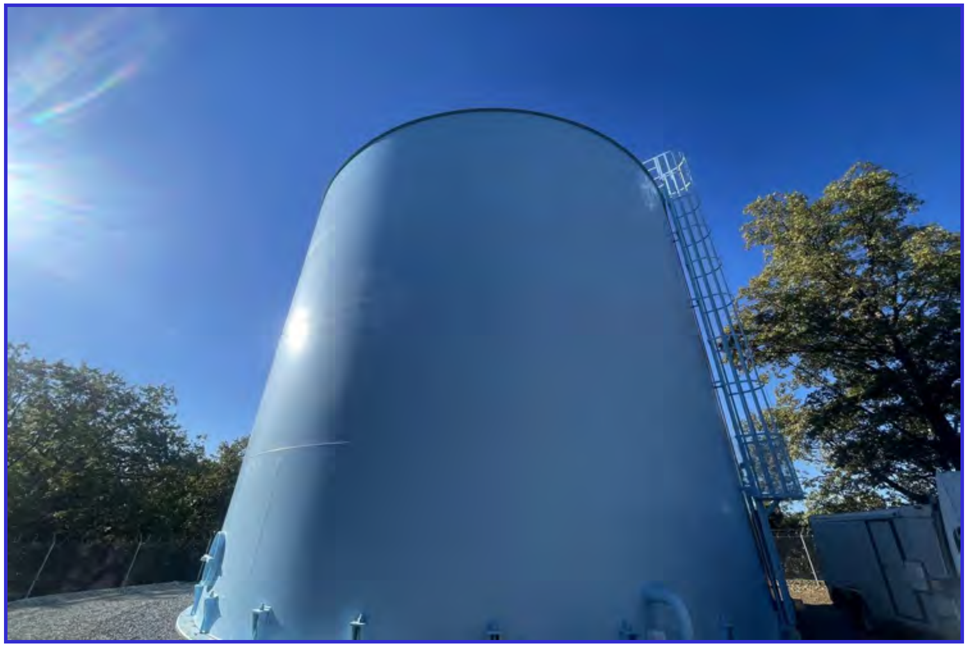
Item	Data			
Outlet Design	floor elbow			
No. Interior Ladder	Yes	one		
CP System/Type	No	None		
Water Depth	34			
Water Agitator	No	None		
Barrier Walls	Four barrier walls			
No. of Columns	one column			
Caulking	Roof	No	Columns	No

Exterior Structural Characteristics

Item	Data	
Capacity (gallons)	506,000	
Diameter (feet)	47	
Height (feet)	40	
Erection Year	2001	
Contract No.	37131840	
Tank Type	Welded Steel	
Tank Profile	on grade	
Tank Geometry	Cylinder	
Number of Courses	four	
Height of Each Course	10 ft	
Roof Design	Pitched roof with drip ring	
No. Shell Manways	two shell manways	
Type of Manways	round	
Manway Cover Design	unibolt	
Diameter of Manways	30 in	
No. Roof Hatches/Location	one	near edge
Hatch Design	square shoe box	
Size of Roof Hatch	24 in	
No. Roof Vents/Location	one	center
Roof Vent Design	round hood	
Construction Co.	CB&I	

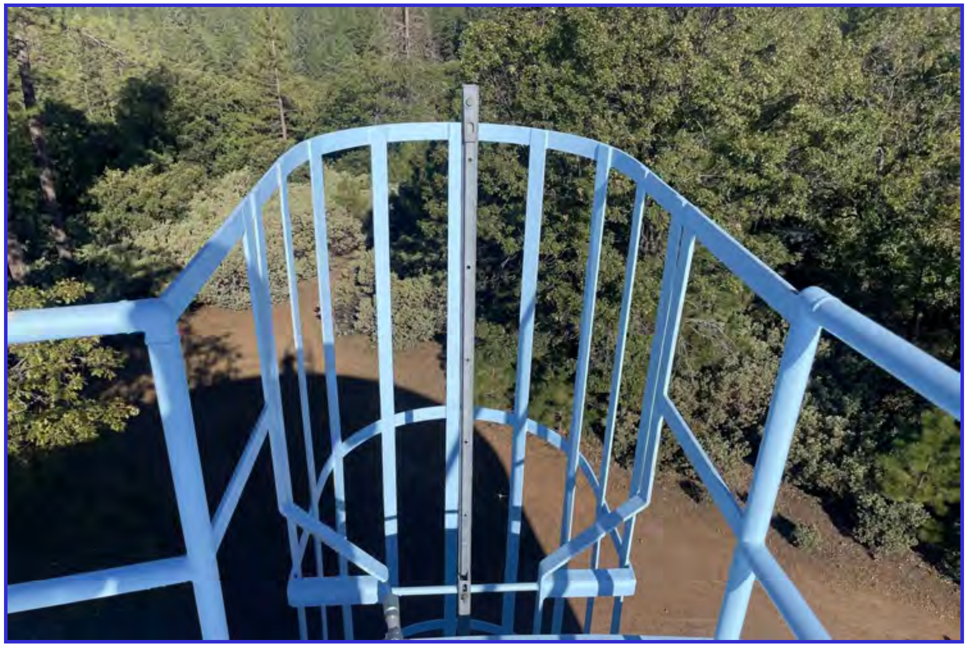
Item	Data	
Center Roof Vent Size	24 in	
Roof Vent Sealed	Yes	Satisfactory
Roof Rail System	Yes	No Comments
Roof Rail Satisfactory	Yes	No Comments
Rail Location	top of ladder	
No. & Type Roof Access	one	ladder
Exterior Vandal Deterrent	yes	
Ext Ladder Satisfactory	one	yes
Ext Ladder Fall Prevent	yes	
Roof Tie-Off Present	yes	
Tank Piping	floor	
Inlet Diameter	12 in	
Outlet Diameter	12 in	
Flexible Pipe Coupling	no	
Overflow Pipe Diameter	8 in	
Overflow Exterior Design	to ground	
Drain Location	floor	
Tank Foundation	concrete ring wall with anchor bolts	
Water Level Indicator	Yes	
Tank Type	potable	
Lining Type/Original	Urethane	Yes

Miscellaneous Notes



EXTERIOR - CPUD - Railroad Flat Reservoir - Maintenance Inspection

EXTERIOR - CPUD - Railroad Flat Reservoir - Maintenance Inspection -001



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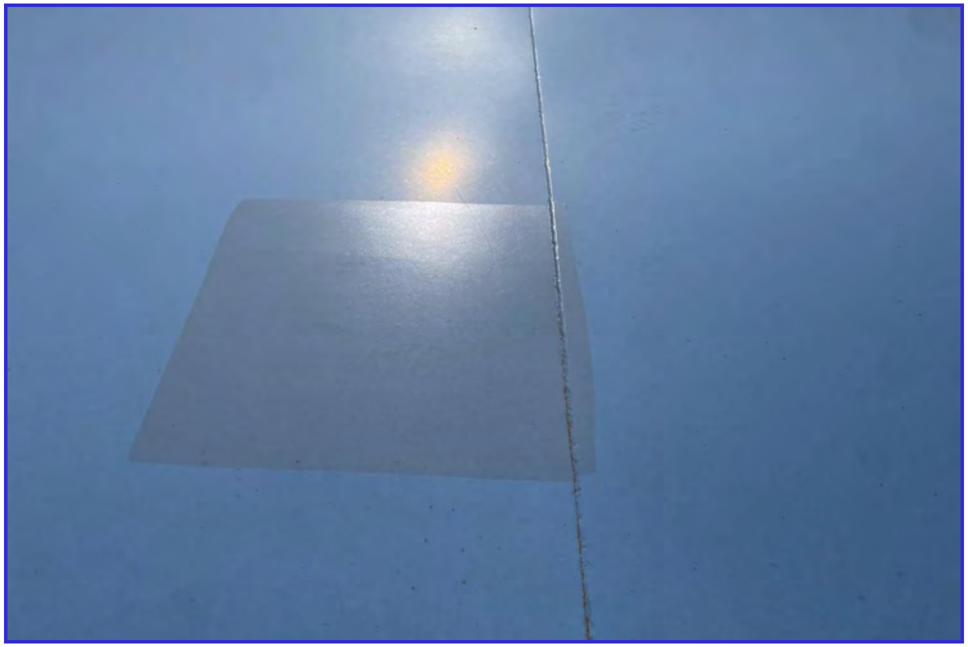

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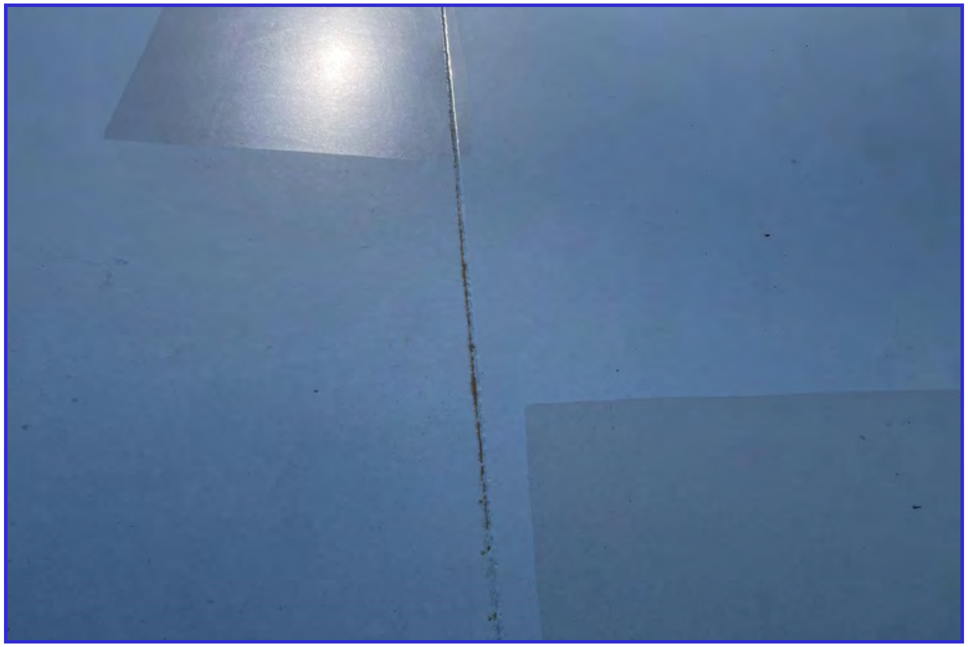

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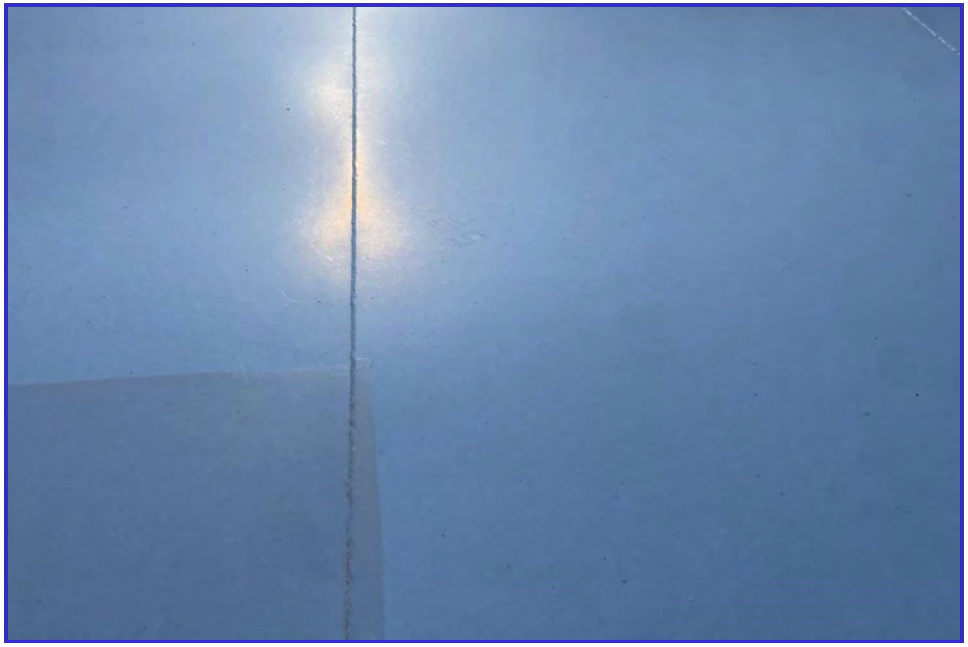

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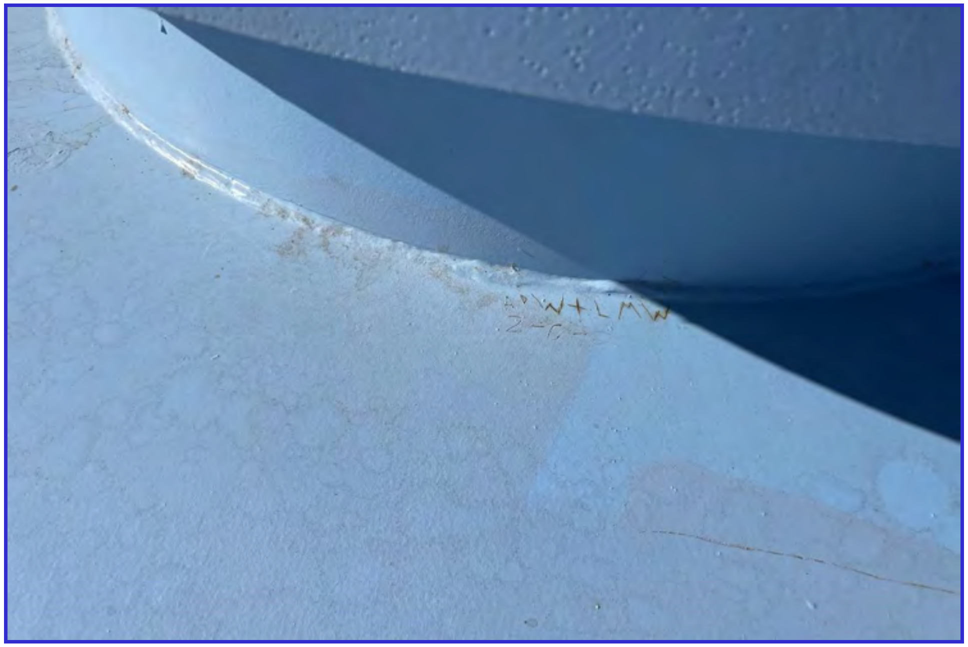

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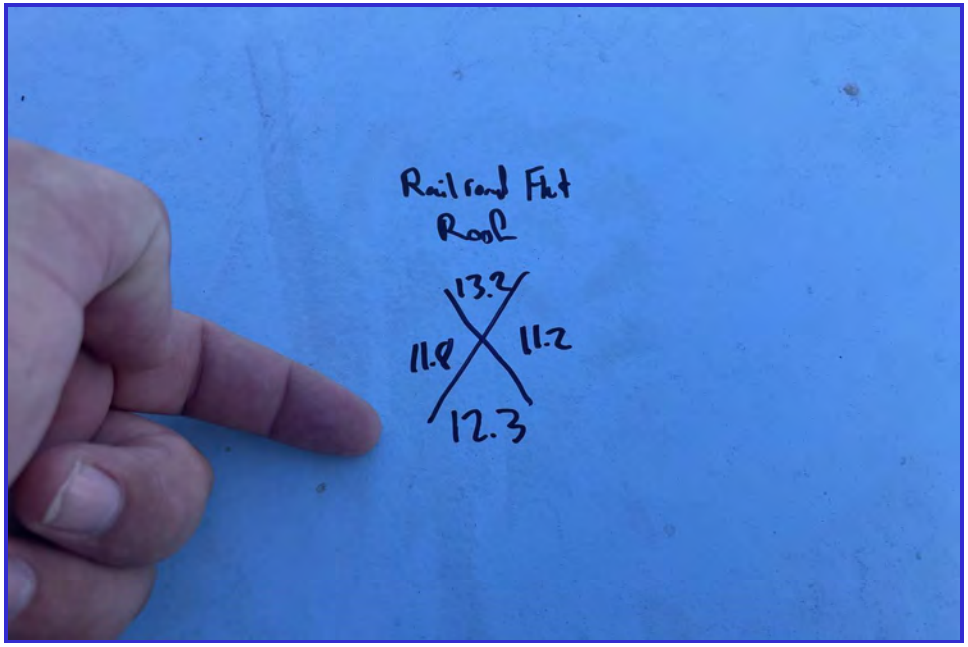

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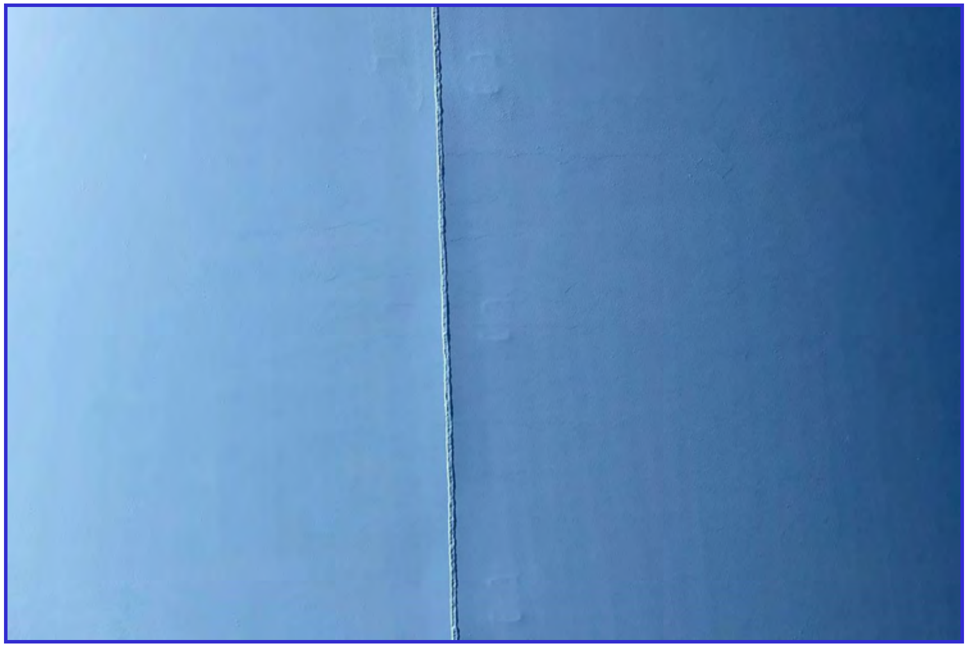

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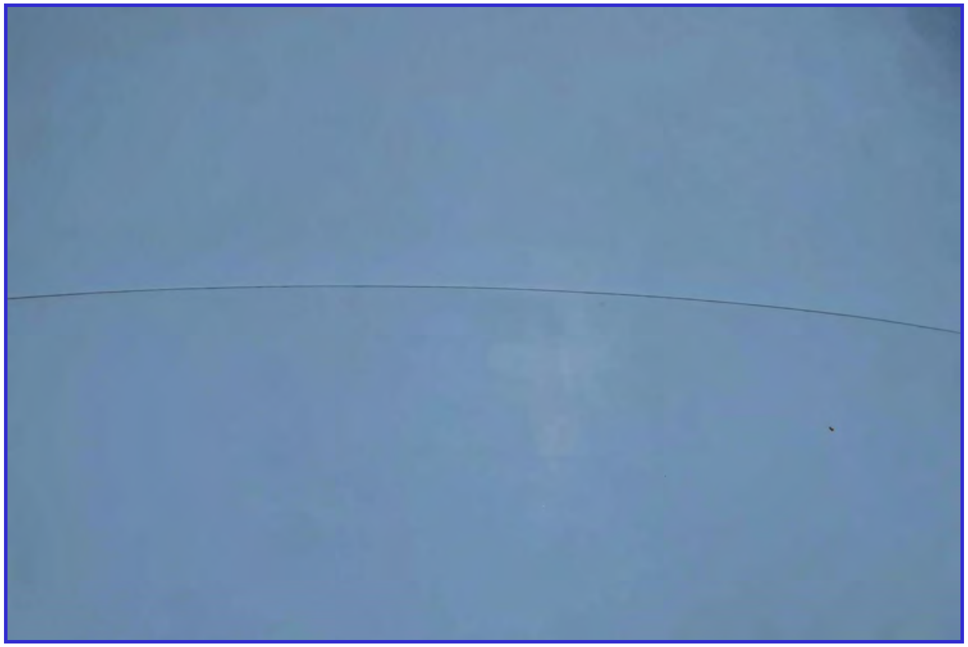

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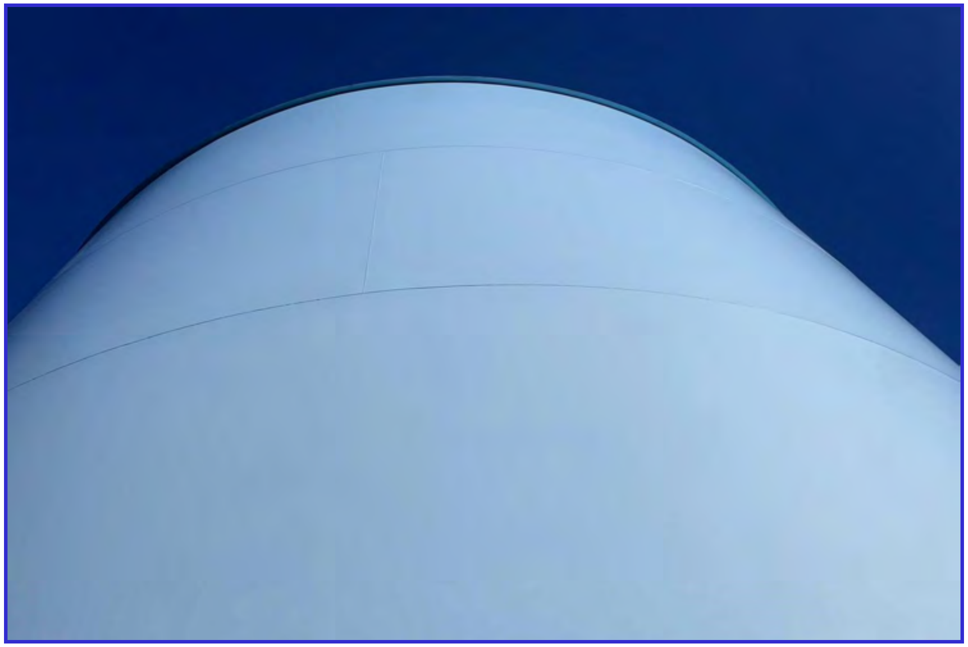

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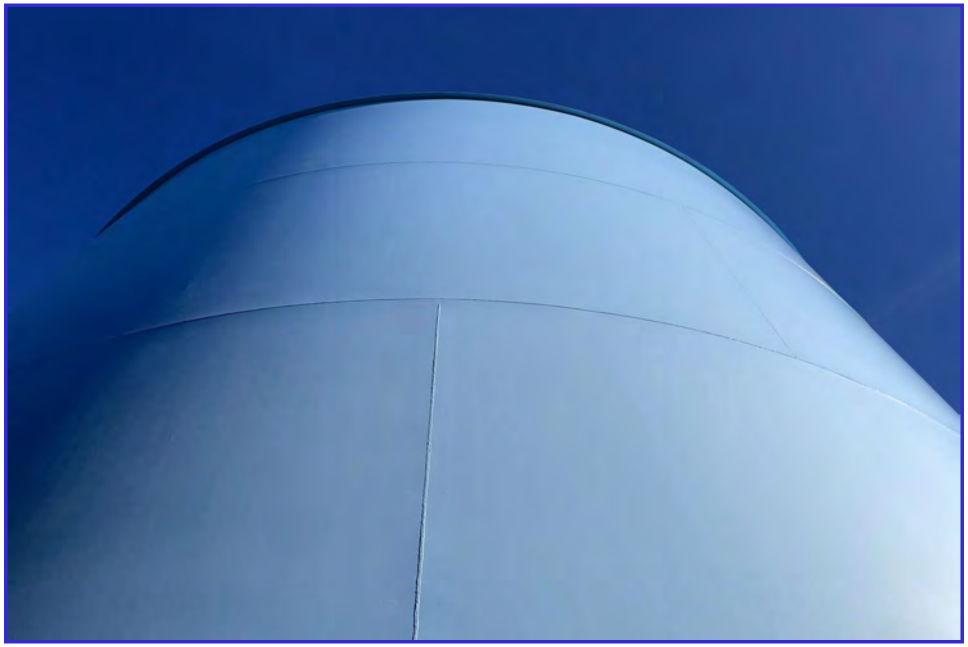

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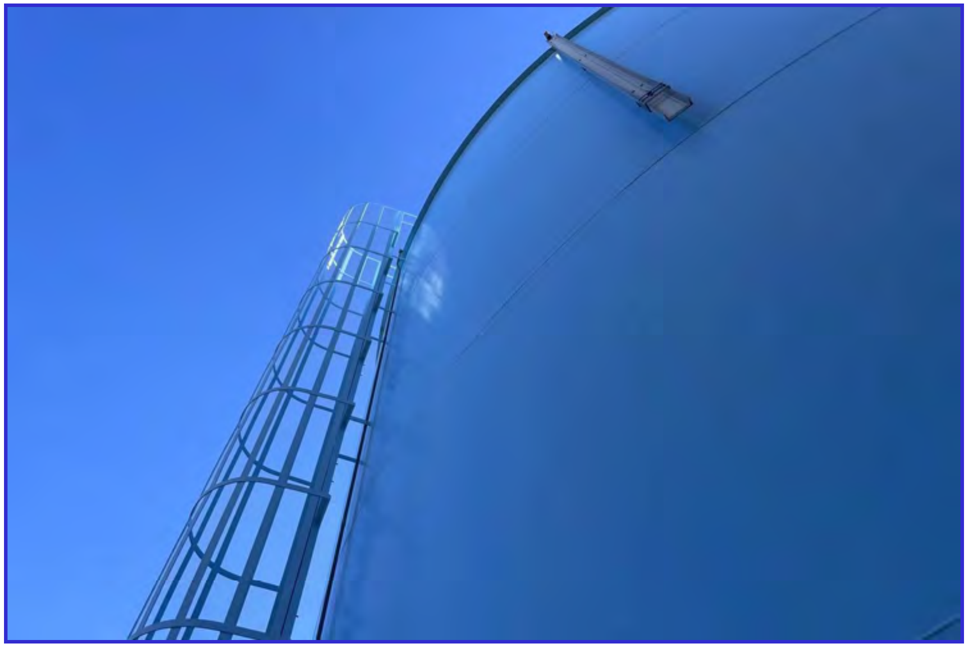

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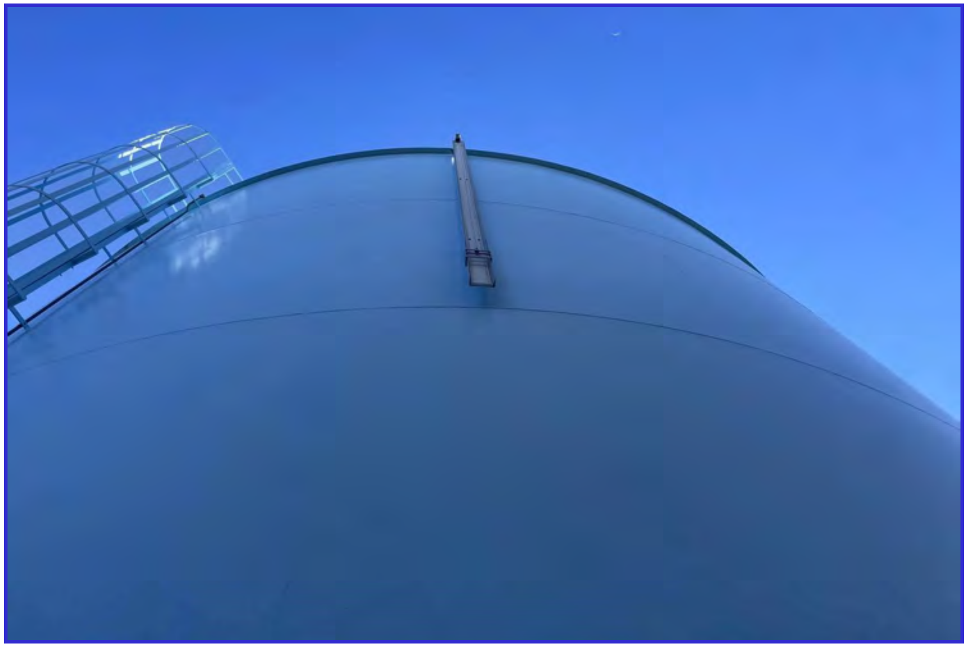

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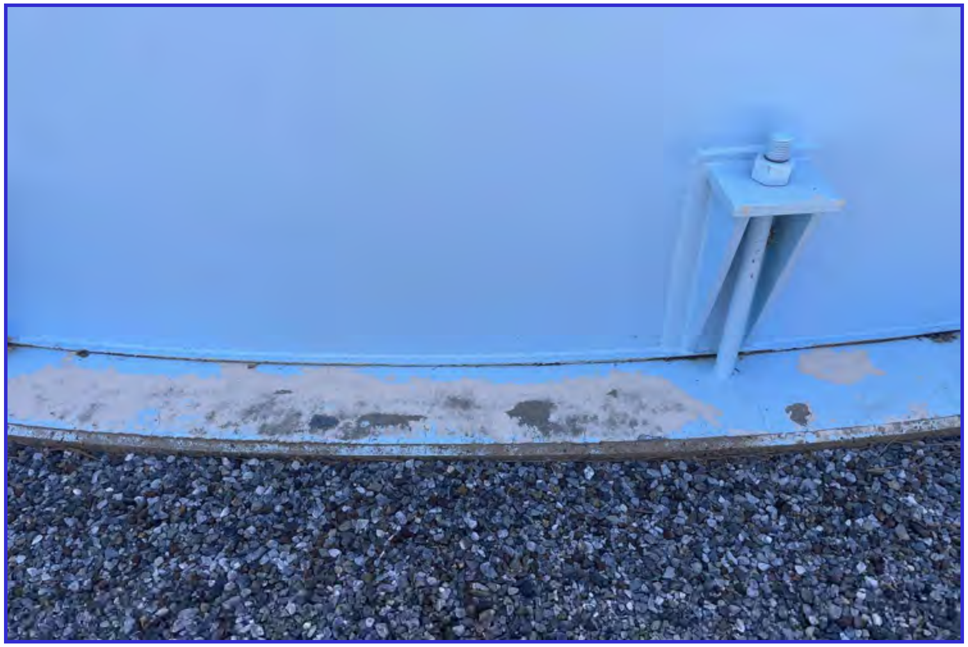

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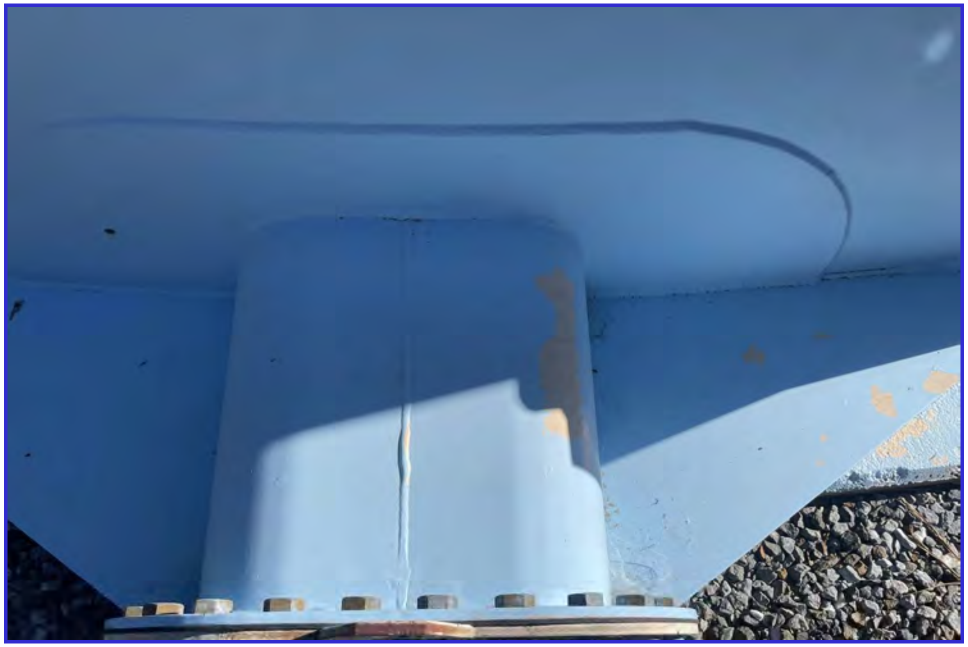

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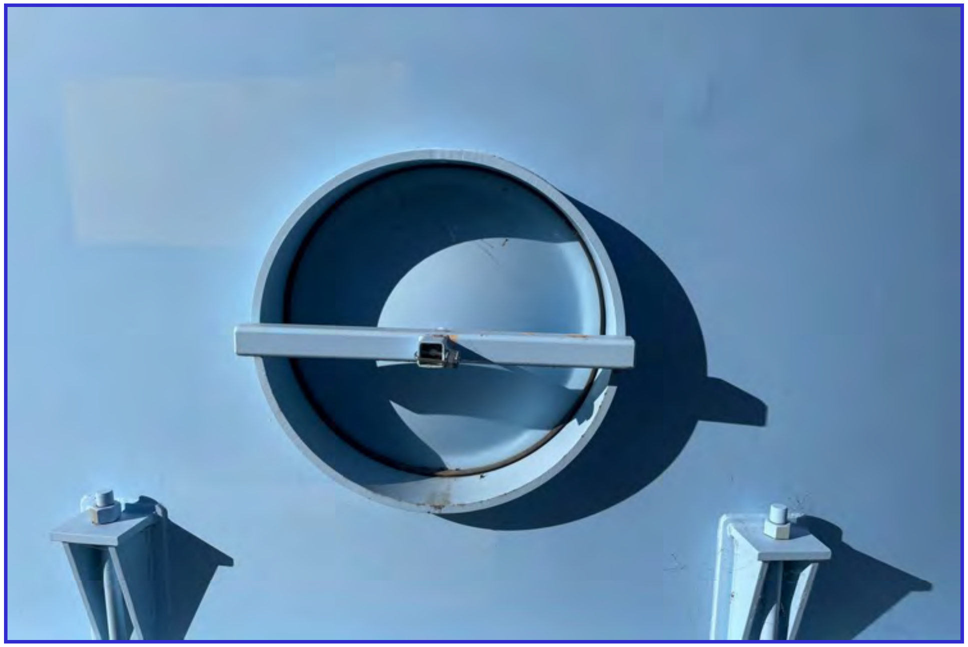

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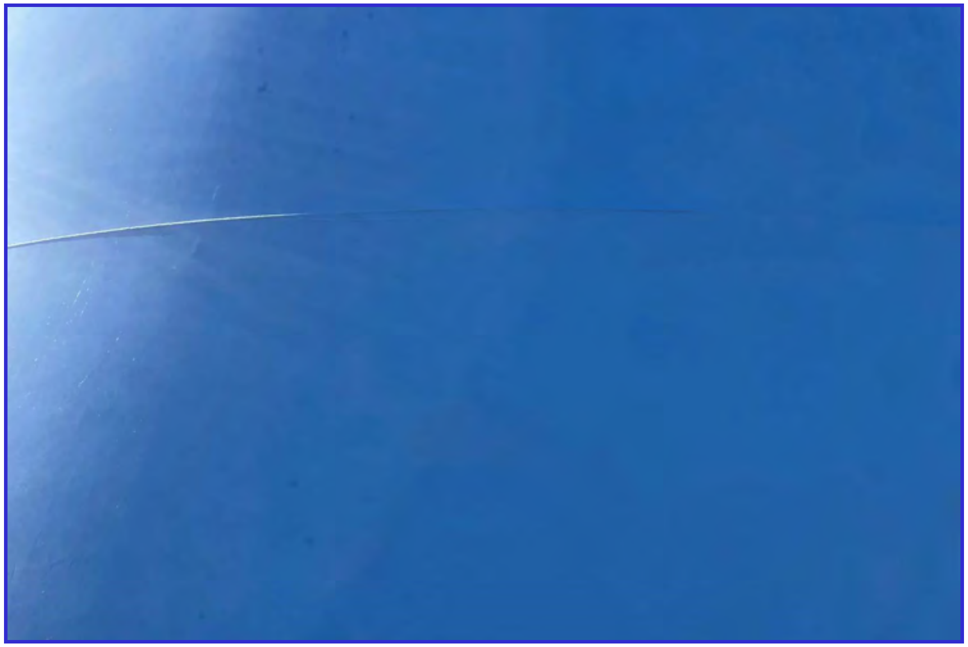

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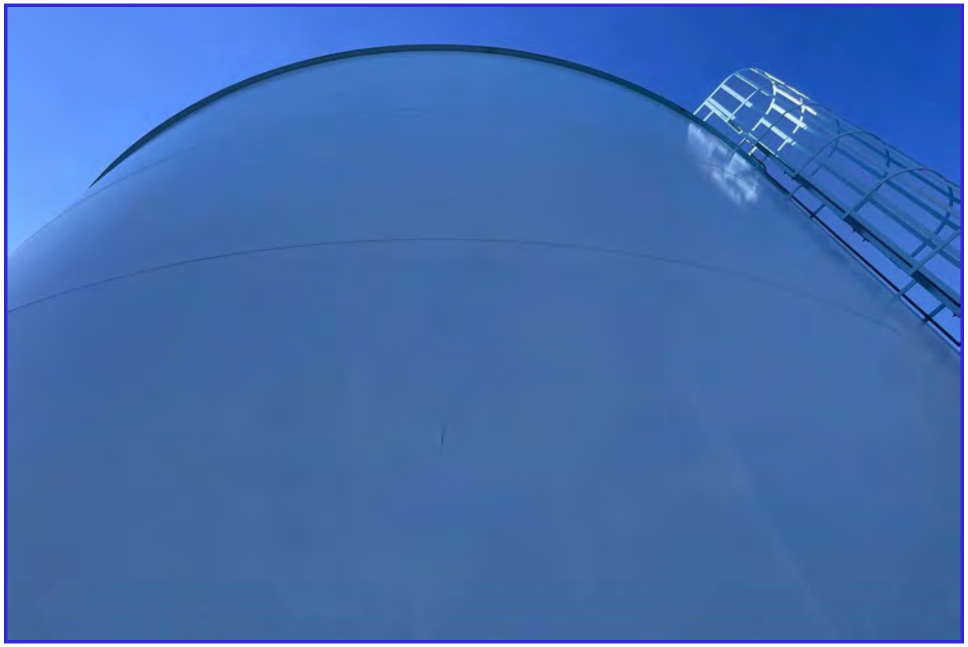

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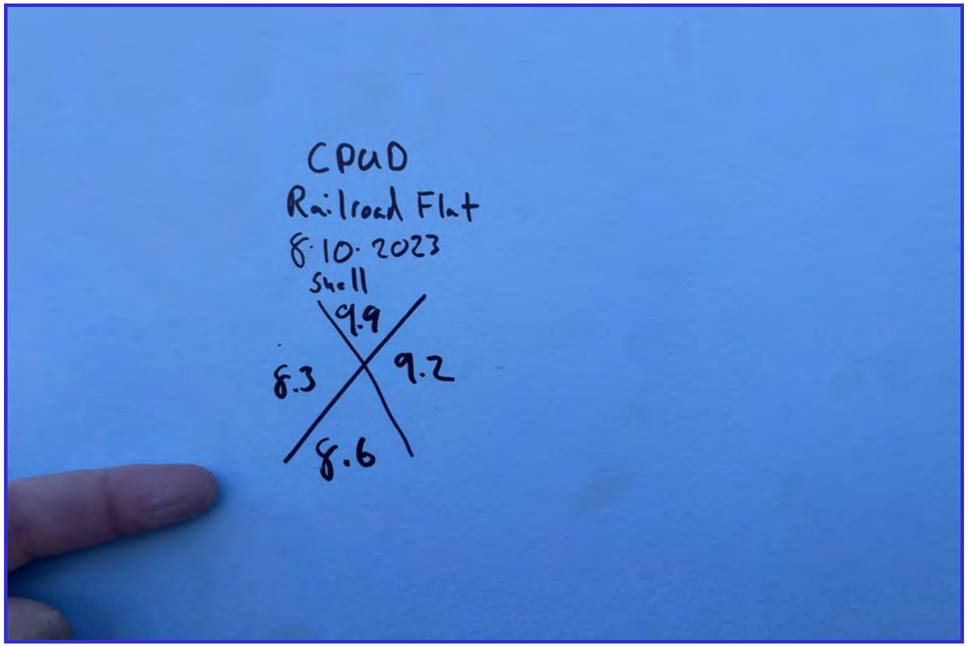

EXTERIOR - CPUD - Railroad Flat Reservoir - Maintenance Inspection -099

INTERIOR - CPUD - Railroad Flat Reservoir - Maintenance Inspection

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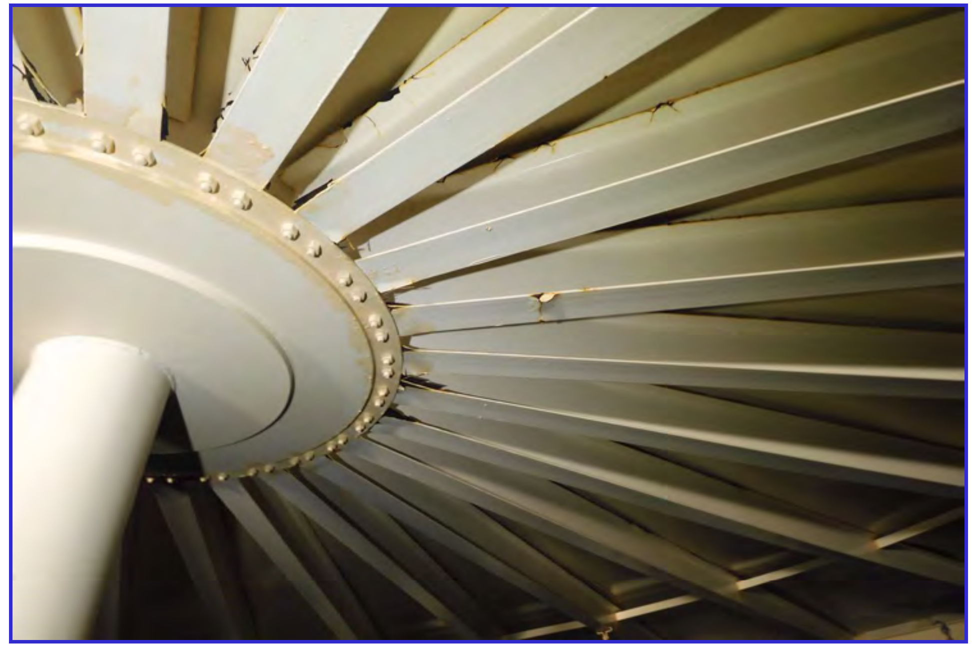
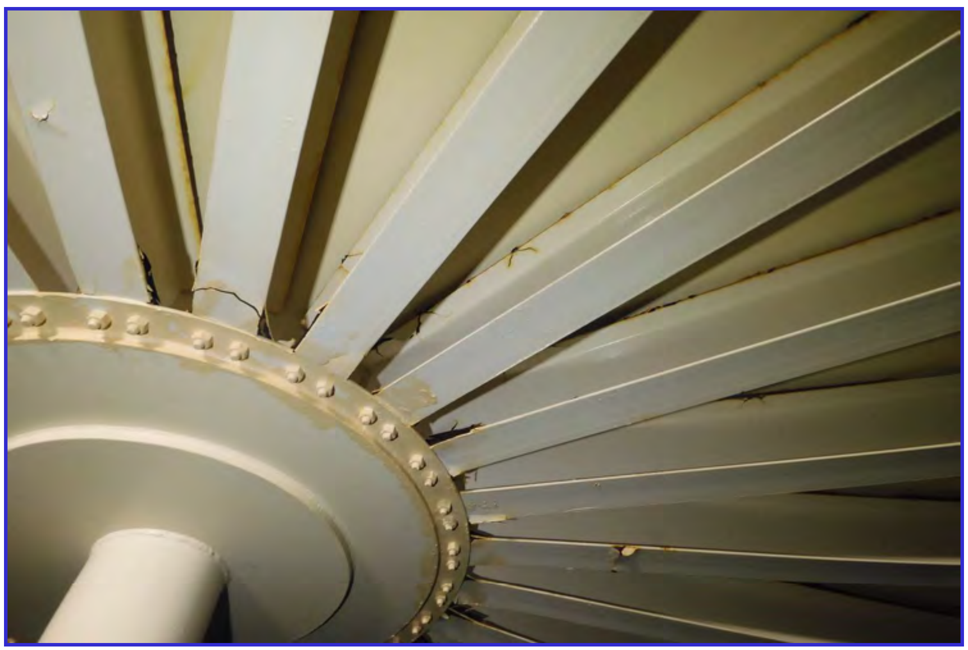


INTERIOR - CPUD - Railroad Flat Reservoir - Maintenance Inspection -033



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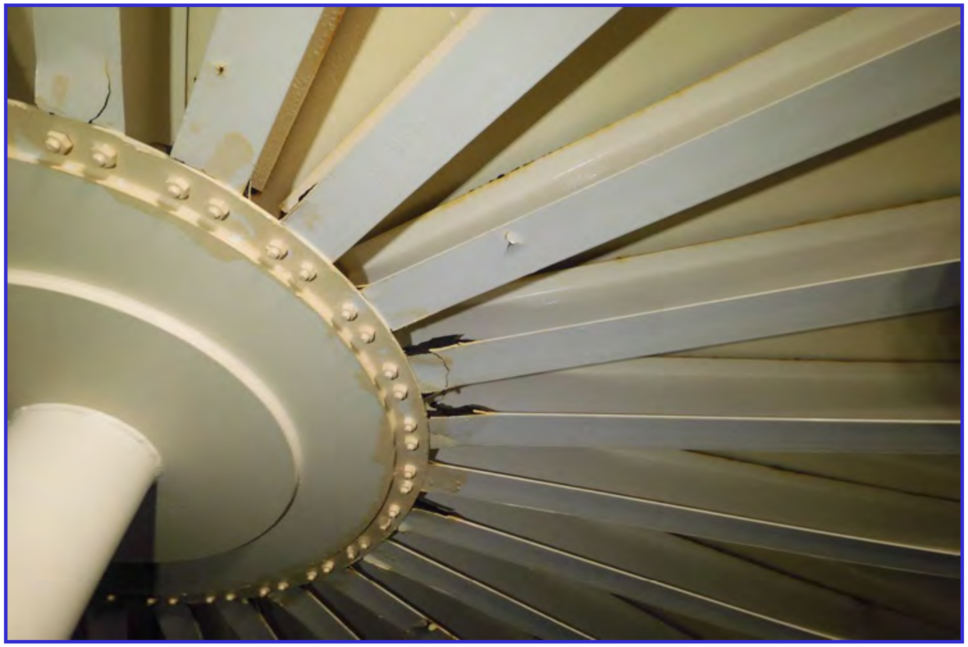

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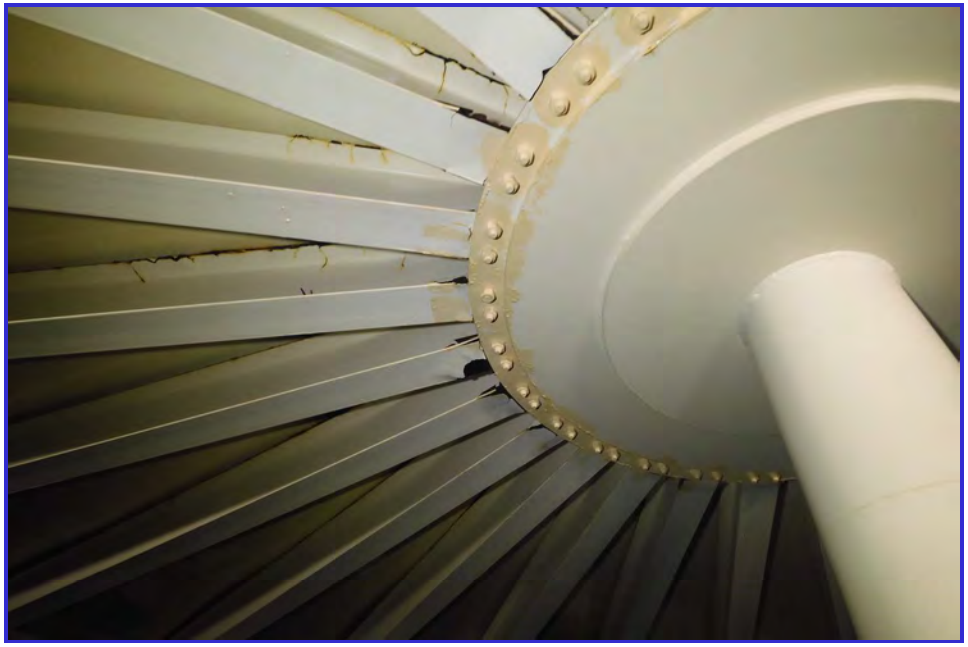

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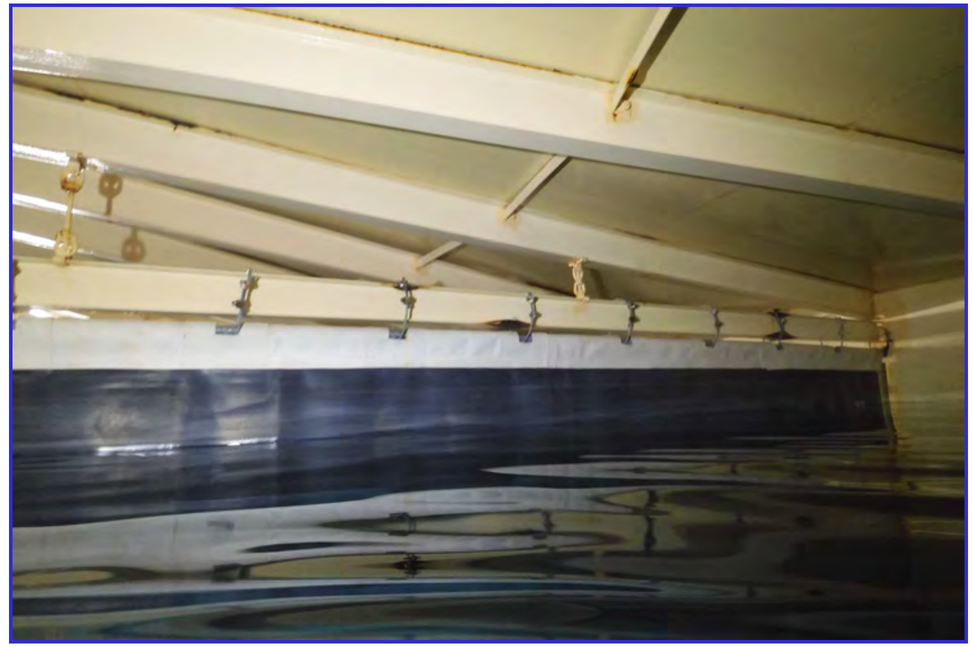
INTERIOR - CPUD - Railroad Flat Reservoir - Maintenance Inspection -048



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INTERIOR - CPUD - Railroad Flat Reservoir - Maintenance Inspection -058

INTERIOR - CPUD - Railroad Flat Reservoir - Maintenance Inspection -059

INTERIOR - CPUD - Railroad Flat Reservoir - Maintenance Inspection -060

INTERIOR - CPUD - Railroad Flat Reservoir - Maintenance Inspection -061

INTERIOR - CPUD - Railroad Flat Reservoir - Maintenance Inspection -062

INTERIOR - CPUD - Railroad Flat Reservoir - Maintenance Inspection -063

INTERIOR - CPUD - Railroad Flat Reservoir - Maintenance Inspection -064

INTERIOR - CPUD - Railroad Flat Reservoir - Maintenance Inspection -065

INTERIOR - CPUD - Railroad Flat Reservoir - Maintenance Inspection -066

INTERIOR - CPUD - Railroad Flat Reservoir - Maintenance Inspection -067

INTERIOR - CPUD - Railroad Flat Reservoir - Maintenance Inspection -068

INTERIOR - CPUD - Railroad Flat Reservoir - Maintenance Inspection -069

INTERIOR - CPUD - Railroad Flat Reservoir - Maintenance Inspection -070

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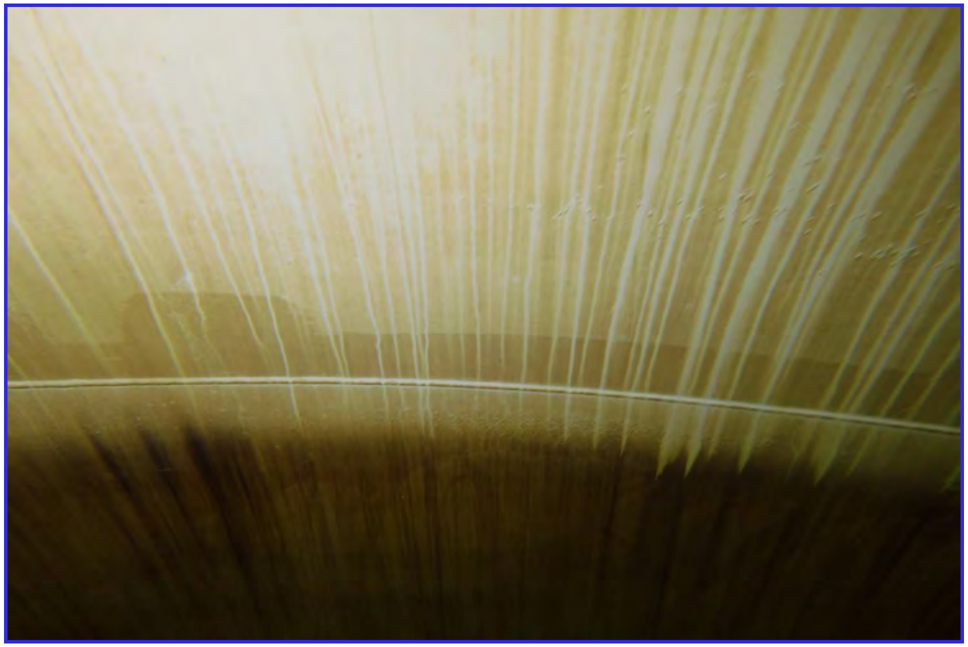

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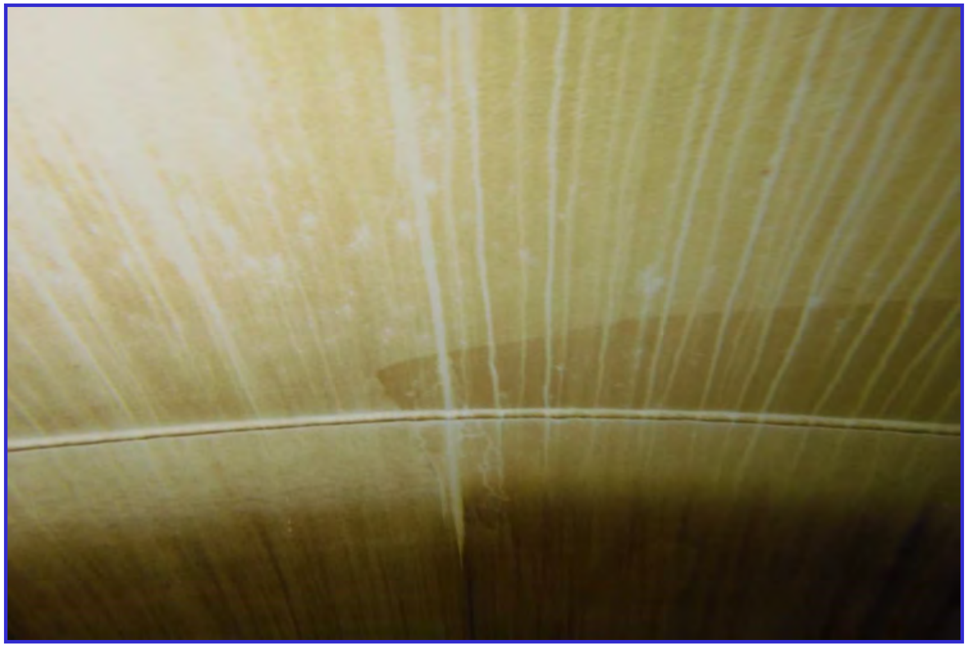

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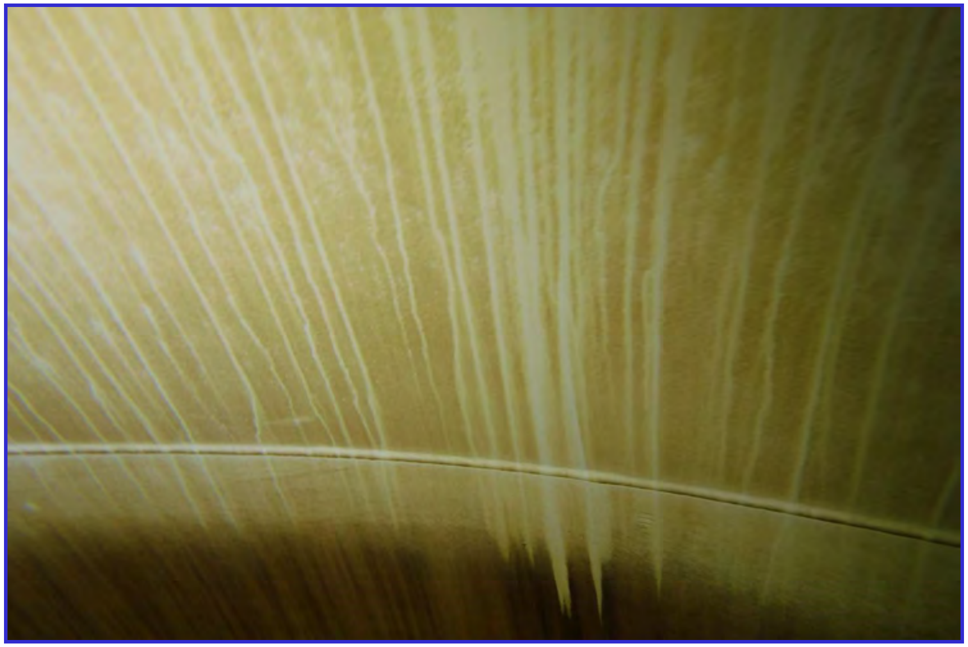

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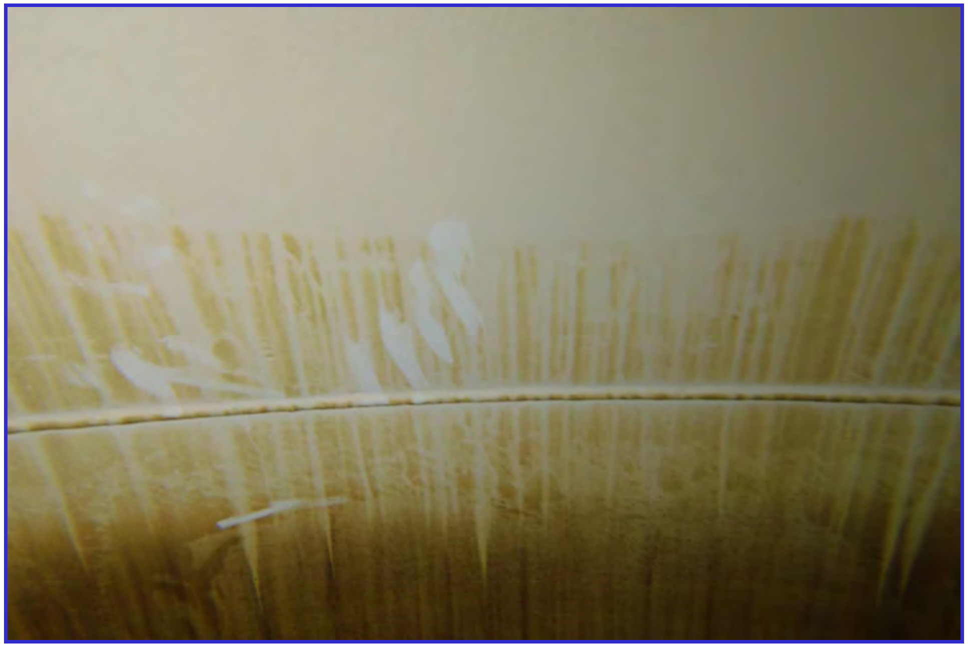

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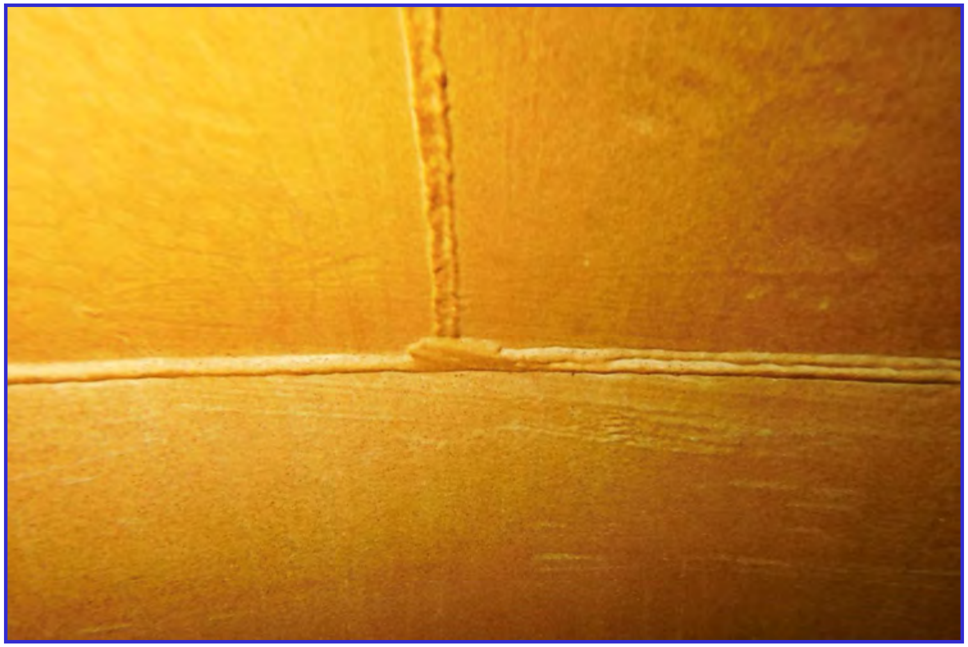

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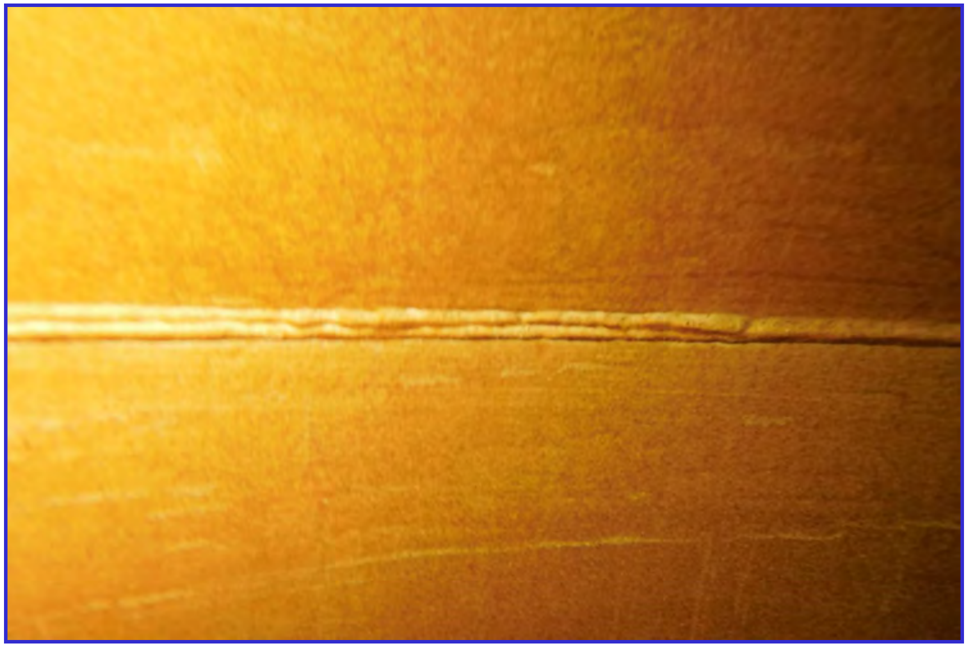

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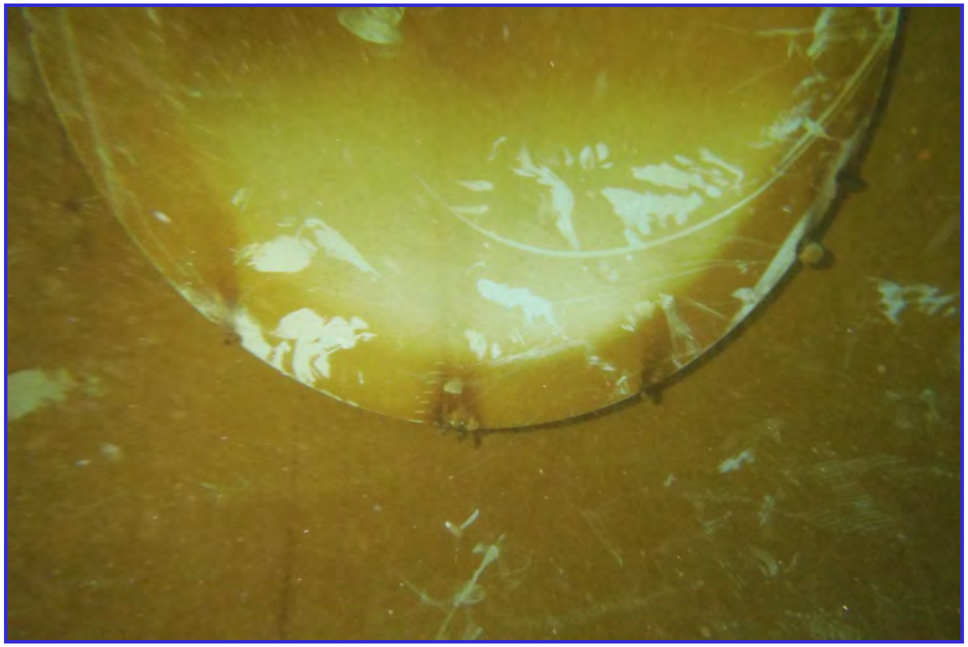

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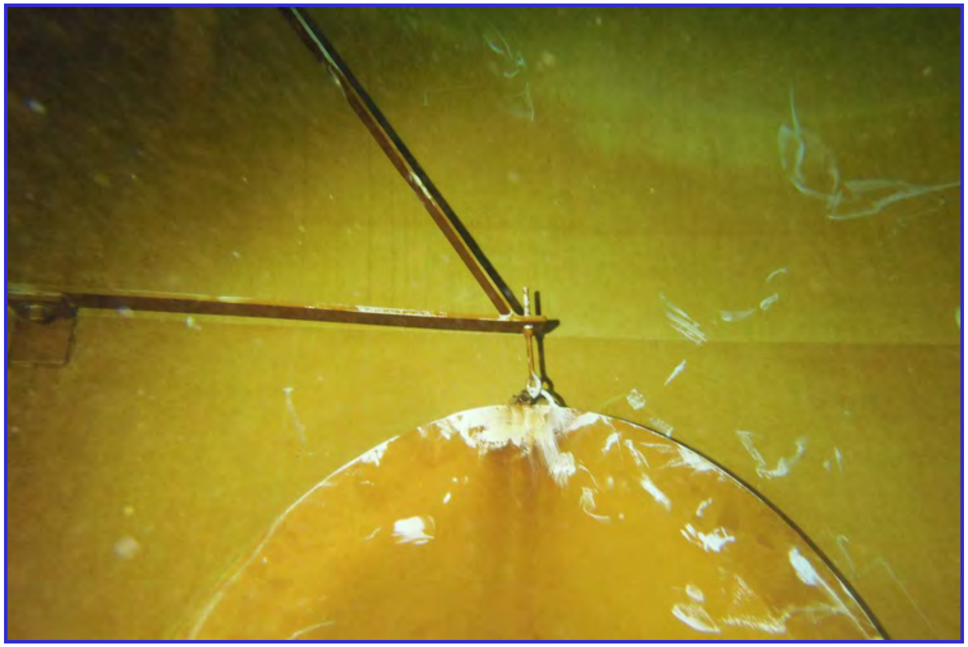

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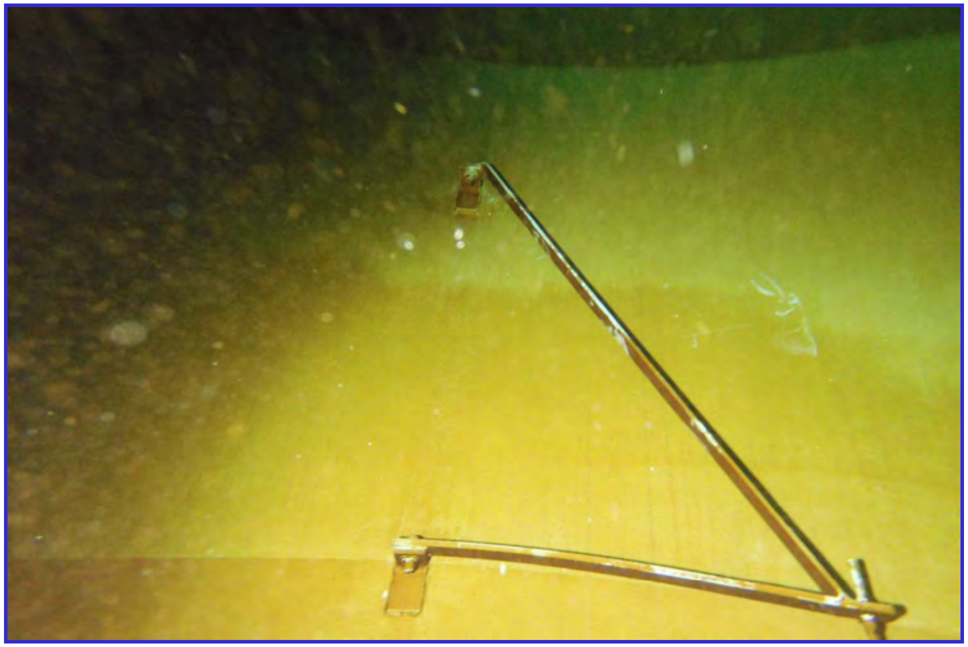

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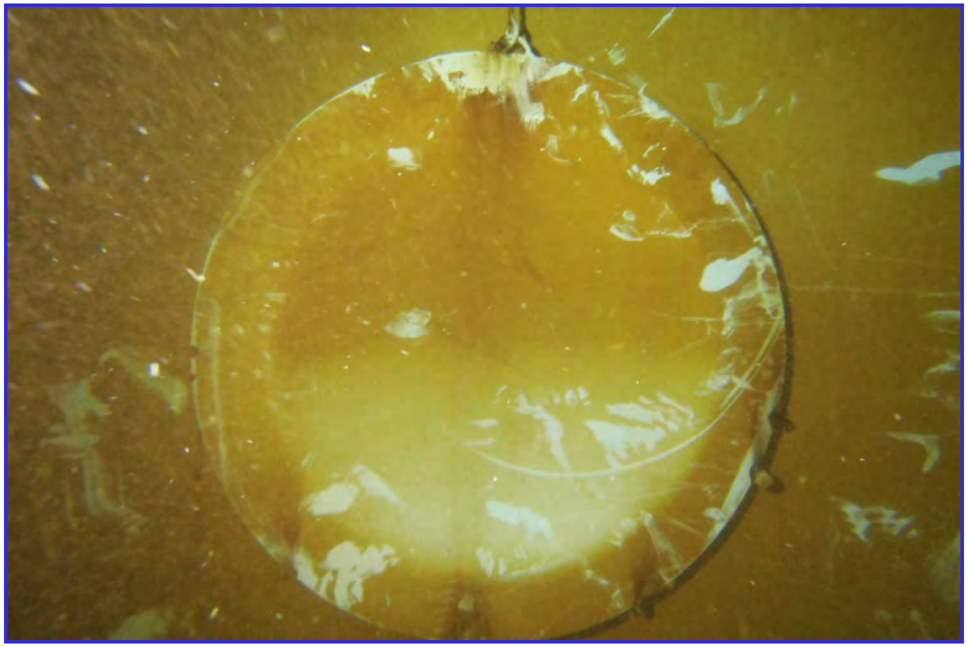

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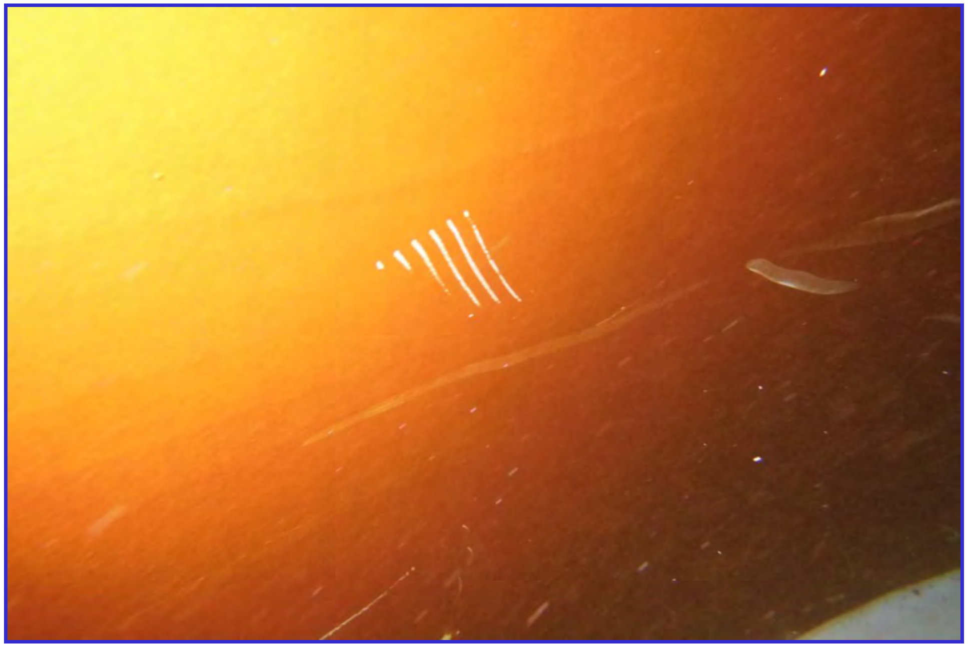

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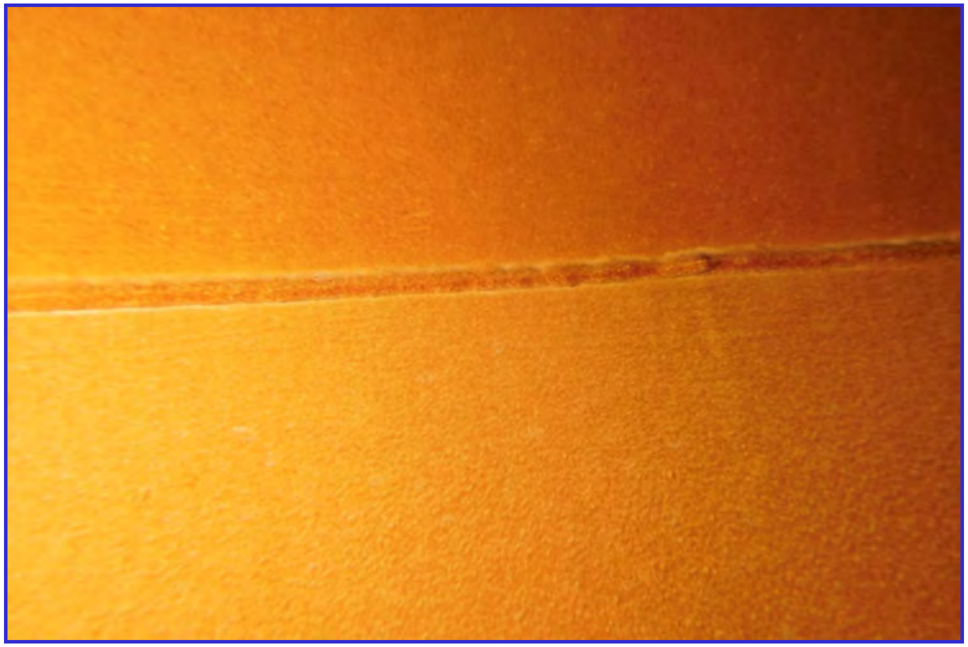
INTERIOR - CPUD - Railroad Flat Reservoir - Maintenance Inspection -094



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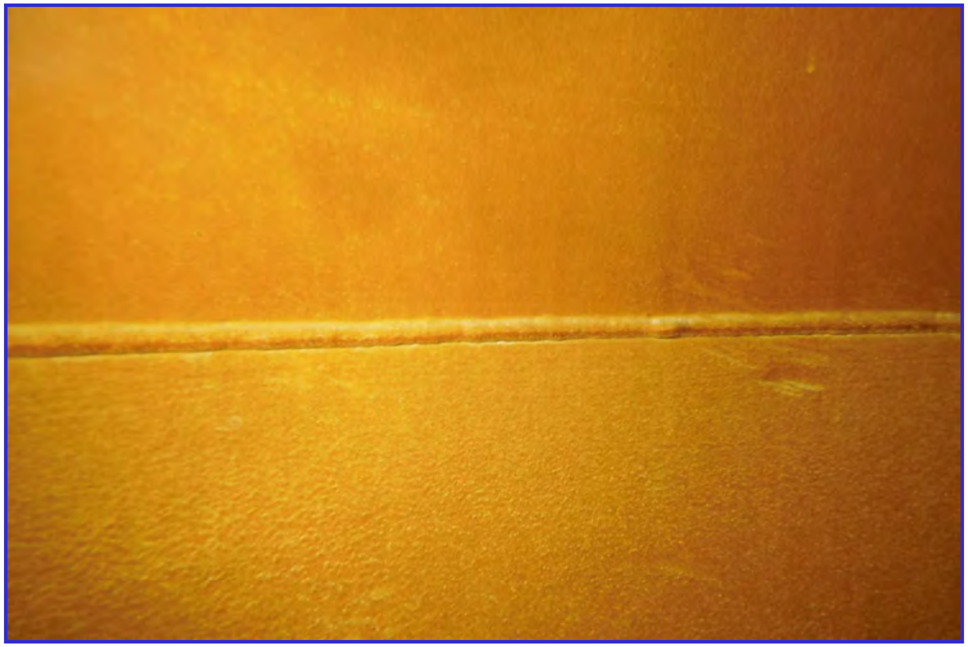

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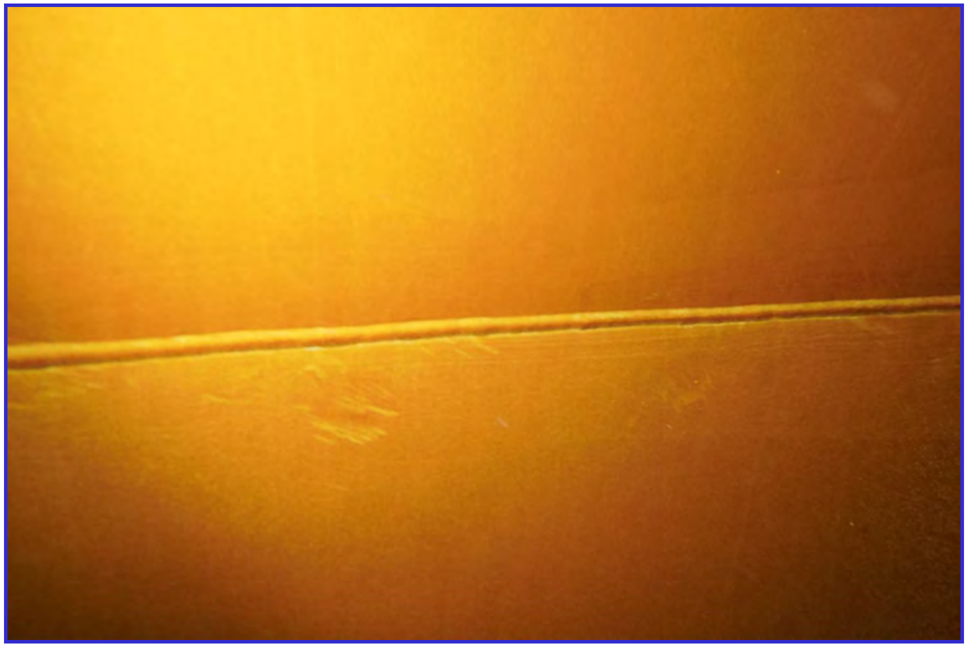

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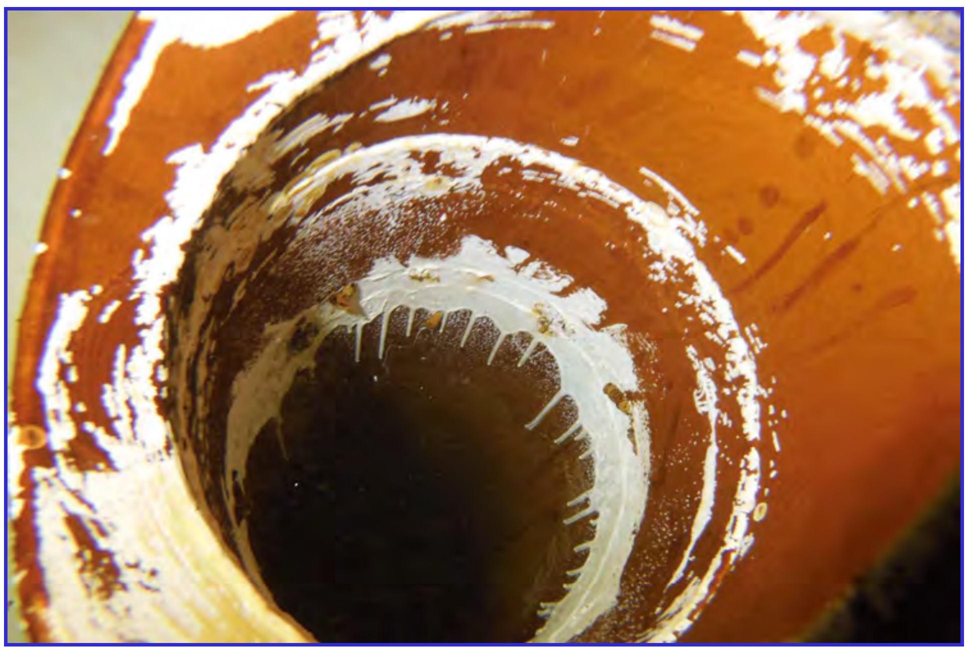

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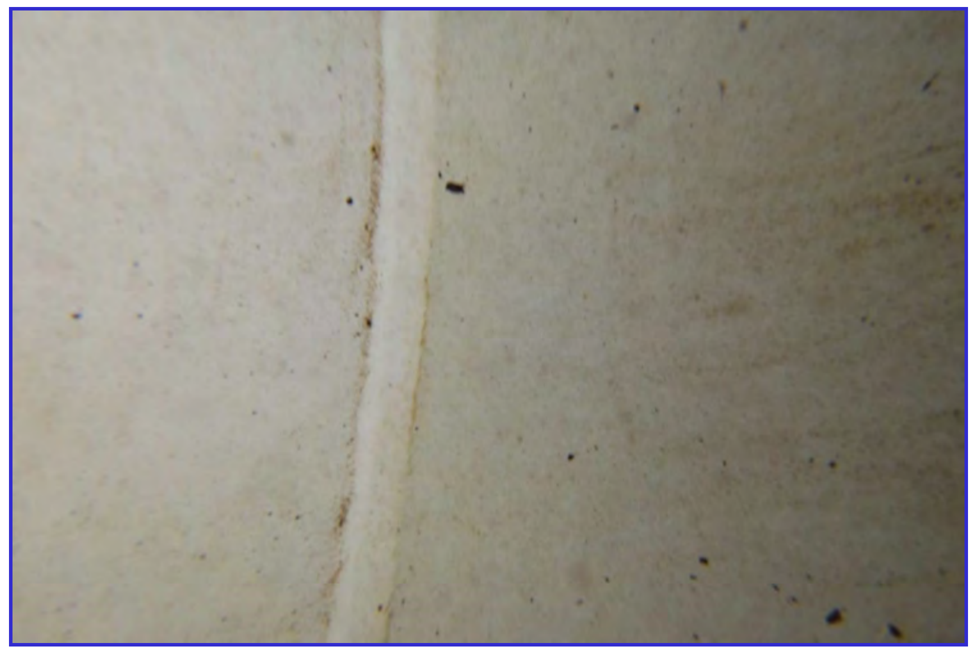
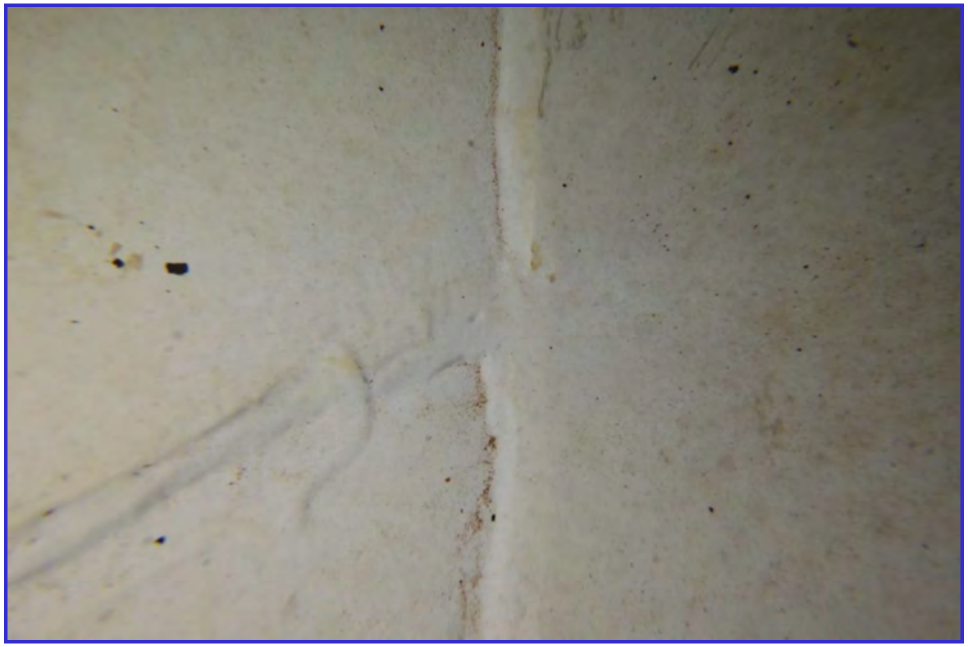


INTERIOR - CPUD - Railroad Flat Reservoir - Maintenance Inspection -107



INTERIOR - CPUD - Railroad Flat Reservoir - Maintenance Inspection -108

INTERIOR - CPUD - Railroad Flat Reservoir - Maintenance Inspection -109

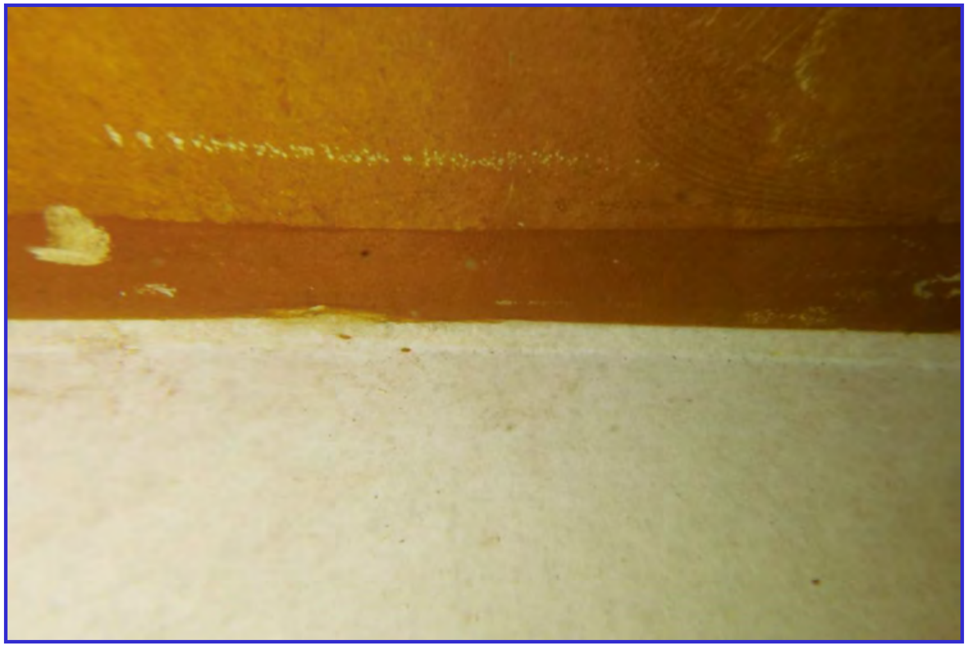
INTERIOR - CPUD - Railroad Flat Reservoir - Maintenance Inspection -110

INTERIOR - CPUD - Railroad Flat Reservoir - Maintenance Inspection -111

INTERIOR - CPUD - Railroad Flat Reservoir - Maintenance Inspection -112

INTERIOR - CPUD - Railroad Flat Reservoir - Maintenance Inspection -113

INTERIOR - CPUD - Railroad Flat Reservoir - Maintenance Inspection -114



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INTERIOR - CPUD - Railroad Flat Reservoir - Maintenance Inspection -116

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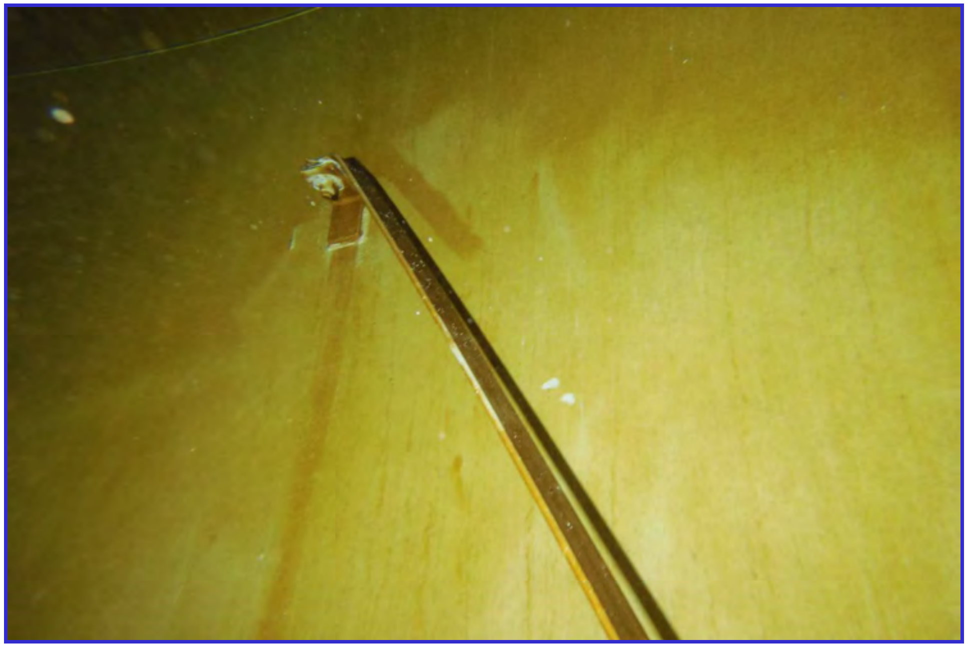
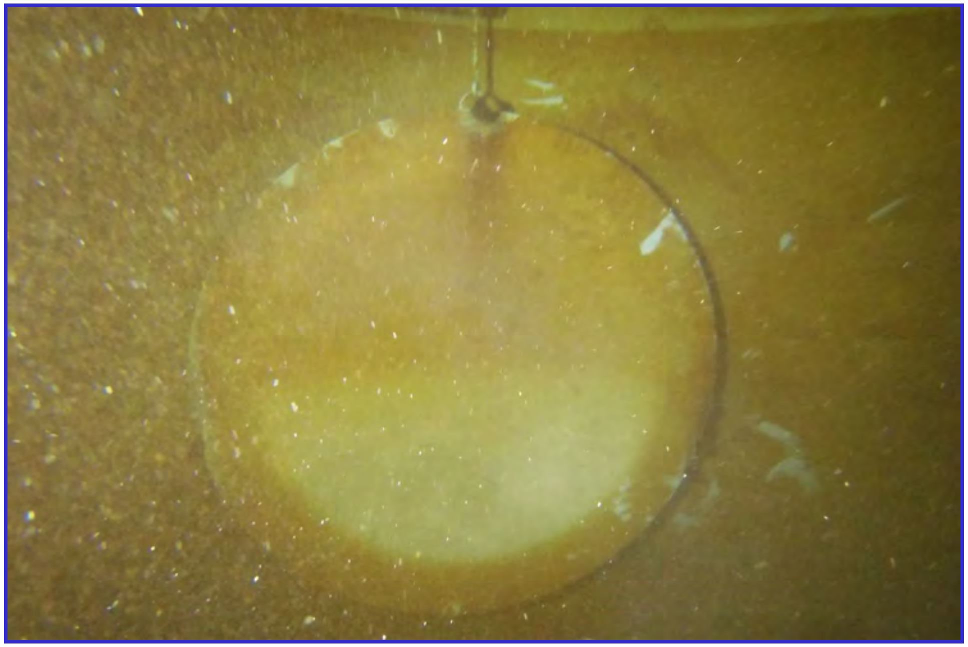
INTERIOR - CPUD - Railroad Flat Reservoir - Maintenance Inspection -119



INTERIOR - CPUD - Railroad Flat Reservoir - Maintenance Inspection -120



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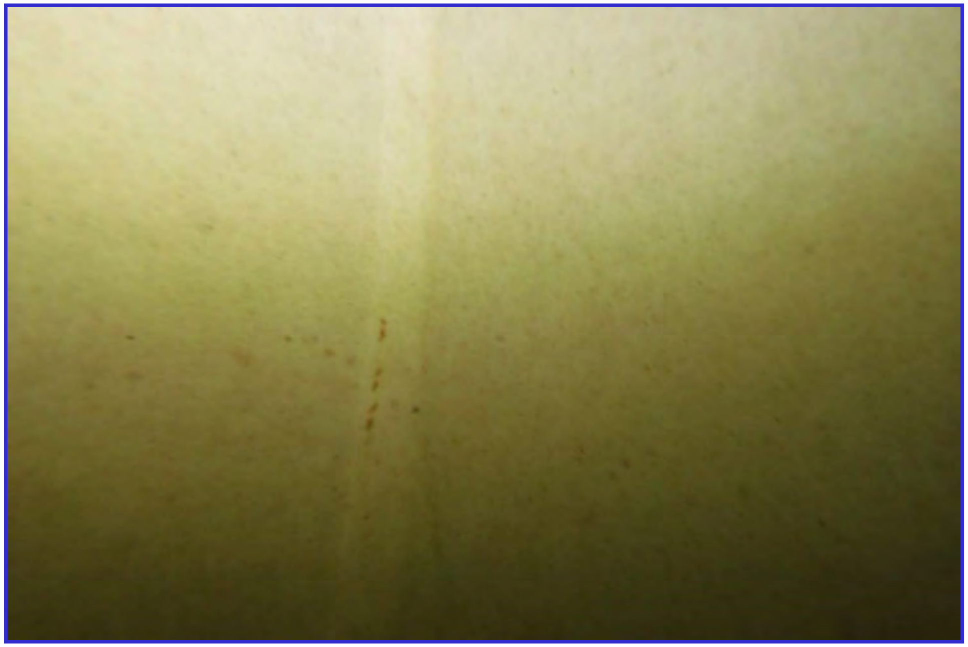
INTERIOR - CPUD - Railroad Flat Reservoir - Maintenance Inspection -122

INTERIOR - CPUD - Railroad Flat Reservoir - Maintenance Inspection -123

INTERIOR - CPUD - Railroad Flat Reservoir - Maintenance Inspection -124

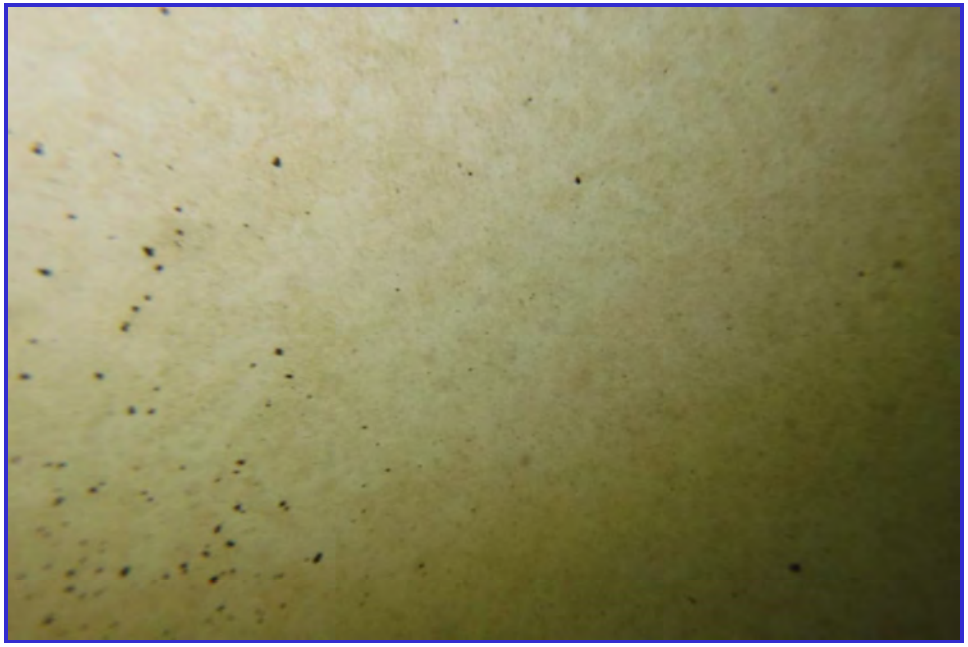
INTERIOR - CPUD - Railroad Flat Reservoir - Maintenance Inspection -125

INTERIOR - CPUD - Railroad Flat Reservoir - Maintenance Inspection -126



INTERIOR - CPUD - Railroad Flat Reservoir - Maintenance Inspection -127

INTERIOR - CPUD - Railroad Flat Reservoir - Maintenance Inspection -128



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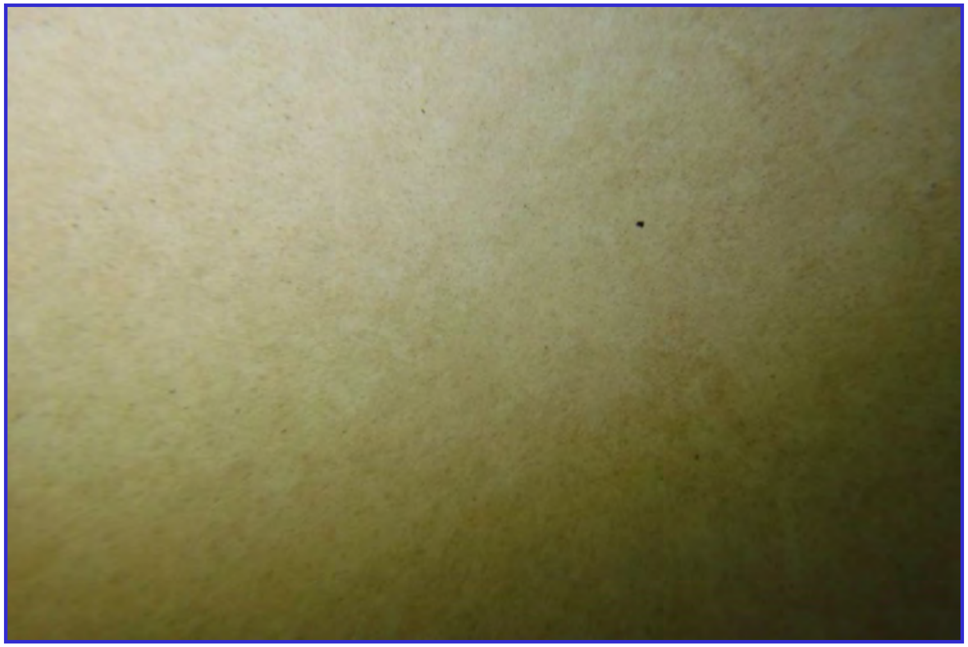

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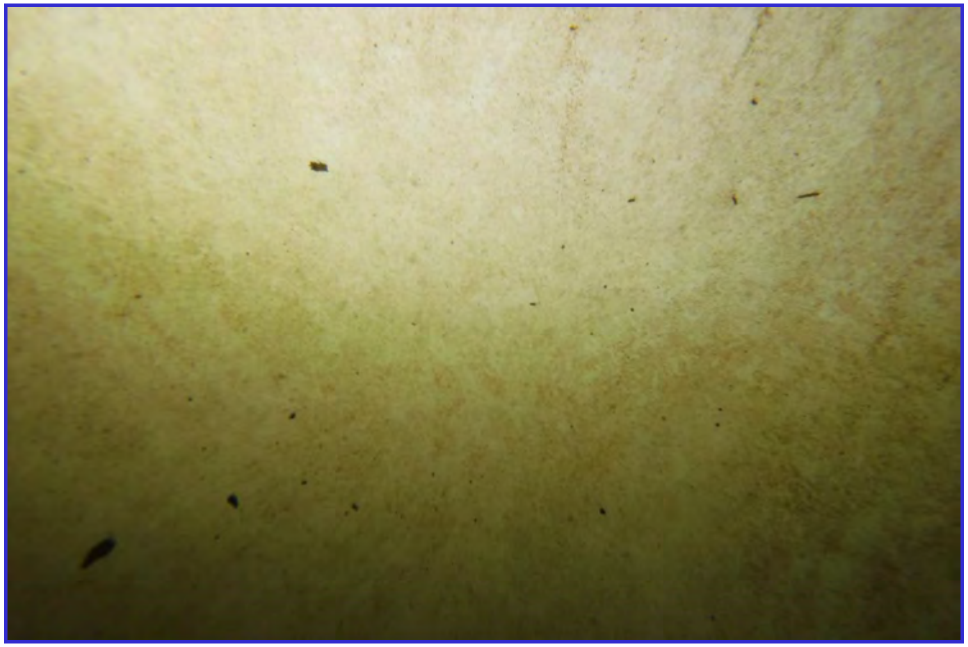

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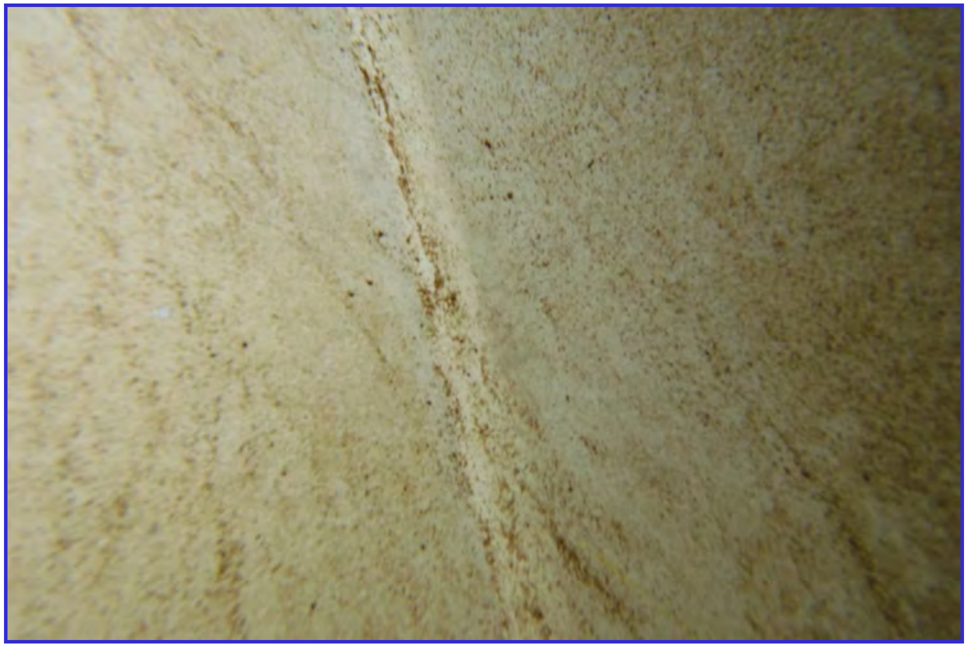

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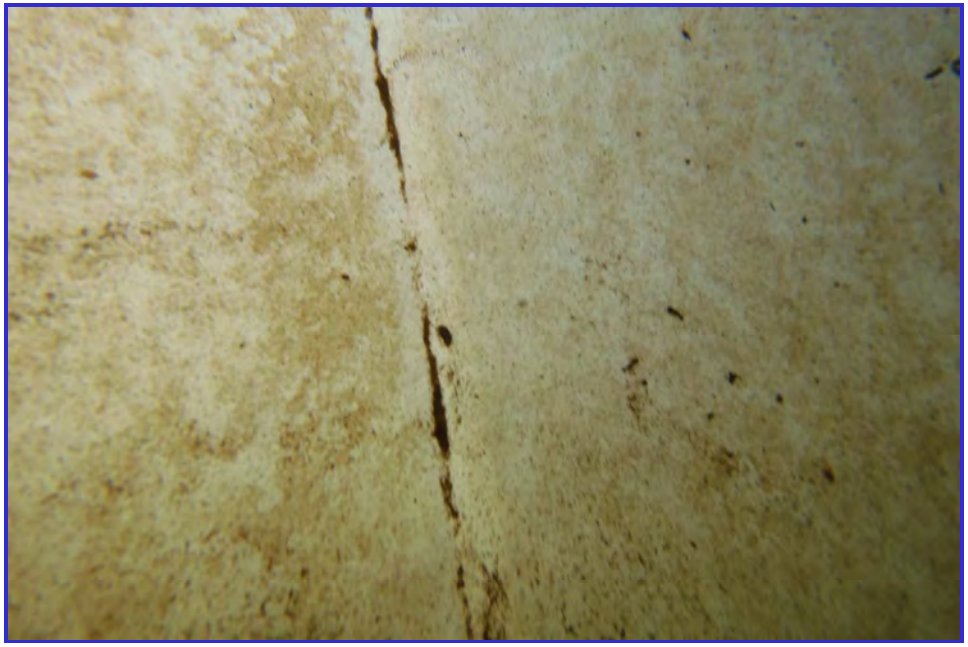
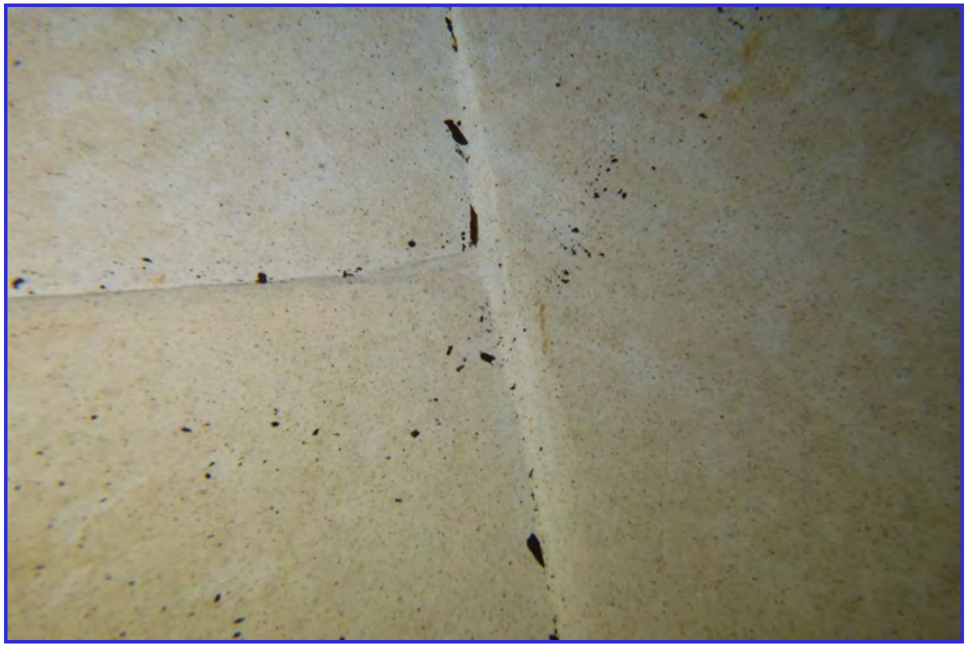


INTERIOR - CPUD - Railroad Flat Reservoir - Maintenance Inspection -133



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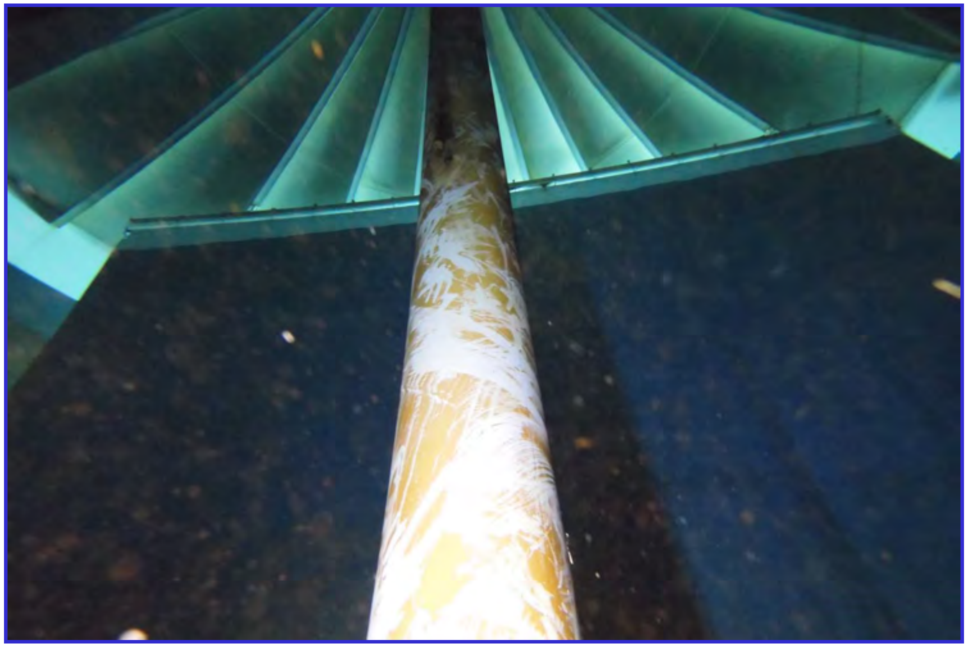
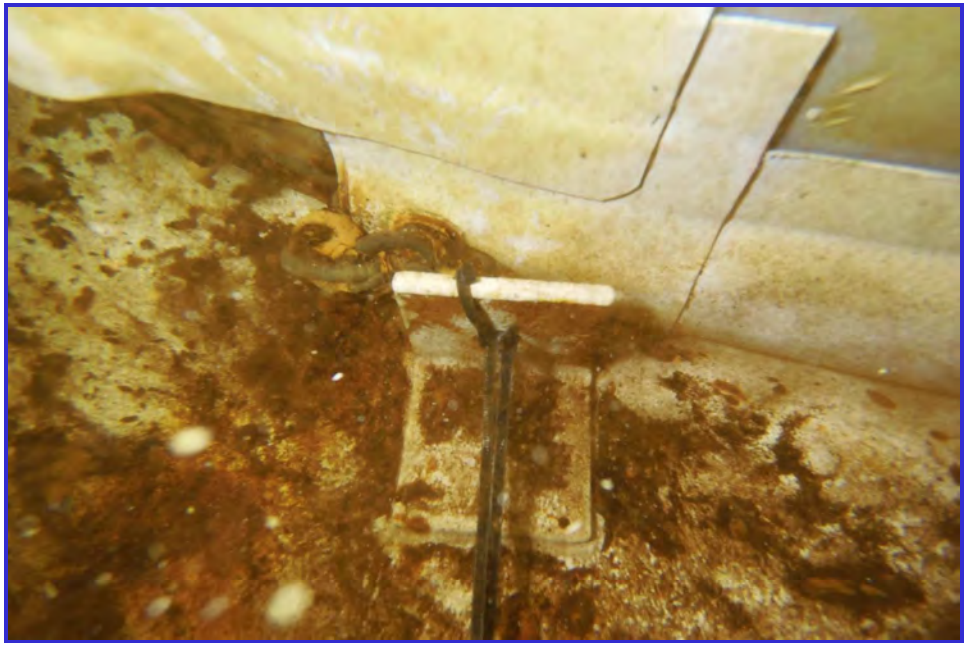
INTERIOR - CPUD - Railroad Flat Reservoir - Maintenance Inspection -136

INTERIOR - CPUD - Railroad Flat Reservoir - Maintenance Inspection -137



INTERIOR - CPUD - Railroad Flat Reservoir - Maintenance Inspection -138

INTERIOR - CPUD - Railroad Flat Reservoir - Maintenance Inspection -139



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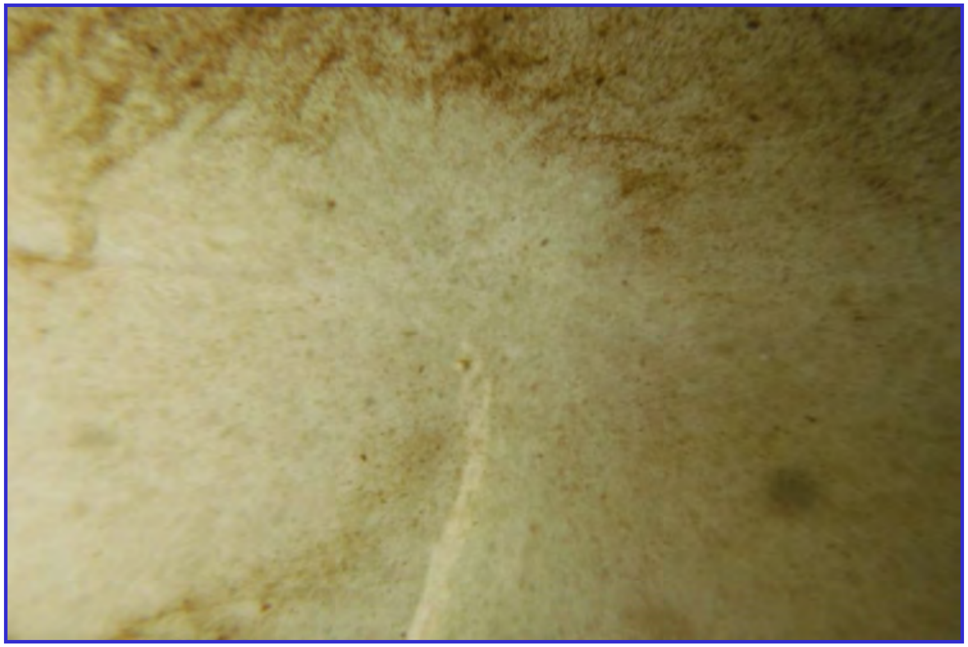
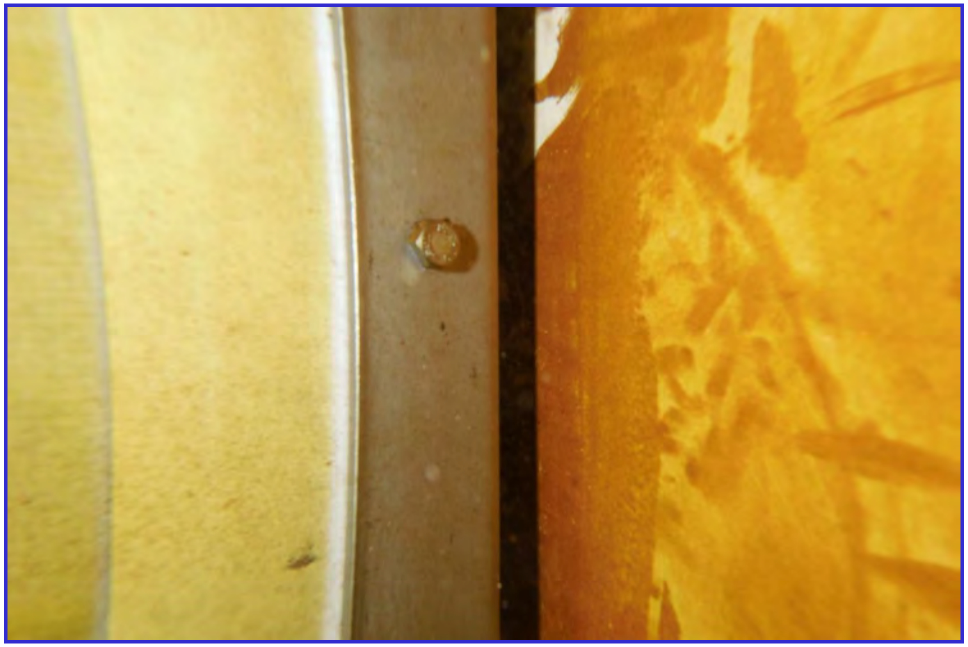


INTERIOR - CPUD - Railroad Flat Reservoir - Maintenance Inspection -141

INTERIOR - CPUD - Railroad Flat Reservoir - Maintenance Inspection -142



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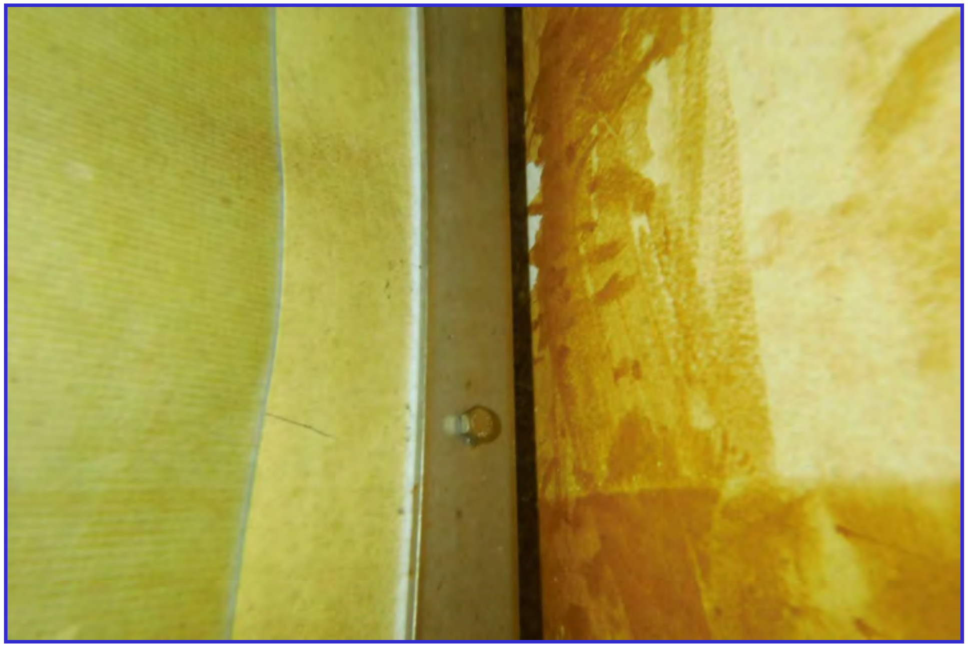

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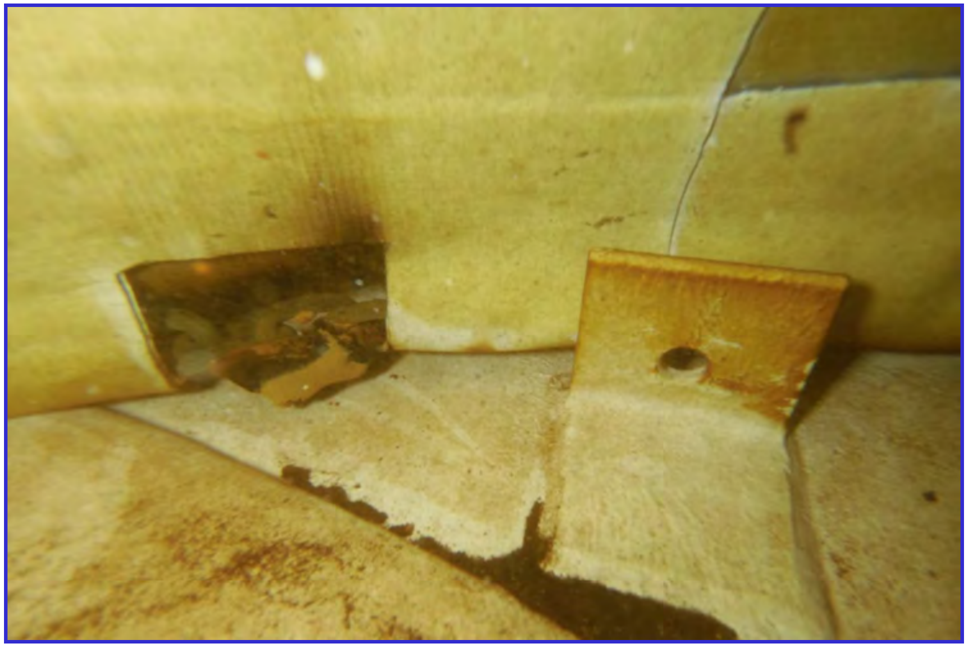

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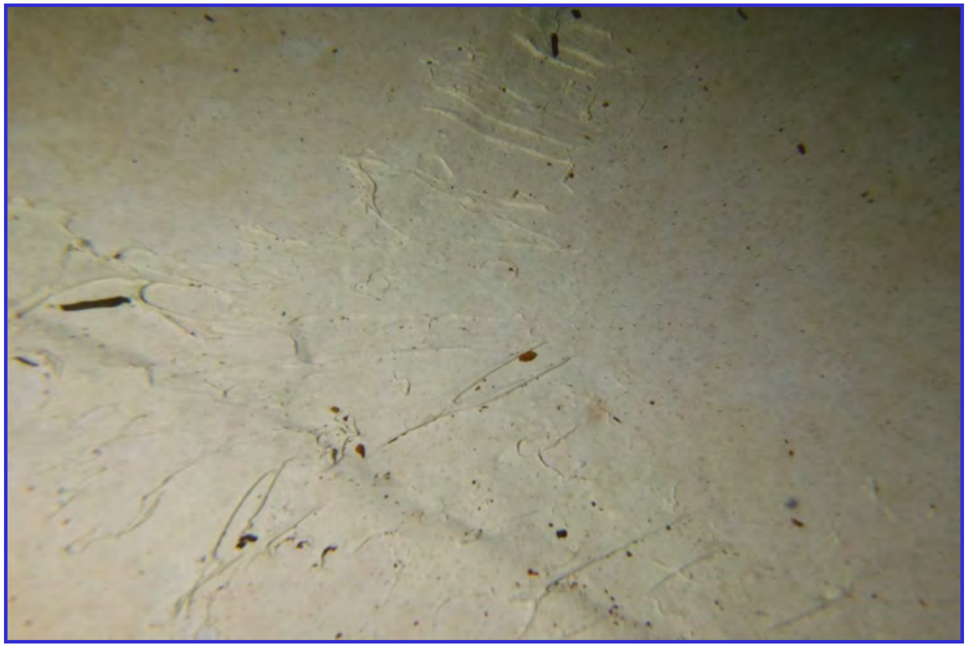

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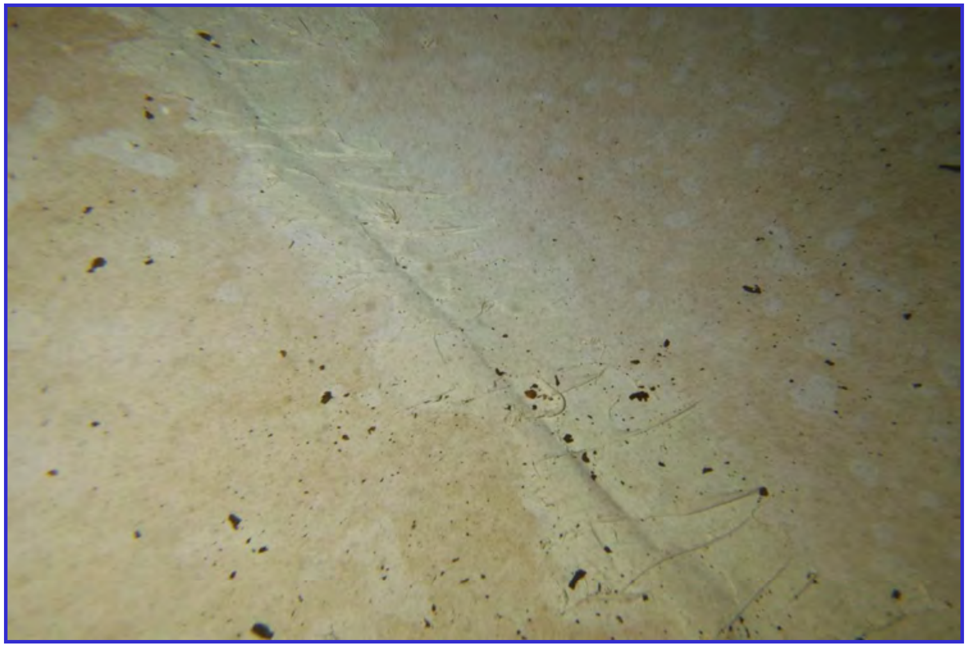

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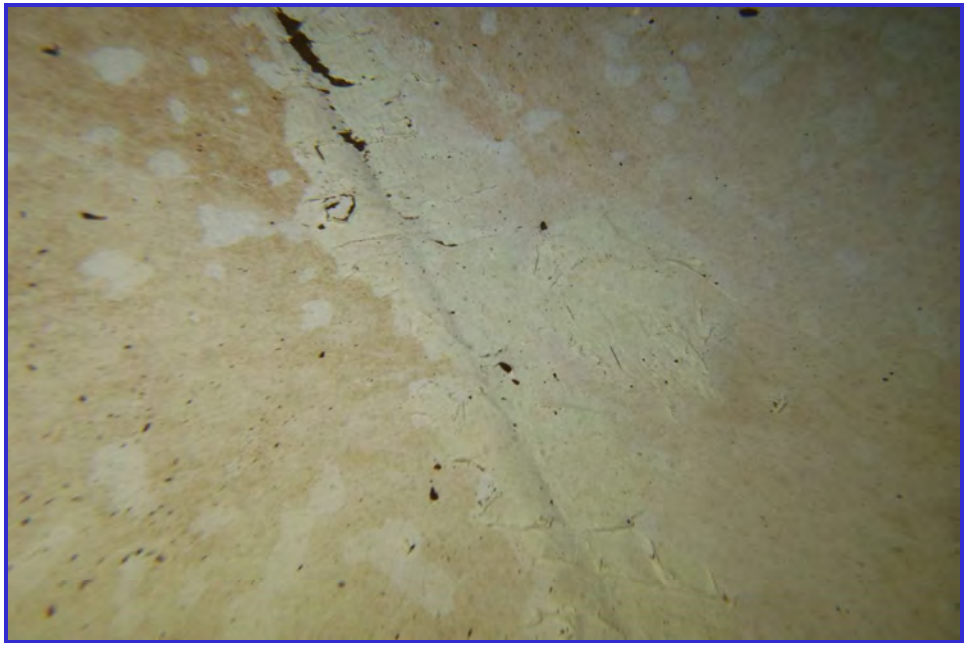

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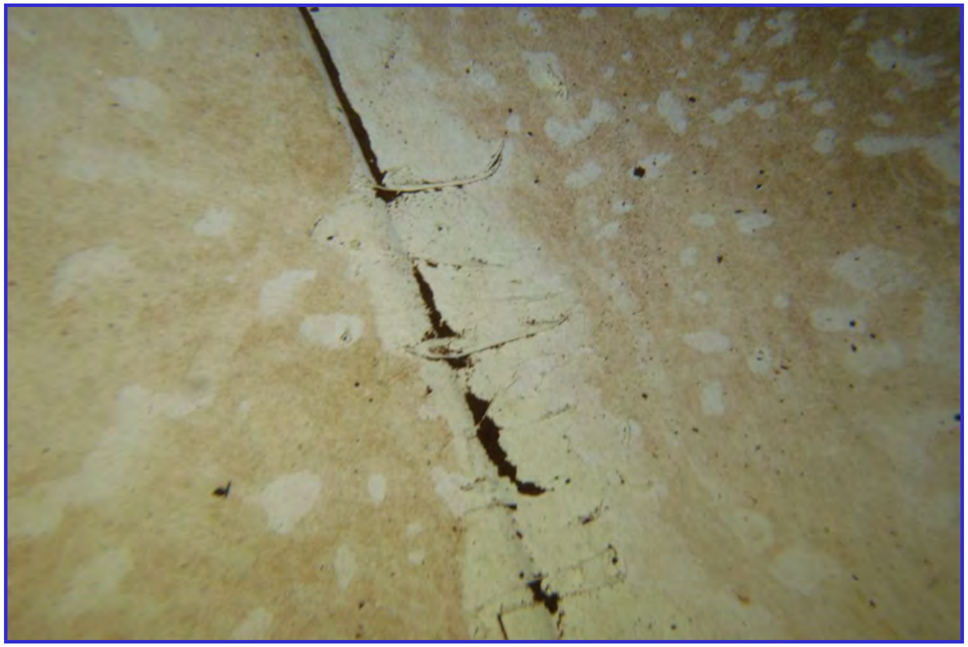

INTERIOR - CPUD - Railroad Flat Reservoir - Maintenance Inspection -151

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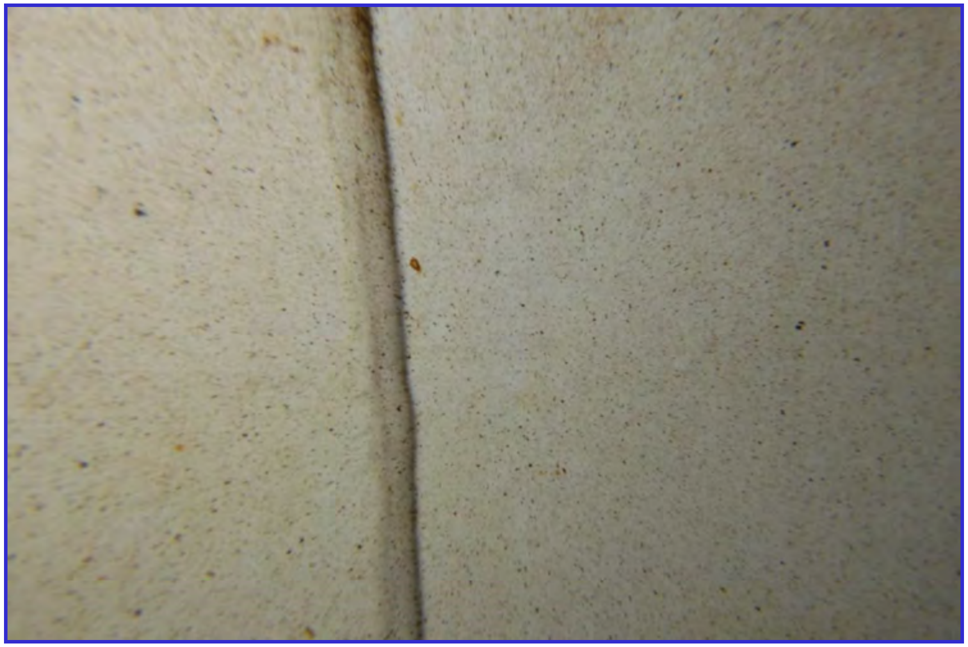

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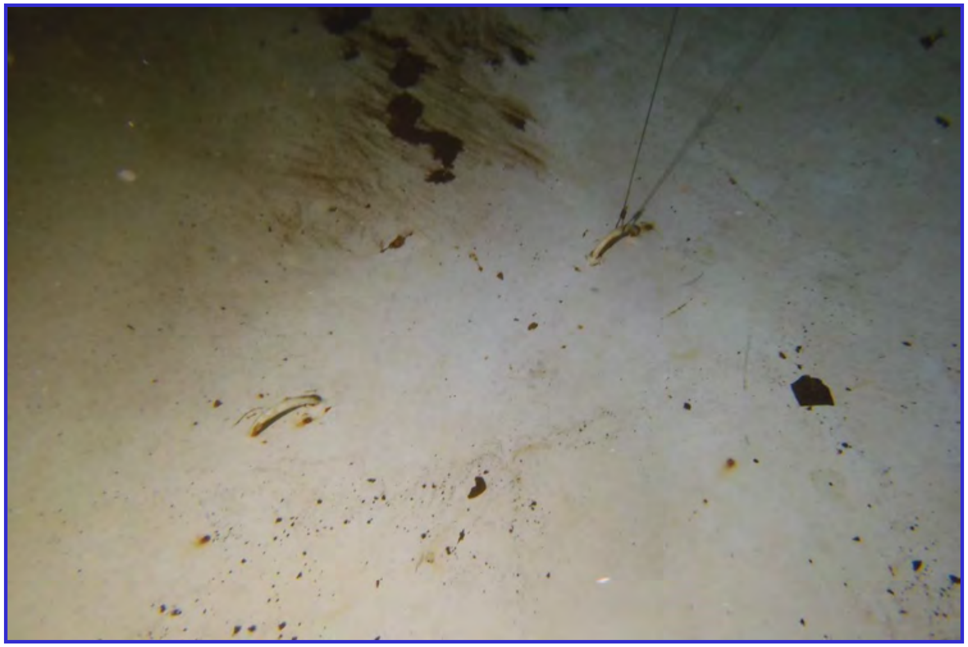
INTERIOR - CPUD - Railroad Flat Reservoir - Maintenance Inspection -157

INTERIOR - CPUD - Railroad Flat Reservoir - Maintenance Inspection -158

INTERIOR - CPUD - Railroad Flat Reservoir - Maintenance Inspection -159



INTERIOR - CPUD - Railroad Flat Reservoir - Maintenance Inspection -160

INTERIOR - CPUD - Railroad Flat Reservoir - Maintenance Inspection -161

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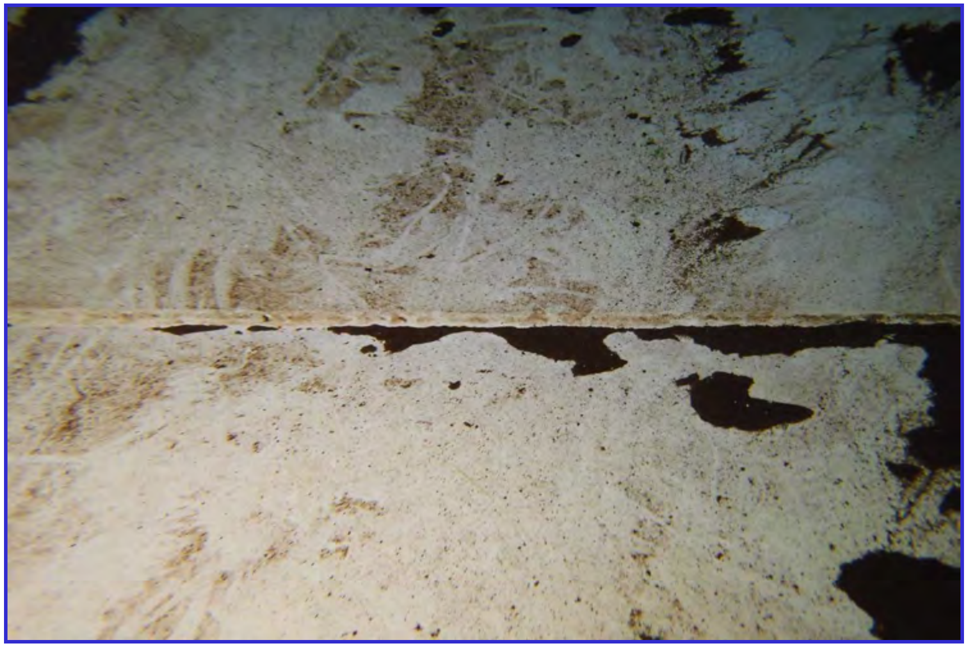
INTERIOR - CPUD - Railroad Flat Reservoir - Maintenance Inspection -163



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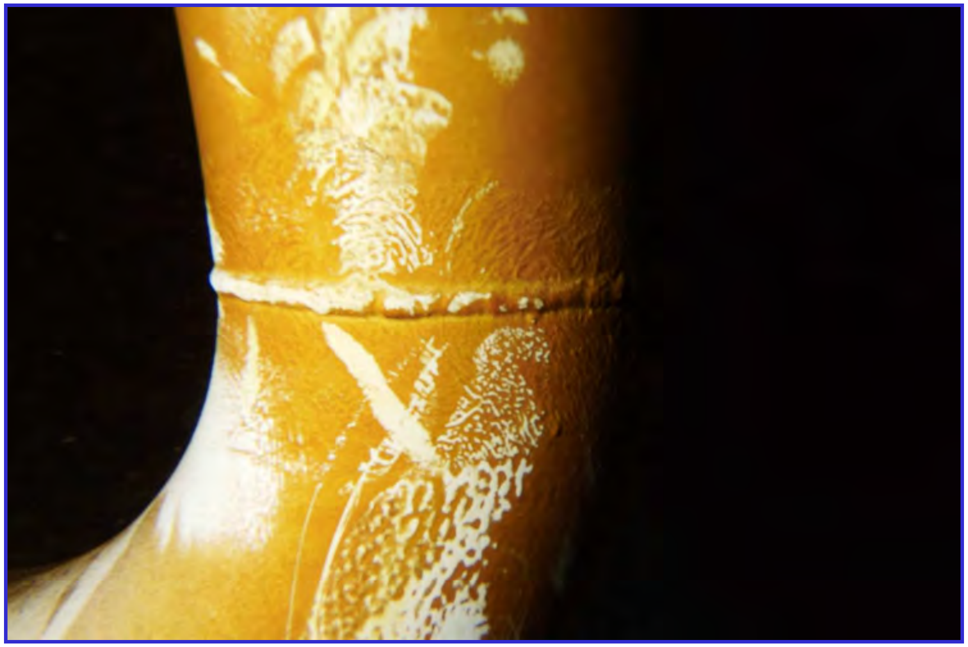
INTERIOR - CPUD - Railroad Flat Reservoir - Maintenance Inspection -166

INTERIOR - CPUD - Railroad Flat Reservoir - Maintenance Inspection -167



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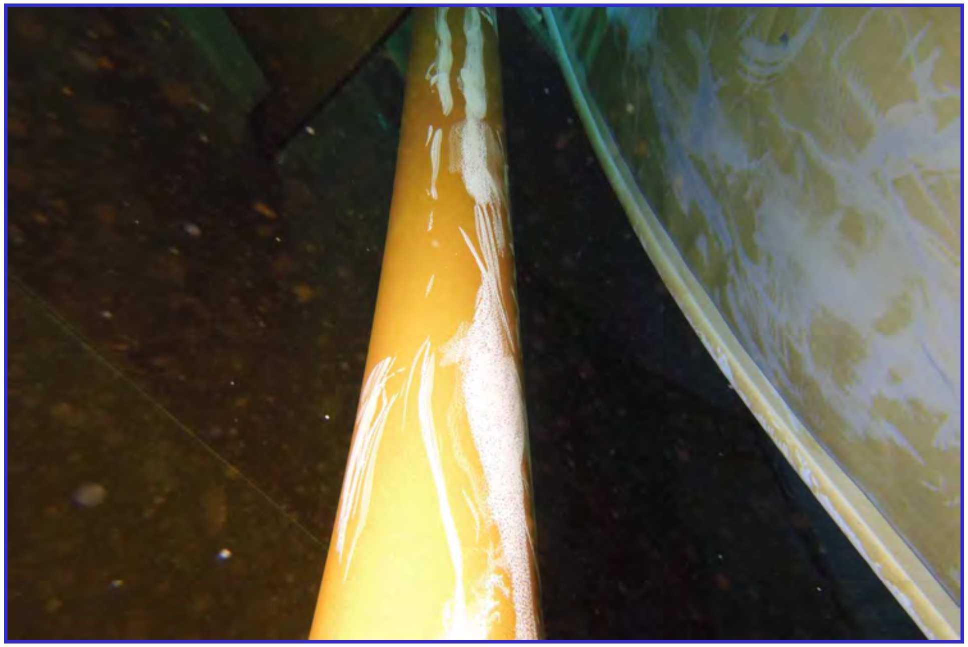
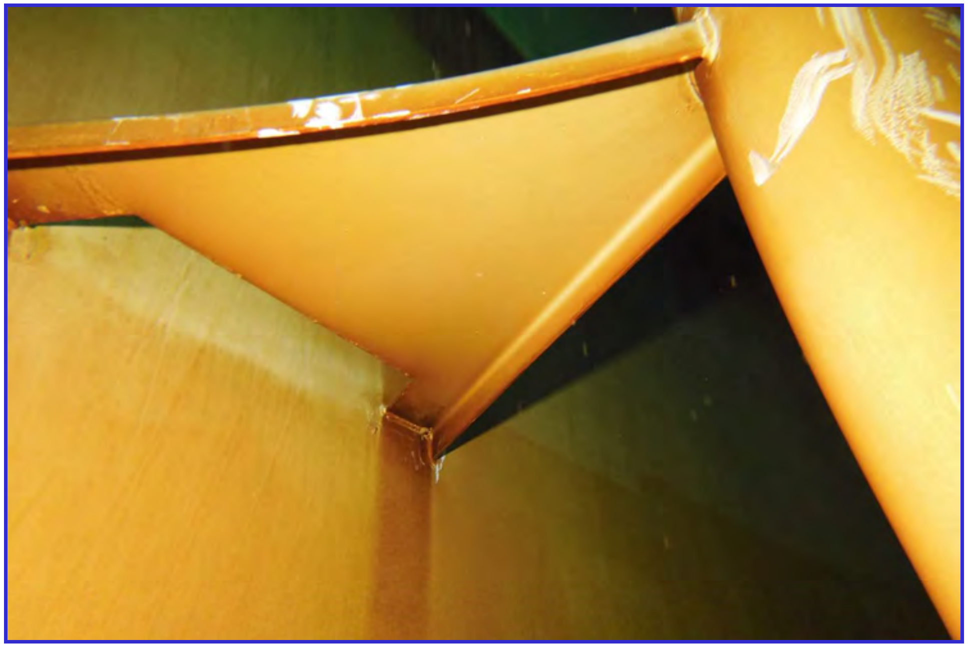
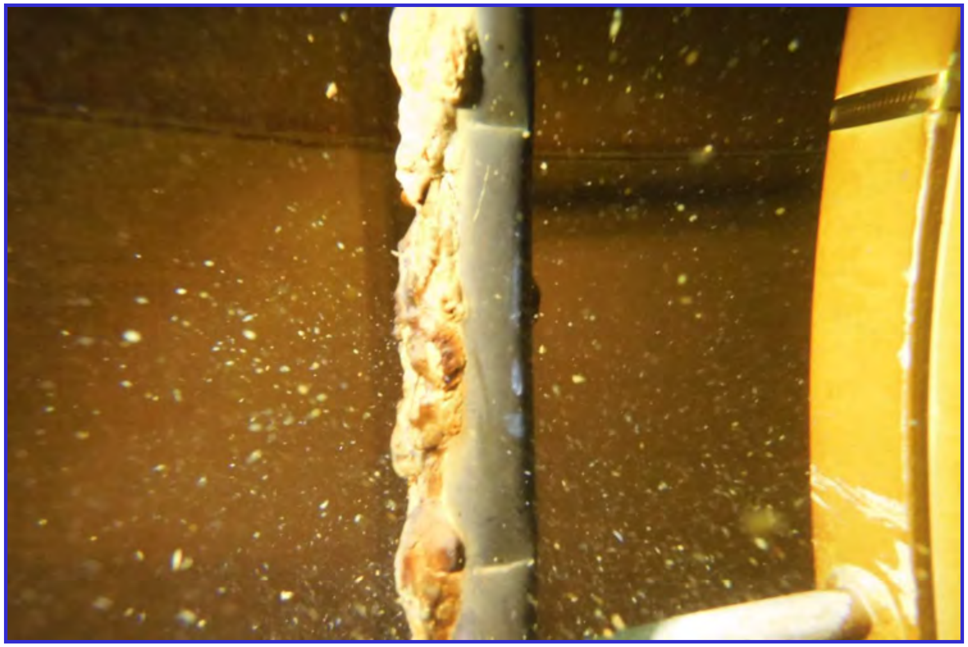


INTERIOR - CPUD - Railroad Flat Reservoir - Maintenance Inspection -170

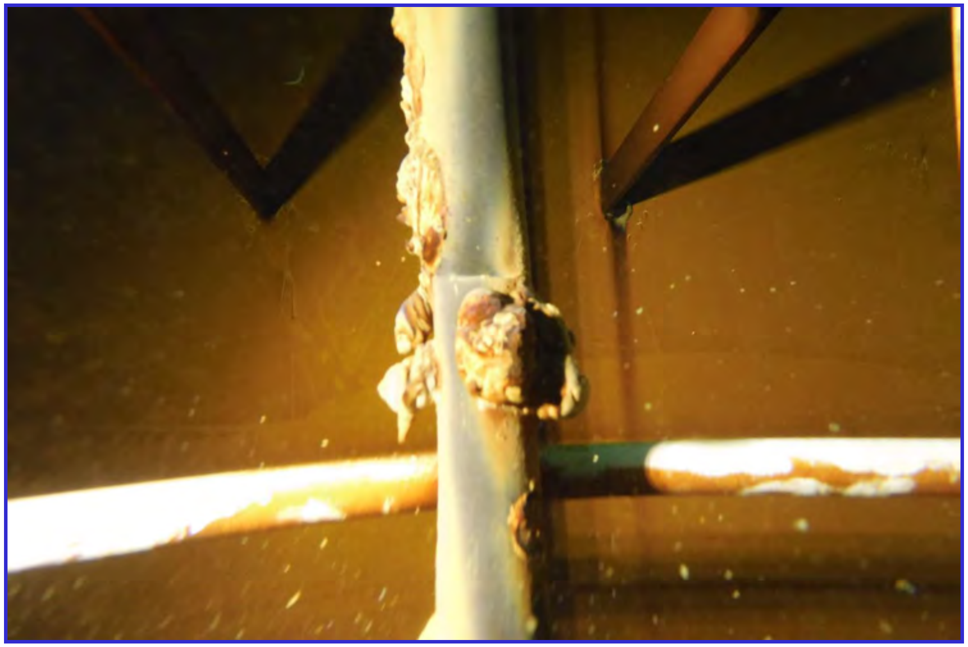


INTERIOR - CPUD - Railroad Flat Reservoir - Maintenance Inspection -171

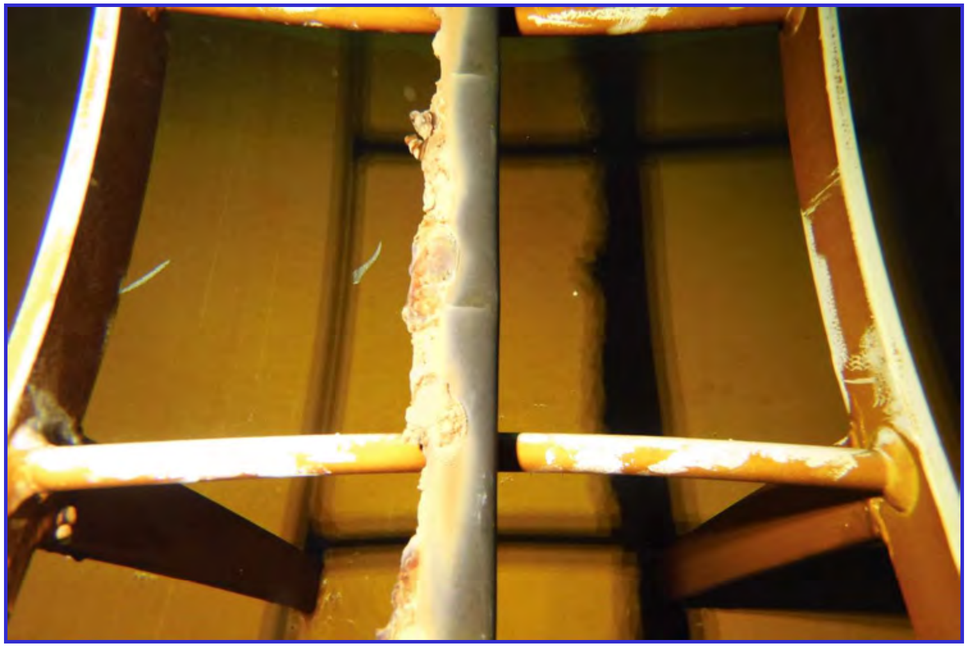
INTERIOR - CPUD - Railroad Flat Reservoir - Maintenance Inspection -172



INTERIOR - CPUD - Railroad Flat Reservoir - Maintenance Inspection -173



INTERIOR - CPUD - Railroad Flat Reservoir - Maintenance Inspection -174

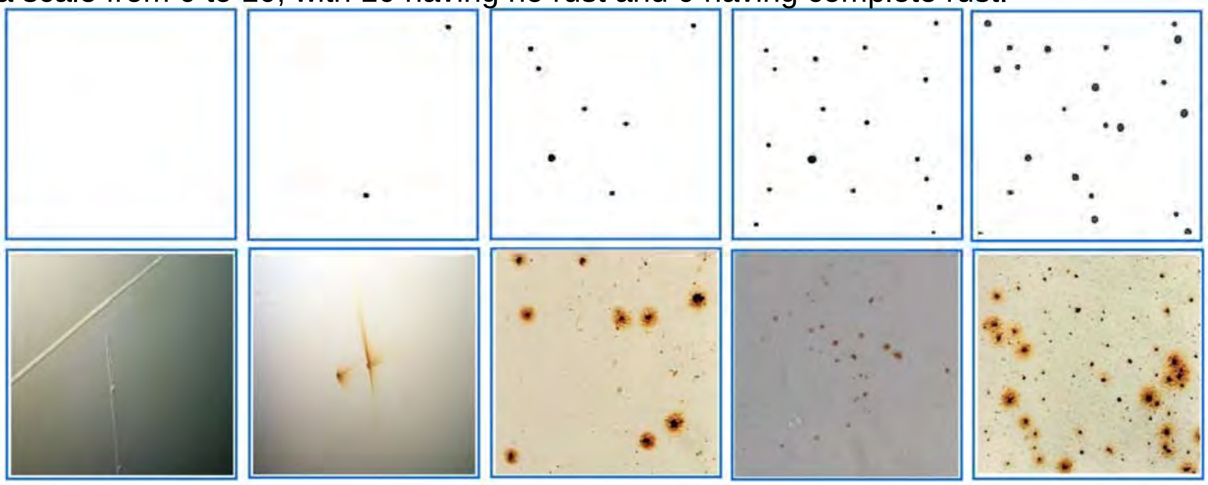


INTERIOR - CPUD - Railroad Flat Reservoir - Maintenance Inspection -175

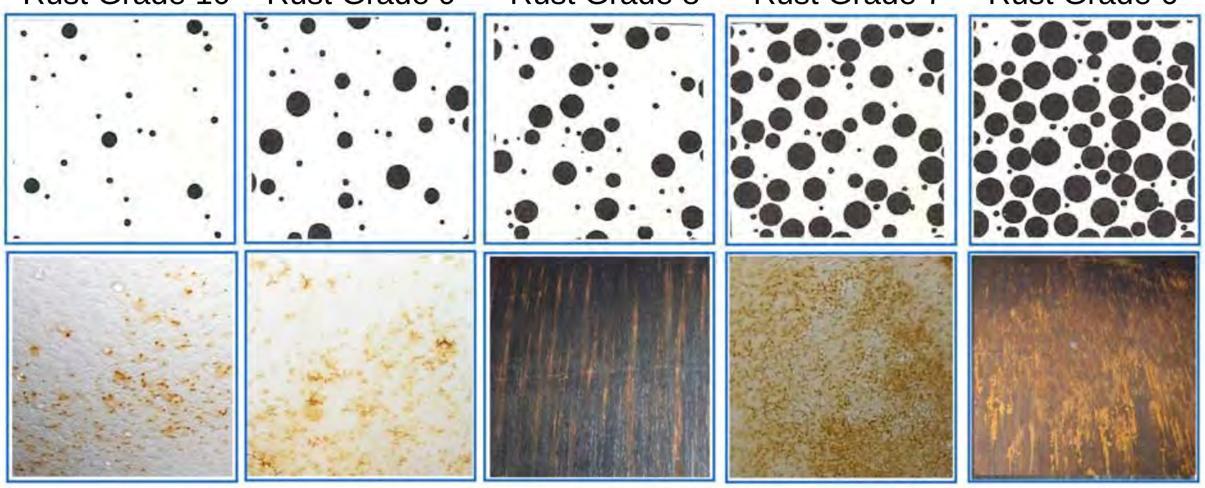
Chart 1 - Condition Rating The table below gives a basic description of the four different categories that CSI Services, Inc. uses to provide a general depiction of the condition of each defined area of a structure. The categories are Poor, Fair, Good, or Excellent. The development of these categories is based on historical knowledge and experience of various paint and lining systems over given periods of time in certain service environments. Basically, the rating is determined based on what should be expected of the paint or lining system at that point in its life cycle. As a result, different determinations are made for maintenance inspection versus warranty inspections. A detailed description of each rating with relative consideration addressed follows:

Rating	General Description of Conditions	
	Maintenance Inspection	Warranty Inspection
Poor	This condition is usually prioritized for rework in the short-term. Typically, these surfaces have considerably more coating defects and/or corrosion than what is expected for the age of the system.	This condition identifies an area with wholesale coating defects or corrosion concerns that will typically require significant removal and replacement of the coatings in the area.
Fair	Typically, these surfaces have a level of coating defects and/or corrosion that is slightly worse than what should be expected for the age of the system. This condition is placed on a short-term monitoring schedule.	This condition identifies an area with partial coating defects or corrosion concerns that will require significant rework.
Good	This condition is rated for areas without any considerable coating defects or corrosion. These surfaces are in a condition that is typical for the age of the coating system.	This condition identifies areas with coating defects or corrosion that is typically seen in one-year warranty inspections. Typically, only minor spot repairs are required.
Excellent	This condition is for areas without any considerable coating defects or corrosion. Typically, these surfaces are in a condition that is better than expected for the age of the system.	This condition identified areas that typically are in perfect condition and require no repair work.

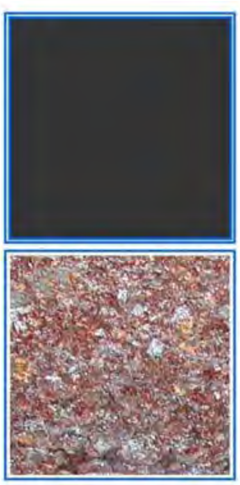
Chart 2 -Rust Grade The black and white figures below depict the standards referenced in ASTM D610 “Standard Test Method for Evaluating Degree of Rusting on Painted Surfaces.” Below each standard is a photographic depiction of each level of corrosion, as used by CSI Services, Inc. The standards depict the percentage of rust on a scale from 0 to 10, with 10 having no rust and 0 having complete rust.



Rust Grade 10 Rust Grade 9 Rust Grade 8 Rust Grade 7 Rust Grade 6



Rust Grade 5 Rust Grade 4 Rust Grade 3 Rust Grade 2 Rust Grade 1



Rust Grade 0

Rust Grade	Description
10	No rusting or less than 0.01% of surface rusted
9	Minute rusting, less than 0.03% of surface rusted
8	Few isolated rust spots, less than 0.1% of surface rusted
7	Less than 0.3% of surface rusted
6	Excessive rust spots, but less than1% of surface rusted
5	Rusting to the extent of 3% of surface rusted
4	Rusting to the extent of 10% of surface rusted
3	Approximately one-sixth of the surface rusted
2	Approximately one-third of the surface rusted
1	Approximately one-half of the surface rusted
0	Approximately 100% of the surface rusted

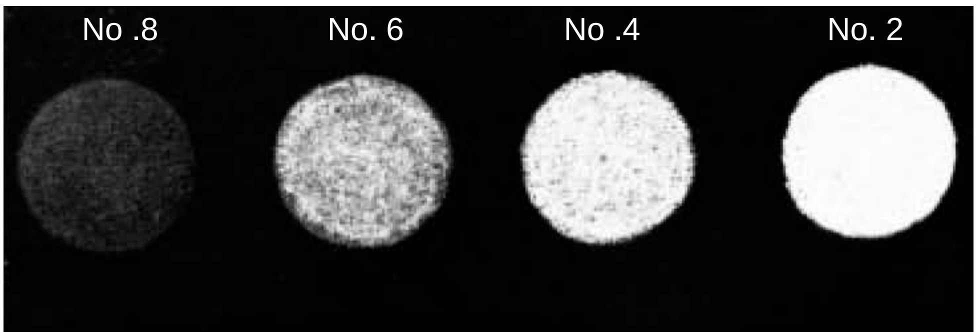
Chart 3 - Corrosion Grade The figure below depicts the photographic standards referenced by CSI Services, Inc. in the determination of the characteristics and stages of corrosion progression. This standard is used to better quantify the level of corrosion once it has progressed to Rust Grades 3, 2, 1, or 0 (see Chart 2). When applicable, CSI classifies an area as one or more of the five different Corrosion Grades. Corrosion Grades 1 through 5 are described below:

Grade	Description	Photo Examples
1	Light Rust - This condition involves relatively light colored rust that does not have any significant metal loss.	 
2	Dark Rust -This condition involves relatively dark colored, thicker rust that is progressing towards the next phase, significant metal loss.	 
3	Pitting - This condition involves isolated or widespread deep spot corrosion (pitting).	
4	Scale - Also known as lamellar or exfoliation corrosion. The edges of the affected area are leaf like and resemble the separated pages of a wetted book.	 
5	Structural Loss - This condition involves metal loss or failure where components will require structural consideration	 

The photos depicted are examples and were not taken on this project.

Chart 4 - Chalking The figure below depicts the photographic standards referenced in ASTM D4214 “Standard Test Method for Evaluating the Degree of Chalking of Exterior Paint Films,” Method D659, Method C. Generally speaking, chalking is the degradation of a paint’s binder leaving behind loose pigments as the binder reacts with the environment, primarily ultraviolet light and oxygen. Evaluating chalking is a means to measure the performance of a coating system and its life cycle projection. It is also important to quantify for consideration of future overcoating options. This test uses these pictorial standards to quantify the amount of chalking present on paint films. The depictions below represent the mount of colored chalk removed onto a cloth during the test. The scale ranges from 2 to 8 with the rating 2 having the most chalk.

Light Colored Paints



Dark Colored Paints

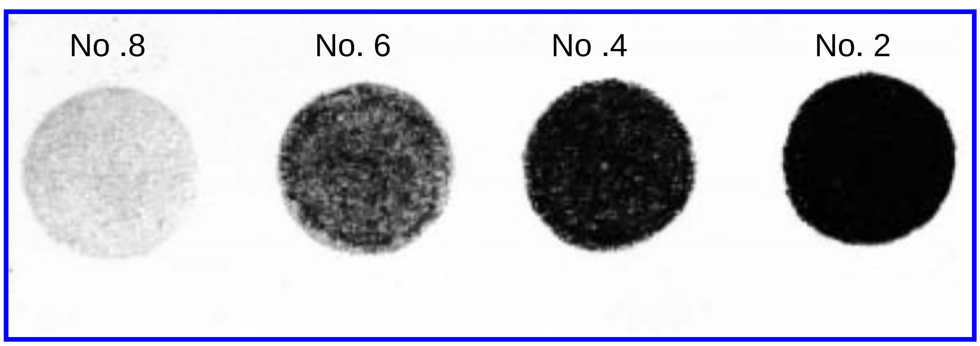
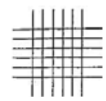
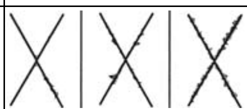
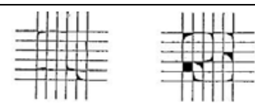
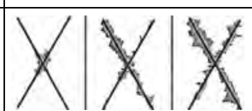
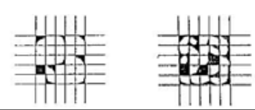
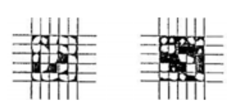
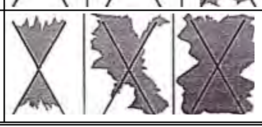
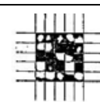
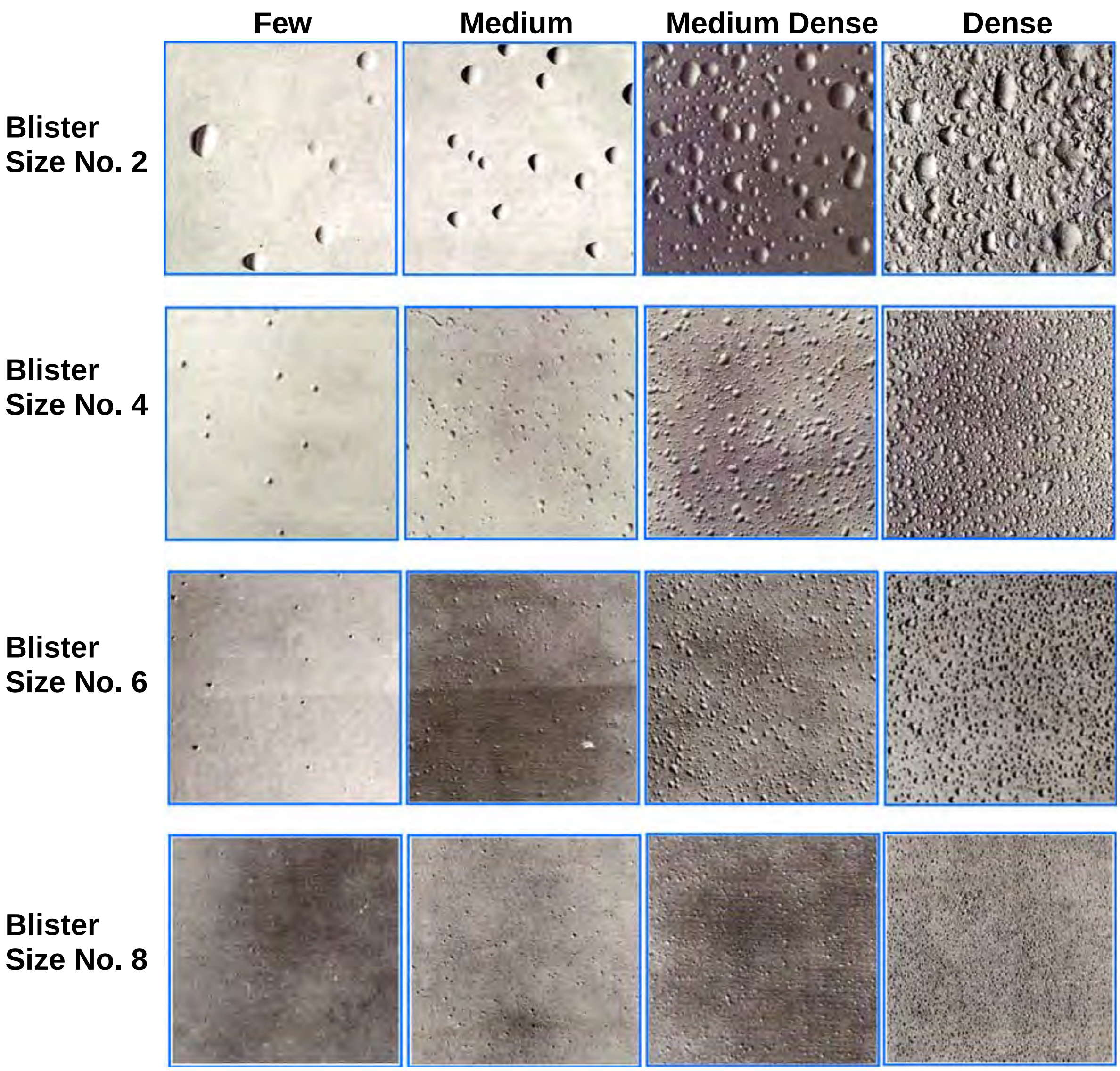


Chart 5 - Adhesion Rating The figures below depict the photographic standards and criteria referenced in ASTM D3359 “Standard Test Method for Evaluating Adhesion by Tape Test” and ASTM D6677 “Standard Test Method for Evaluating Adhesion by Knife.” Both Standards are used to assess the condition of a paint system for life-cycle projections. It is also used to evaluate an existing paint system’s ability to withstand the added stress that any overcoating strategies can create. Depending upon the thickness of the paint system, ASTM D3359 has two different test methods. The rating criteria for both standards follow:

ASTM D3359					
Method A			Method B		
Rating	**Observation**	**Surface of X-cut from which flaking/peeling has occurred**	**Rating**	**Percent Area Removed**	**Surface of cross-cut area from which flaking has occurred for six parallel cuts and adhesion range by percent**
5A	No peeling or removal	None	5B	0% none	
4A	Trace peeling or removal along incisions or their intersection		4B	Less than 5%	
3A	Jagged Removal along incisions up to 1/16” on either side		3B	5 – 15%	
2A	Jagged removal along most of incisions up to 1/8” on either side		2B	15 – 35%	
1A	Removal from most of the area of the X under the tape		1B	35-65%	
0A	Removal beyond the area of the X		0B	Greater than 65%	

ASTM D6677	
Rating	Description
10	Fragments no larger than $\frac{1}{32}$” x $\frac{1}{32}$” can be removed with difficulty
8	Chips up to $\frac{1}{8}$” x $\frac{1}{8}$” can be removed with difficulty
6	Chips up to $\frac{1}{4}$” x $\frac{1}{4}$” can be removed with slight difficulty
4	Chips larger than $\frac{1}{4}$” x $\frac{1}{4}$” can be removed with slight pressure
2	Once coating removal is initiated by knife, it can be peeled at least $\frac{1}{4}$”
0	Coating can be peeled easily to length greater than $\frac{1}{4}$”

Chart 6 – Blistering Rating The figure below depicts the photographic standards referenced in ASTM D714 “Standard Test Method for Evaluating Degree of Blistering of Paints”. This test uses these pictorial standards to quantify both the size and density of blisters that may develop in linings. Although the standard uses a blister size scale of 0 to 10 this chart uses the most common sizes of blisters found in the field. The standard does not use a reference for the size of each of the blisters depicted. CSI used this scale as a means for further quantification by qualifying the largest blister depicted as being 1 inch in width (Blister Size No. 2) and the smallest blister being 1/32 of an inch in width (Blister Size No. 8).



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Providing Quality Technical Services to the Coating Industry

November 19, 2023

Via Email: asmith@pbieng.com

Ashley Smith, PE
Peterson Brustad Inc.
80 Blue Ravine Road, Suite 280
Folsom, CA 95630

Office: 916.608.2212
Cell: 530.200.6309

Subject: **Final Report - Maintenance Inspection**

Re: **CPUD – San Andreas Reservoir**

Dear Ashley:

Please find attached the final report for the evaluation that was completed on the above referenced tank.

Thank you for your business and please let me know if you have any questions or comments about our findings. I can always be reached by cell at 951.609.6991 or by e-mail at rgordon@csiservices.biz.

Sincerely,
CSI Services, Inc.

N. Randy Gordon

N. Randy Gordon, PCS
Technical Services Manager

CSI SERVICES

P. O. Box 801357, Santa Clarita, CA 91380 877.274.2422

Final Report
Maintenance Inspection
San Andreas Reservoir
Calaveras Public Utility District

Prepared for:
Ashley Smith, PE
Peterson Brustad Inc.
80 Blue Ravine Road, Suite 280
Folsom, CA 95630

Prepared by:
CSI Services, Inc.

N. Randy Gordon, PCS
Technical Services Manager

PROTECTIVE COATING SPECIALIST
N. RANDY GORDON
No. 2018-621-011
Exp. 12-31-26
PCS
STATE OF CALIFORNIA

November 19, 2023

Hawaiian Office: P.O. Box 671, Aiea, HI 96701
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Coating Specialists and Inspection Services, Inc.

Consulting *Evaluations* *Tank Diving* *Inspection*

Table of Contents

Attachments

- Field Notes
- Exterior Photos
- Interior Photos
- CSI Chart 1 – General Description of Conditions
- CSI Chart 2 – Rust Grade Criteria
- CSI Chart 3 – Corrosion Grade Criteria
- CSI Chart 4 – Coating Chalking Criteria
- CSI Chart 5 – Coating Adhesion Criteria
- CSI Chart 6 – Coating Blistering Criteria

Introduction

Peterson Brustad Inc. authorized CSI Services, Inc. (CSI) to conduct a maintenance inspection on the Calaveras Public Utility District, San Andreas Reservoir located at 2573 San Andreas Vista Drive, San Andreas, CA. This report documents the findings of the inspection and services performed.

Any recommendations have been made in accordance with the applicable requirements of American Water Works Association's Standard (AWWA) D102 "Coating Steel Water Storage Tanks," AWWA Standard M42 "Steel Water Storage Tanks," and CSI's experience with evaluating over a thousand water storage facilities. A photo summary and narrated video are also included to document the condition of the tank.

The field-work was completed on August 8, 2023 by a team primarily comprised of Anthony Jackson, Steven Metcalf and Steven Metcalf Jr. The exterior shell observations were made mostly from grade level, while the exterior of the roof was examined close-up. The interior inspection was carried out with the tank's water level at approximately 21 feet using special underwater diving equipment and techniques. Steve Metcalf was the site supervisor and Anthony Jackson was the lead diver. Mr. Randy Gordon, Technical Services Manager, reviewed the results of the field data and prepared recommendations for maintenance work. Mr. Gordon has over 30 years of experience through the evaluation of thousands of storage tanks and other structures. He is certified as an SSPC Protective Coating Specialist (PCS) and NACE/SSPC Level 3 Coating Inspector.

Summary

The estimated 51 year old coating system on the tank is in overall poor condition with widespread and extensive corrosion. The exterior paint system is severely weathered yet this system maintains satisfactory adhesion. The exterior paint is believed to be the original system applied and very likely has high concentrations of heavy metals (e.g. lead, chromium, etc.) that will require special precautions to protect the workers and environment when it is disturbed.

The lining in the tank is in an overall unsatisfactory condition with widespread rust including undercutting, pitting, exfoliation and structural loss. Blistering of the lining below the MWL is pervasive and widespread. The majority of the corrosion is in the upper part of the tank and includes the structural loss of several roof rafters. The most advanced corrosion spots below the CWL were patched during this inspection using an NSF certified underwater curing epoxy. The existing lining conditions dictate that the existing exterior paint and interior lining systems should be removed and replaced as soon as possible to prevent further metal loss which ultimately leads to the structural failure of the roof.

Background

The San Andreas Reservoir is a welded steel on grade structure built in 1972 by Pittsburg Des Moines Steel Company. The tank is approximately 110 feet in diameter by 41 feet high providing a nominal capacity of 3,000,000 gallons.

The tank shell has five courses that are connected to a knuckle radiused roof with rafters, girders and six columns. The tank has one roof vent, one roof hatch, and two shell manways. There is one interior ladder and one exterior ladder. The exterior ladder has fall a protection system and a vandal deterrent. The tank is not seismically anchored to its concrete ringwall foundation. There is no internal or external cathodic protection (CP) system associated with this tank. The tank has a water level sensor, rigid piping connections, and the overflow is internal.

It is believed that the interior linings are the original coatings applied. The interior steel surfaces, including the roof and roof support members are coated with an aluminum alkyd system. The exterior roof, shell, and appurtenances are painted with what appears to be an alkyd system. The internal roof lap seams are not caulked.

Field Evaluation

The purpose of this survey was to assess the condition of the existing coatings and recommend maintenance coating work, where needed. The evaluation mainly involved visual observations, but also involved various testing procedures. Photographs and video were taken to document the field inspections, and a photo summary and narrated video is included within this report.

For survey purposes, the tank has been segmented into defined areas: exterior roof, exterior shell, interior roof, interior shell, and interior floor. The various appurtenances within each of these areas have also been evaluated. A rating system has been developed to quantify the condition of these various tank areas. Each of the rating criteria is found in the Attachments (Charts 1 through 6).

The condition of the coating systems was rated as being poor, fair, good, or excellent (Chart 1). The extent of any rust defects identified within each of the areas was generally determined using the guidelines set forth in ASTM D610 “Standard Test Method for Evaluating the Degree of Rusting of Painted Steel Surfaces” (Chart 2).

Where applicable, the characteristic or stage of corrosion was determined in accordance with CSI Corrosion Grade criteria (Chart 3). The degree of paint chalking was determined in accordance with ASTM D4214 “Standard Test Method for Evaluating the Degree of Chalking of Exterior Paint Films,” Test Method D659, Method C (Chart 4). Coating adhesion was assessed in accordance with ASTM D3359 “Standard Test Method for Evaluating Adhesion by Tape Test, modified Method A and/or a modified version of ASTM D6677 “Standard Test Method for Evaluating Adhesion by Knife” (Chart 5). The modified version of ASTM D6677 was used in areas where destructive testing was not found to be practical. Any blistering that may have been present was rated in accordance with ASTM D714 “Standard Test Method for Evaluating the Degree of Blistering in Paints” (Chart 6), and the paint dry film thickness was measured with a Positector 6000FN3 Type II gage in accordance with the applicable guidelines set forth SSPC PA2. The visual observations and data collected from the various areas of the tank are found in the charts below:

Exterior

Close-up visual examination of the coating was limited to the first (lowest) shell course, upper shell areas adjacent to the ladder, and the roof. The exterior paint on the heavily weathered roof is in poor condition and the shell was in fair condition, both with minimal chalking (ASTM D4214, No. 8). Dark rust (CSI Corrosion Grade 2) was present in areas that had been mechanically damaged from operations or vandalism and areas where paint was peeling. The amount of rust on the roof was less than ten percent of the overall surface area (ASTM D610, 5). Areas where paint was found to be cracking were rated a 2 in accordance with ASTM D661. The paint thickness was found to range from 6.0 to 9.0 mils, and the paint was estimated to exhibit satisfactory adhesion (ASTM D6677, 5A).

Some of the specific data collected from the exterior evaluation follows:

Exterior Paint — Overall Condition: Fair

Paint Defects	Roof Quadrant				Shell Quadrant				Tank Support			
	Exterior		Poor		Exterior		Fair		Exterior		Fair	
	S	W	N	E	S	W	N	E	S	W	N	E
Rust spots (ASTM D610)	5	5	5	5	7	7	7	7	7	7	7	7
Corrosion Grade	2	2	2	2	2	2	2	2	2	2	2	2
Rusting at crevices												
Spot peeling	Yes	Yes	Yes	Yes								
Delamination												
Cracking (ASTM D661)					2	2	2	2				
Checking (ASTM D660)												
Chemical staining												
Chalking	8	8	8	8	8	8	8	8	8	8	8	8

Interior

The roof area is defined as those surfaces above the highest water level (HWL). Close-up visual examinations were made to all areas below the waterline and all other areas were assessed from the water level. The coating on the underside of the roof plates and roof support structure is in poor condition with advanced corrosion common to the edges of the support member flanges and roof plates (CSI Corrosion Grades 2, 3, 4, 5). Spot peeling and cracking was observed throughout. The total amount of corrosion on the roof was rated to be approximately one sixth of the total surface area (ASTM D610, 3), and there was a moderate amount of rust staining present at the faying surfaces of the roof structure.

The shell surfaces are in poor condition with areas of dark rust (CSI Corrosion Grade 2, 3), especially below the high-water level segment of the shell. The total amount of corrosion on the shell was rated to be excessive but less than 1 percent of the total surface area (ASTM D610, 6) with some minor pitting observed. Fields of intact and broken, medium dense blisters were observed throughout (ASTM 714, 2-few).

The floor had sediment upon it, but spot checking revealed the lining system was in poor condition, (ASTM D610, 6) impacting less than 1 percent of the total surface area. There were fields of small, medium-dense blisters (ASTM 714, 2-few). Some pitting of the floor plate was uncovered during the inspection and these areas were patched. It appears that prior patches were performing properly.

The data collected from the underwater inspection follows:

Interior Paint	Above Water Condition			Poor		Below Water Condition			Poor			
Paint Defects/Overall Grade	Roof Quadrant				Shell Quadrant				Floor Quadrant			
	Interior		Poor		Interior		Poor		Interior		Poor	
	S	W	N	E	S	W	N	E	S	W	N	E
Rust spots (ASTM D610)	3	3	3	3	6	6	6	6	6	6	6	6
Rust areas (ASTM D610)												
Corrosion Grade	2,3,4,5	2,3,4,5	2,3,4,5	2,3,4,5	2,3	2,3	2,3	2,3	2,3	2,3	2,3	2,3
Rust staining	Moderate	Moderate	Moderate	Moderate								
Rusting at crevices	Yes	Yes	Yes	Yes								
Spot peeling	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Delamination												
Cracking (ASTM D661)	2	2	2	2	2	2	2	2	2	2	2	2
Blistering (ASTM 714) Size/Densit					2/Few	2/Few	2/Few	2/Few	2/Few	2/Few	2/Few	2/Few
Pitting (Estimated Amount)									5	5	5	5
Pitting (Estimated Deepest Mils)									20 mils	20 mils	20 mils	20 mils

Dive Inspection Video

Click on link or cut and paste the external link: https://youtu.be/RJ1m4Hd2_Ac

Discussion

The paint system on the exterior was found to be relatively thin and in poor condition on the roof and fair condition at the shell. All surfaces have isolated spot rust and areas of peeling, and the paint system was found to have significantly weathered from chalking. It was also noted that the underside of the center vent has heavy corrosion up to and including some metal loss.

Chalking is the term for the powdery characteristic of an aged coating that may also have a faded finish. Chalking is a result of the natural breakdown of a paint system's binder when it is exposed to sunlight. The binder (or resin) degrades in ultraviolet light, which leaves behind the unbound pigment or chalk. Aside from a faded appearance, chalking can result in corrosion as the film weathers (thins) away through cycles of wind and rain. As the paint endures years of direct sunlight, it begins to weather away, which results in the paint no longer providing enough barrier protection from corrosion. On this basis, it is recommended that a plan for recoating the tank with an industrial paint should be completed.

Generally speaking, there are four possible approaches to maintenance coating work. The coatings can be either completely removed and replaced (repainted), spot repaired, spot repaired and overcoated, or simply overcoated. In evaluating the condition of a coating to determine the best approach there are a number of different factors to consider. The first set of factors includes the determination of the coating's ability to withstand the added stress of an additional coat(s). Attributes impacting this decision

include film thickness and adhesion. If a film is too thick or has poor adhesion, the tension from the curing stresses and/or the weight of the additional paint can cause the existing system to disbond. The second set of factors to consider when determining what maintenance coating approach to take is the amount of surface area requiring repair, the overall difficulty in providing access to the structure, and whether the coating system contains heavy metals. The final factor is the condition of the substrate.

When considering whether a spot repair approach is a viable option, a good rule of thumb is that up to 10 percent of the surface area requiring repair is the point at which making spot repairs with overcoat becomes a diminishing return. With 10 percent rusting, overcoating may be an option if the adhesion is better than fair. If there is more than 10 percent rusting and the substrate is free of mill scale, overcoating may be considered an option if the adhesion is satisfactory. Once the amount of surface area exceeds this range, the cost of cleaning and coating the individual rust spots approaches (or exceeds) the total cost of removal and replacement.

On this basis, it is recommended that the tank exterior paint system be spot repaired and overcoated within the next 3 to 5 years before any significant metal loss develops.

At interior surfaces, the tank lining system was found to have widespread dark corrosion above the highest water level (HWL) with lamellar and/or exfoliation corrosion common to knuckle bracing edges and structural loss at the rafters connected to the dollar plate. A significant amount of corrosion was found below HWL with pitting and medium dense patches of broken and unbroken blisters.

Exfoliation corrosion is a form of intergranular corrosion which involves selective attack of a metal at or adjacent to grain boundaries. In this process, corrosion products force metal to move away from the body of the material, giving rise to a layered, laminar appearance. Exfoliation corrosion is also known as layer corrosion or lamellar corrosion.

Since all of the blisters were underwater and below the common water level, it is presumed that the blisters are a result of osmotic forces. Osmotic blistering is typically caused when coatings that are to be placed into immersion service are applied too thick, overcoated too soon, under colder weather conditions, and/or over contaminated surfaces. One form of osmotic blistering is solvent entrapment. Solvents are added to coatings to act as a vehicle during application. When coatings are applied too thick the coating solvents that were designed to be released during application are locked in-place when the catalyzed coating reaches a full chemical cure. Additionally, if coatings are applied under cold or cooler conditions, the solvents have a difficult time escaping from the film before it gets hard. Blisters that result from solvent entrapment tend to be localized to the coolest and lowest areas of a tank. Solvent vapors are typically heavier than air, and the lowest portion of a tank tends to become saturated with these gases

without proper ventilation at the time of application. Coated over contamination creates a source for osmotic forces. This contamination attracts fluid that creates pressures that exceed the film's ability to bond, creating blisters.

Isolated corrosion pits can develop within a coating system that may have only a few small breaks that were not corrected through periodic maintenance repairs. If the remaining, adjacent coating has excellent adhesion, it will inhibit undercutting corrosion. As a result, the corrosion forces will have a tendency to concentrate on the exposed bare metal, which results in pitting. Pitting can be critical in some instances. The maximum corrosion rate for steel in fresh water is typically no more than 30 mils per year (MPY). As a result, the pitting can develop into a perforation if not repaired. If a thru-hole develops within a tank bottom, the isolated issue can develop into a much larger corrosion problem. Corrosion requires oxygen to advance, and the underside of the tank bottoms are considered a dead-air space. As a result, the bottom of tank floors are typically not coated. A perforation or through-hole with even a small trickle of water will reintroduce oxygen into the environment creating active corrosion that is difficult to identify until the steel floor plate requires replacement.

Industrial paint systems such as those applied to industrial facilities (i.e. piping, structural steel, storage tanks) typically have a life expectancy of 25 to 35 years before any spot maintenance coating repairs are required. The interior lining system is estimated to be 51+ years old, far surpassing expectations. The characteristics of the coating defects indicate that the lining failed many years ago. The removal and replacement of the lining system should become a top priority as the structural loss of the roof structure members has created an unsafe condition for entrants.

A common tank design in the past was to run tank piping up through the tank bottom. This design can help prevent piping from obstructing outside areas of the tank but can be problematic during a seismic event. During an earthquake, there is the potential for the tank bottom to move at a different rate than the below grade piping. Past seismic events have resulted in piping connections being sheared or cracked, which resulted in a loss of water capacity during times when it was most needed during the emergency. Moving tank piping to the shell to include flexible connections for inlet/outlets is a better design when considering this issue.

Recommendations

The following activities are recommended for remedial work:

Exterior

Within the next three to five years, spot repair and overcoat the exterior coating. This work should include the following:

1) Spot power tool clean all active rust sites in accordance with SSPC's Surface Preparation Standard No. 15, "Commercial Power Tool Cleaning" followed by 4-6 mils of an industrial epoxy primer and 3-5 mils of a polyurethane finish coat.

2) Test the paint system for heavy metals to determine if any special actions are required to protect workers and the environment during paint disturbance.

Interior

As soon as possible, remove and replace the interior lining. This work should include the following:

3) Remove and replace the lining system at all interior surfaces. This work should include cleaning all surfaces in accordance with SSPC's Surface Preparation Standard No. 10 "Near-White Metal Blast Cleaning" (SSPC-SP10) followed by three 4 to 6 mil coats of an NSF Certified epoxy lining.

4) Caulk all crevices in the tank such as roof lap seams.

5) Anticipate the need for structural repairs (welding, grinding, patch plating and steel member replacement)

6) Consider retrofitting the tank piping to include flexible couplings and the relocation of tank bottom connections to the lower shell.

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Field Water Tank Dive Inspection Report

Tank Name:	San Andreas	Dive Supervisor:	Steven Metcalf
Tank Owner/Client:	CPUD	Dive Leader:	Anthony Jackson
Client Contact:	Ashley Smith	Dive Tender	Steven Metclaf Jr.

Scope Maintenance Inspection

Site Information

Item	Description
Cross Street	San Andreas Vista Dr
Tank Location	2573 San Andreas Vista Dr
GPS Coordinates	38.20399 120.67038
Nearest Structures	None
Surrounding Site	Gravel

Item		Notes
Perimeter Fencing	Yes	No Comments
Site secured on arrival	Yes	No Comments
Overhead Power Lines	No	None
Antenna on Tank	No	None
Roof Accessible	Yes	No Comments

Interior Structural Characteristics

Item	Data	
Roof Structure	Rafters and Center Column	
Column Design	Pipe	
Upper Center Column	Dollar Plate	
Column Base Design	Free Plate with Clips	
Connections	Bolted	
Overflow Design	Funnel and Pipe Floor Exit	
Inlet Interior Design	Floor Stub	
Lining Type/Original	Epoxy	No

Item	Data			
Outlet Design	Floor Stub			
No. Interior Ladder	Yes	One		
CP System/Type	No	None		
Water Depth	21			
Water Agitator	No	None		
Barrier Walls	No			
No. of Columns	One Column			
Caulking	Roof	No	Columns	No

Exterior Structural Characteristics

Item	Data	
Capacity (gallons)	3,000,000	
Diameter (feet)	110	
Height (feet)	40	
Erection Year	1972	
Contract No.	32326	
Tank Type	Welded Steel	
Tank Profile	on grade	
Tank Geometry	Cylinder	
Number of Courses	Five	
Height of Each Course	8 Ft	
Roof Design	Pitched Roof with Nuckle	
No. Shell Manways	Two Shell Manways	
Type of Manways	Round	
Manway Cover Design	Bolted Circle	
Diameter of Manways	20 in	
No. Roof Hatches/Location	One	Near Edge
Hatch Design	Square Shoe Box	
Size of Roof Hatch	24 in	
No. Roof Vents/Location	One	Center
Roof Vent Design	Round Hood	
Construction Co.	Pitt Des Moines	

Item	Data	
Center Roof Vent Size	24 in	
Roof Vent Sealed	Yes	Satisfactory
Roof Rail System	Yes	No Comments
Roof Rail Satisfactory	Yes	No Comments
Rail Location	Top of Ladder	
No. & Type Roof Access	One	Ladder
Exterior Vandal Deterrent	Yes	
Ext Ladder Satisfactory	One	Yes
Ext Ladder Fall Prevent	Yes	
Roof Tie-Off Present	Yes	
Tank Piping	Floor Inlet and Outlet	
Inlet Diameter	12 in	
Outlet Diameter	12 in	
Flexible Pipe Coupling	In Ground	
Overflow Pipe Diameter	12 in	
Overflow Exterior Design	12 in	
Drain Location	Floor	
Tank Foundation	Concrete Ring Wall	
Water Level Indicator	Yes	
Tank Type	Potable	
Lining Type/Original	Polyurethane	No

Miscellaneous Notes

EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection

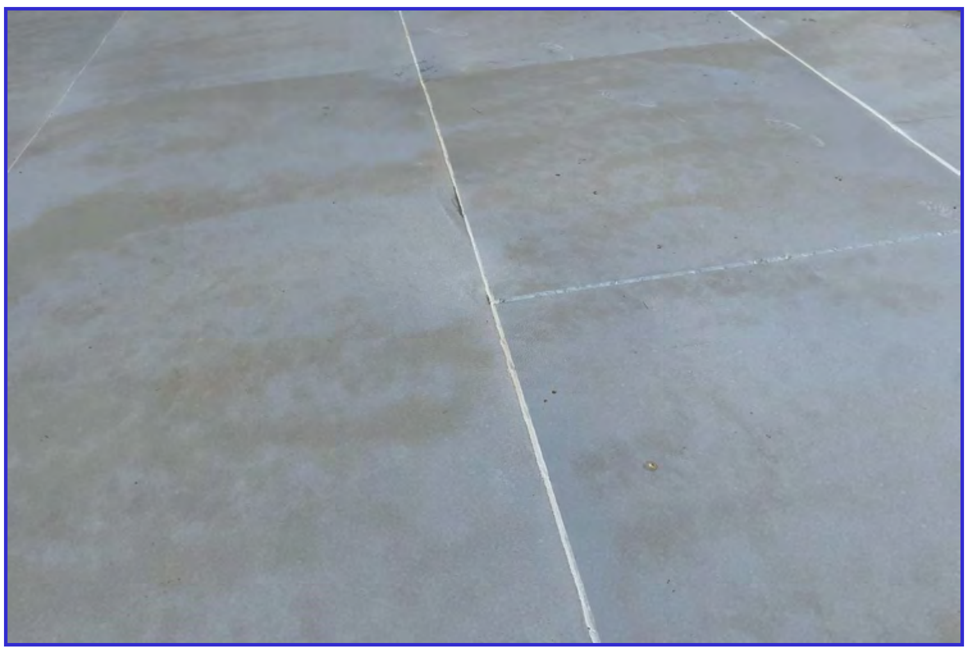
EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -001

EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -002

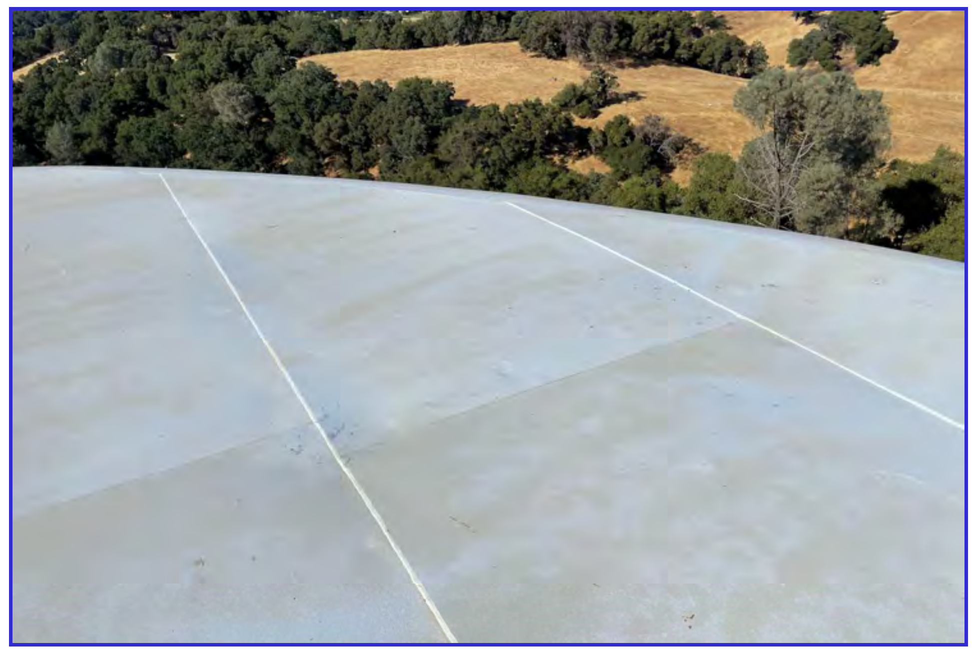
EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -003

EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -004

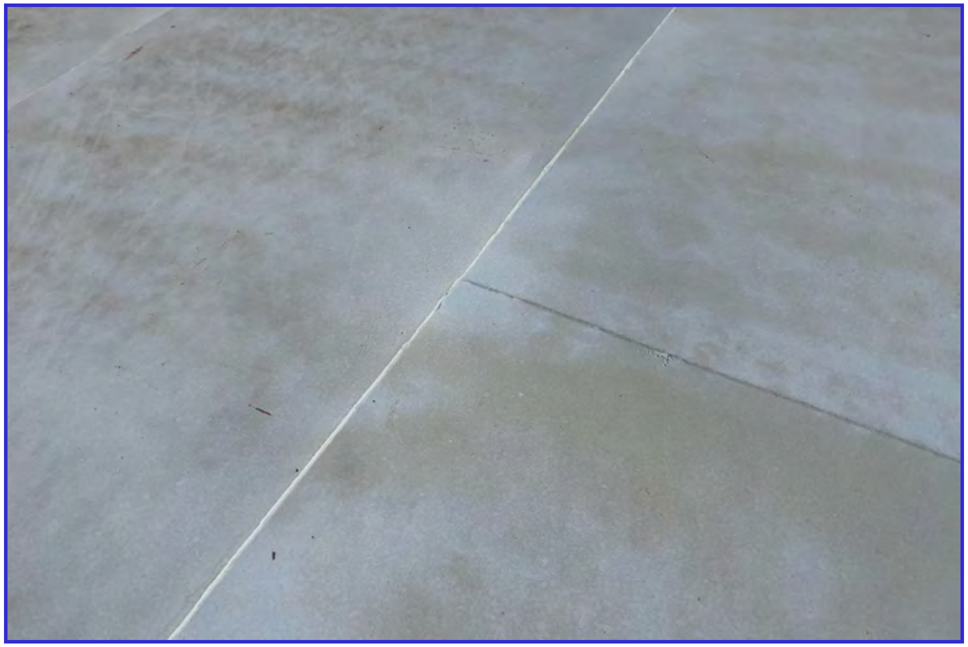
EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -005



EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -006



EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -007



EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -008

EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -009

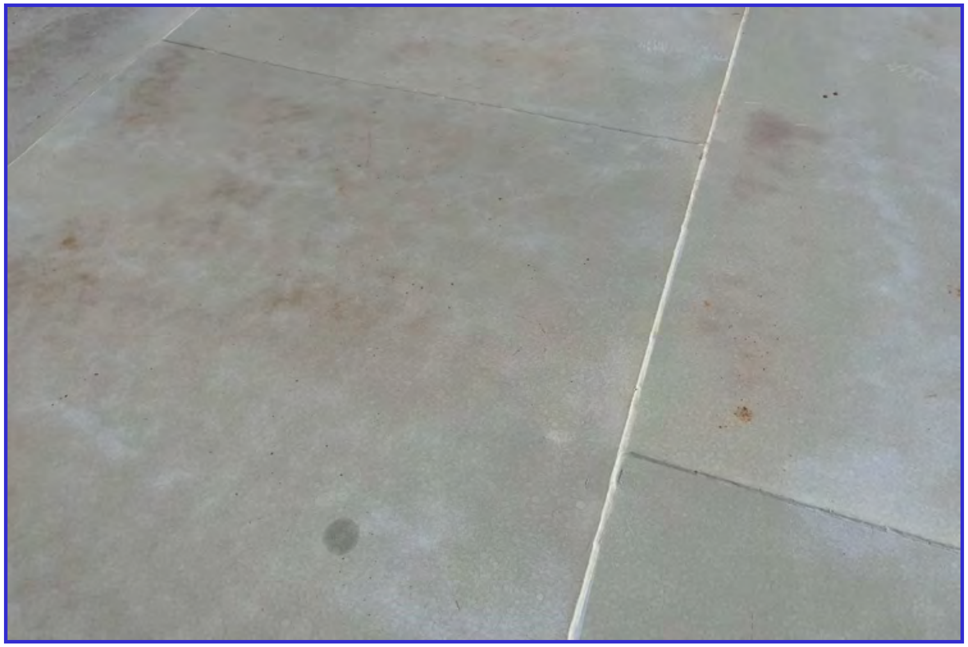
EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -010

EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -011

EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -012

EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -013

EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -014



EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -015

EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -016

EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -017

EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -018

EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -019

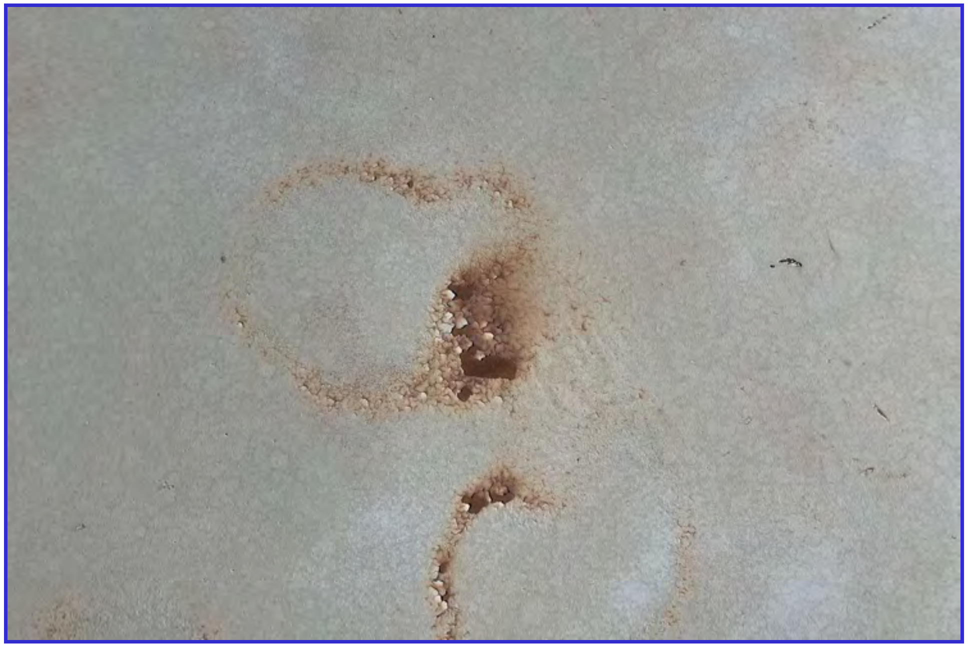
EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -020

EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -021

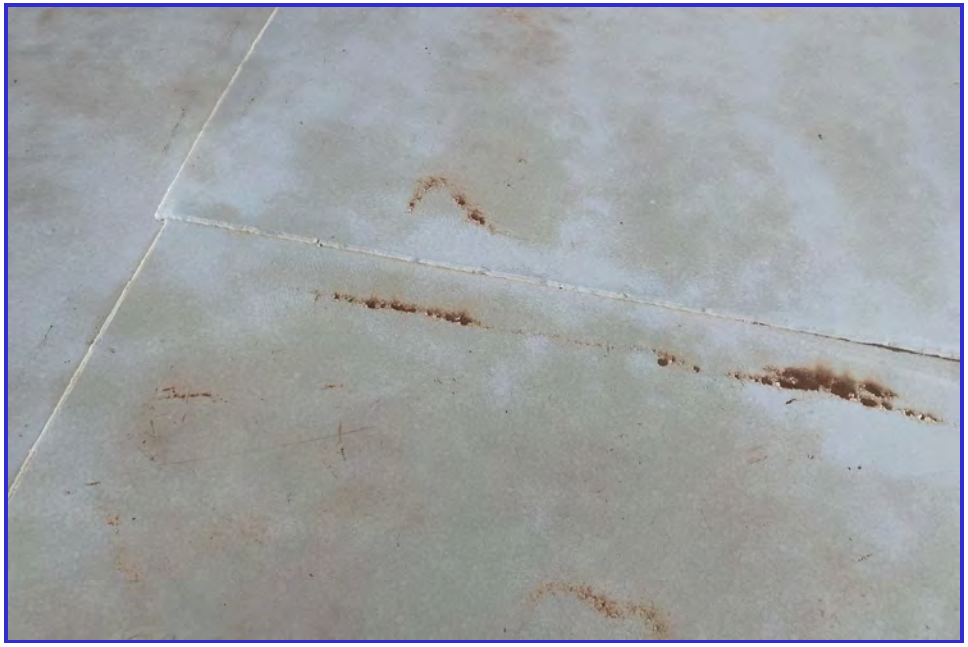
EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -022

EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -023

EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -024



EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -025

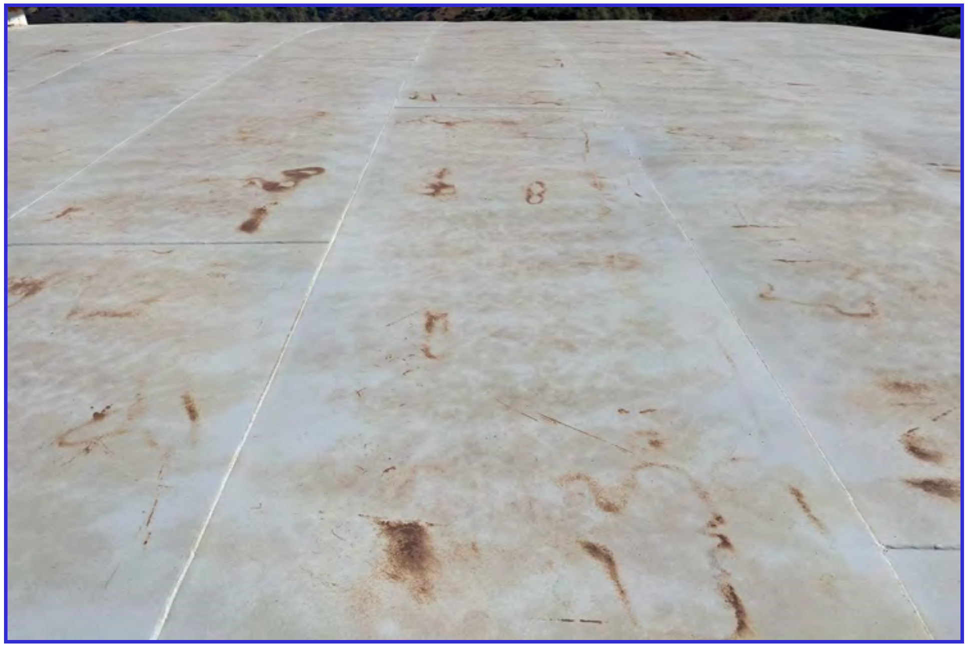


EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -026

EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -027

EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -028

EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -029



EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -030

EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -031

EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -032

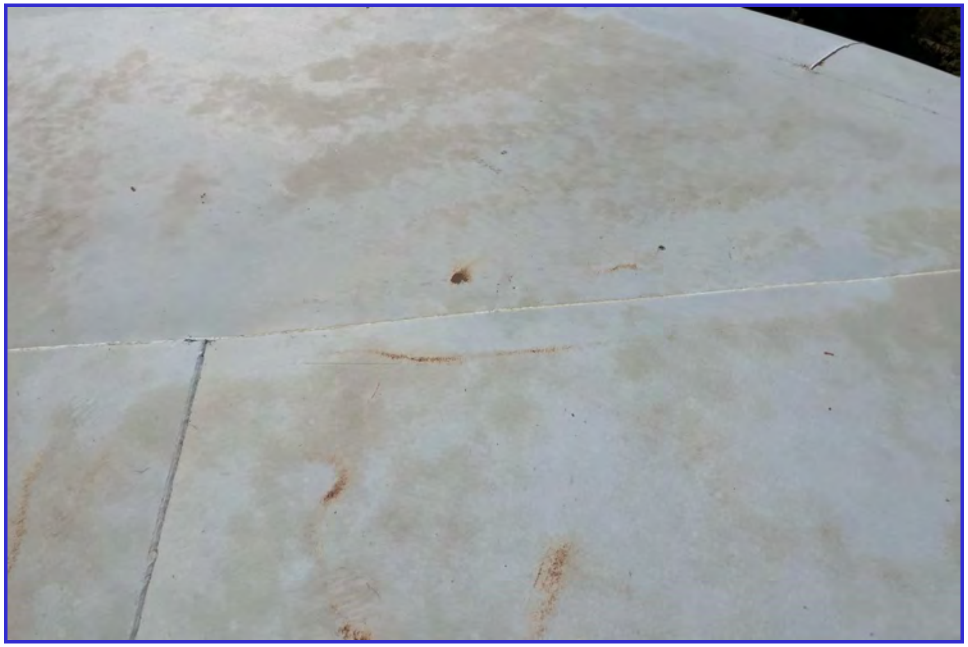
EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -033

EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -034

EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -035

EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -036

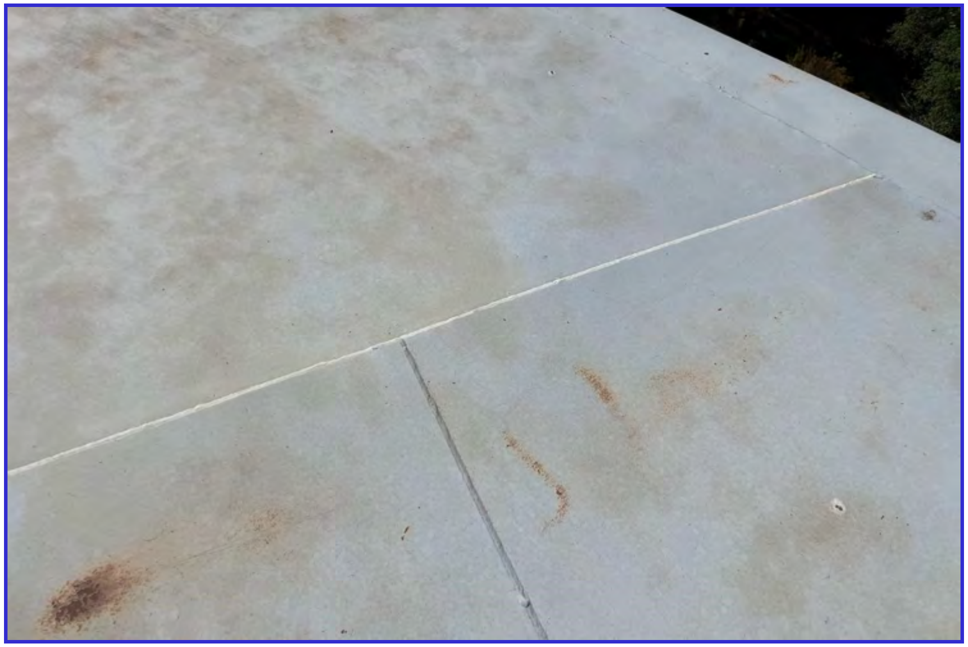
EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -037



EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -038

EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -039

EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -040



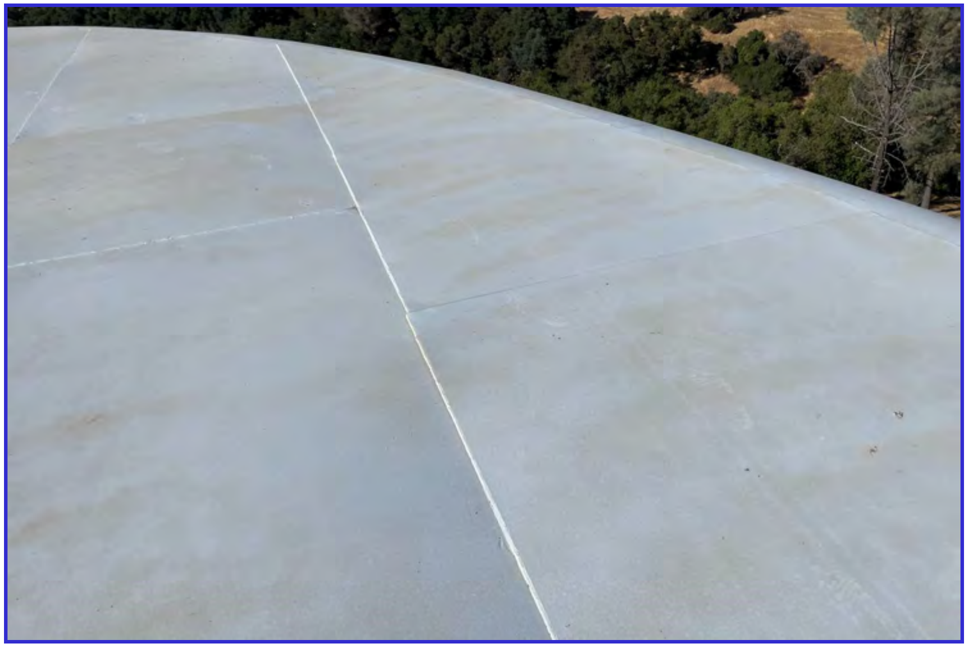
EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -041

EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -042

EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -043

EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -044

EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -045



EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -046

EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -047

EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -048

EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -049

EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -050

EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -051


EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -052


EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -053


EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -054


EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -055


EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -056


EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -057


EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -058


EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -059

EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -060

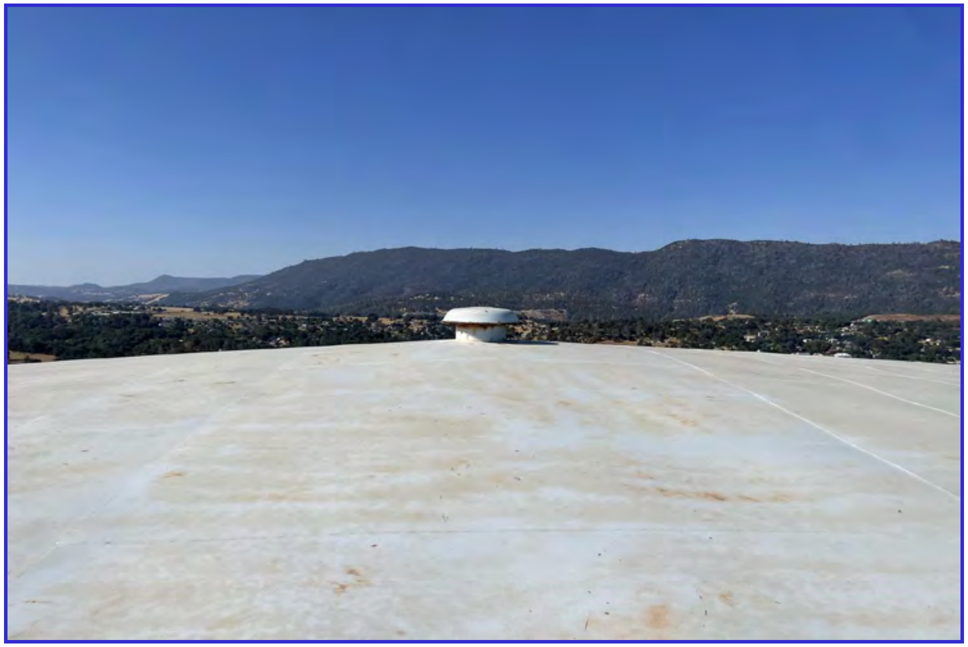
EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -061

EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -062

EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -063

EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -064

EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -065



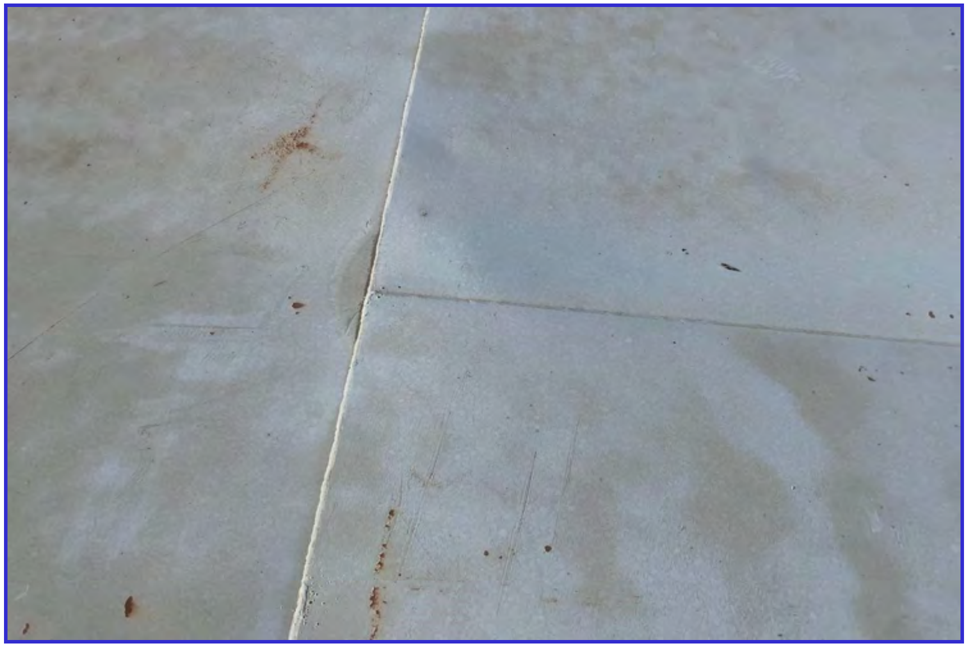
EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -066

EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -067

EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -068

EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -069

EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -070



EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -071

EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -072

EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -073

EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -074

EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -075

EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -076

EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -077

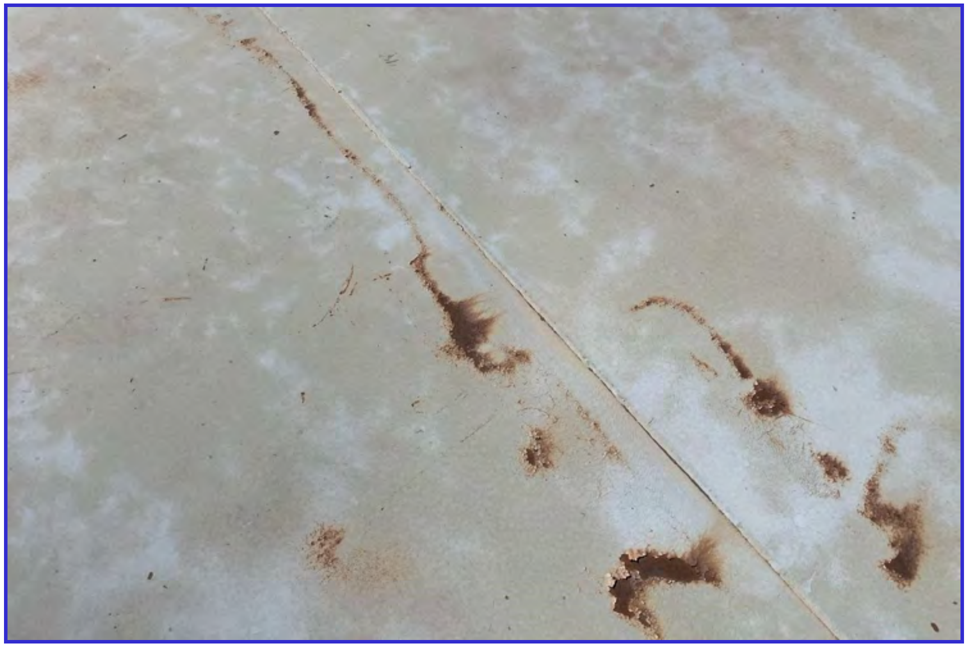
EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -078

EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -079

EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -080

EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -081

EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -082



EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -083

EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -084

EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -085

EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -086

EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -087

EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -088

EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -089

EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -090

EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -091

EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -092

EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -093

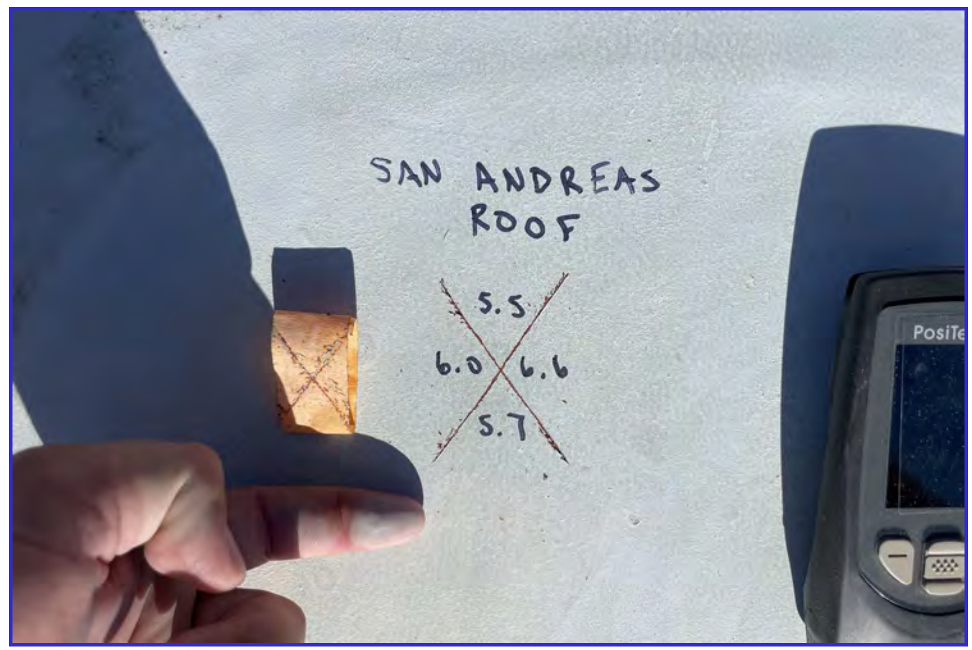
EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -094

EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -095

EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -096

EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -097

EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -098



EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -099

EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -100

EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -101

EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -102

EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -103

EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -104

EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -105

EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -106

EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -107

EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -108

EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -109

EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -110

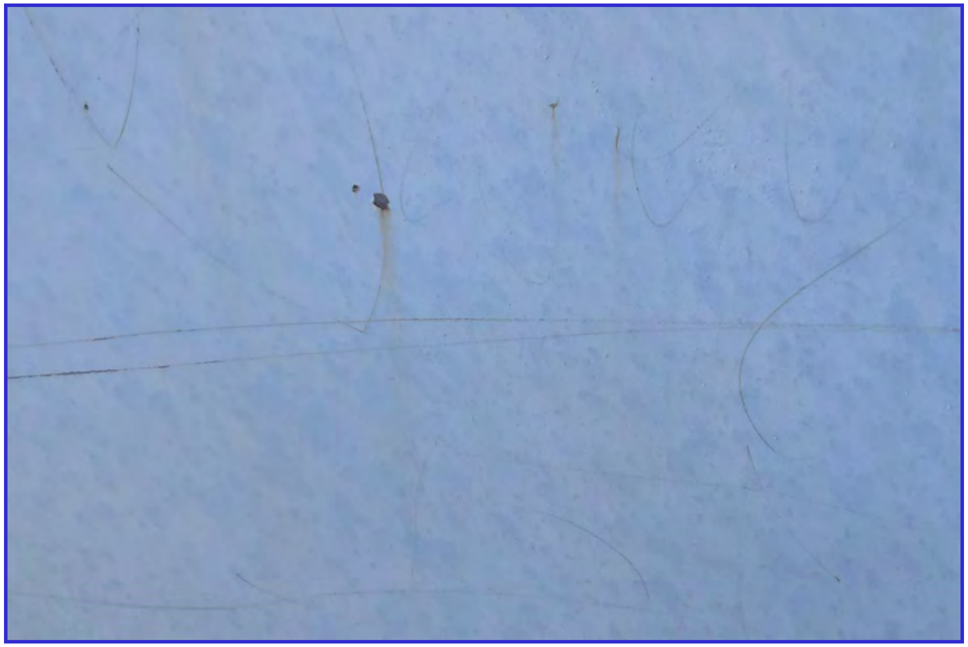
EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -111

EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -112

EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -113

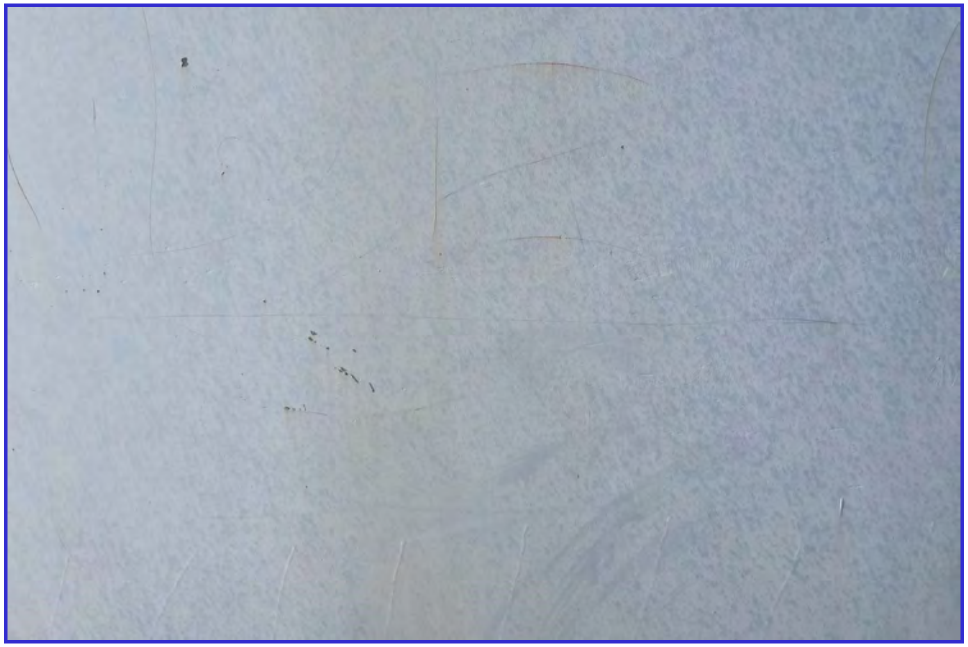
EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -114

EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -115

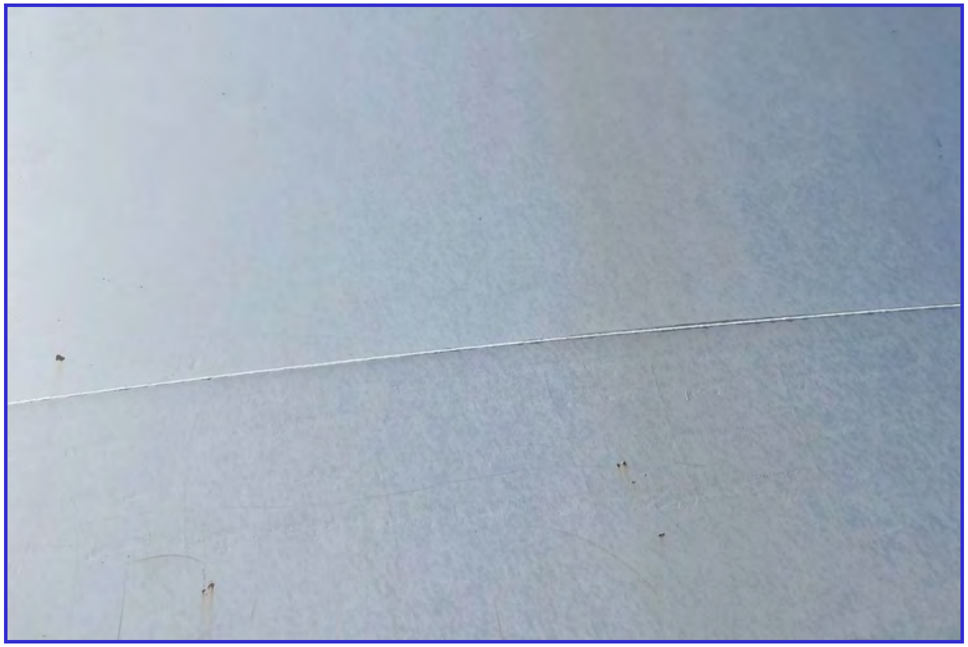


EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -116

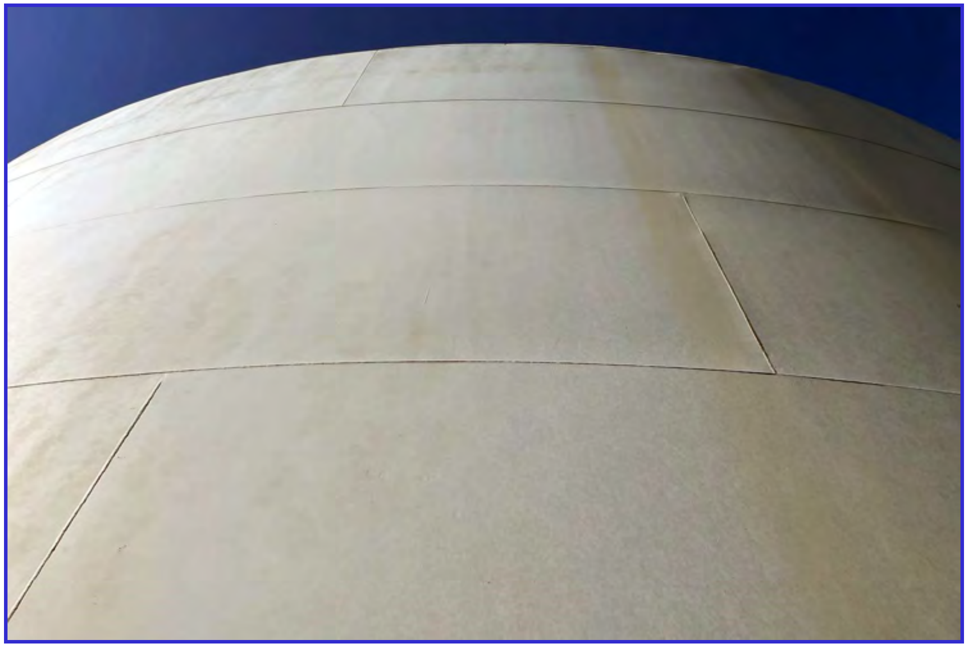
EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -117



EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -118



EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -119

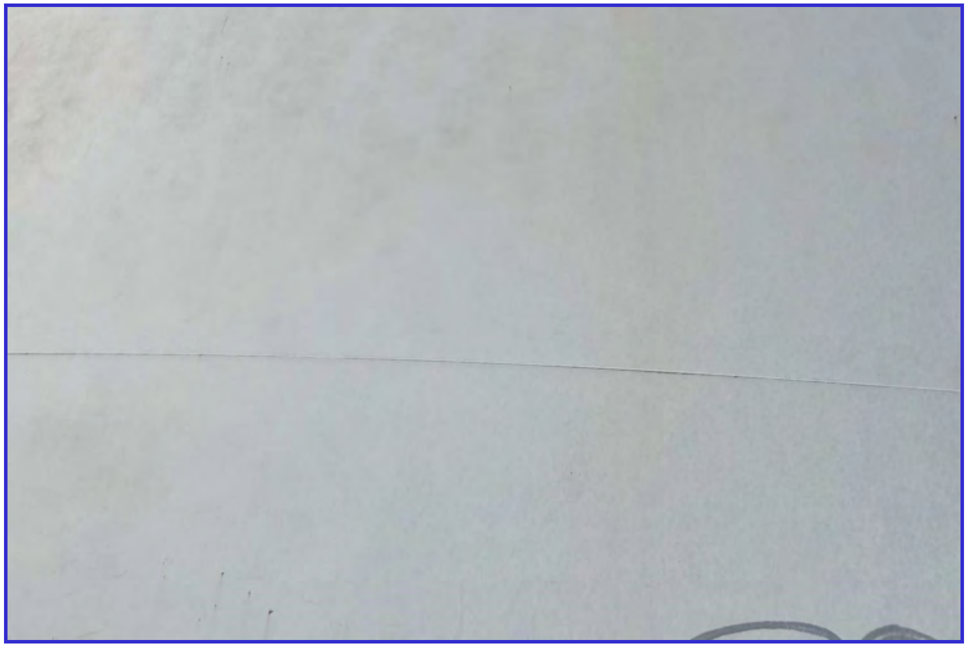


EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -120

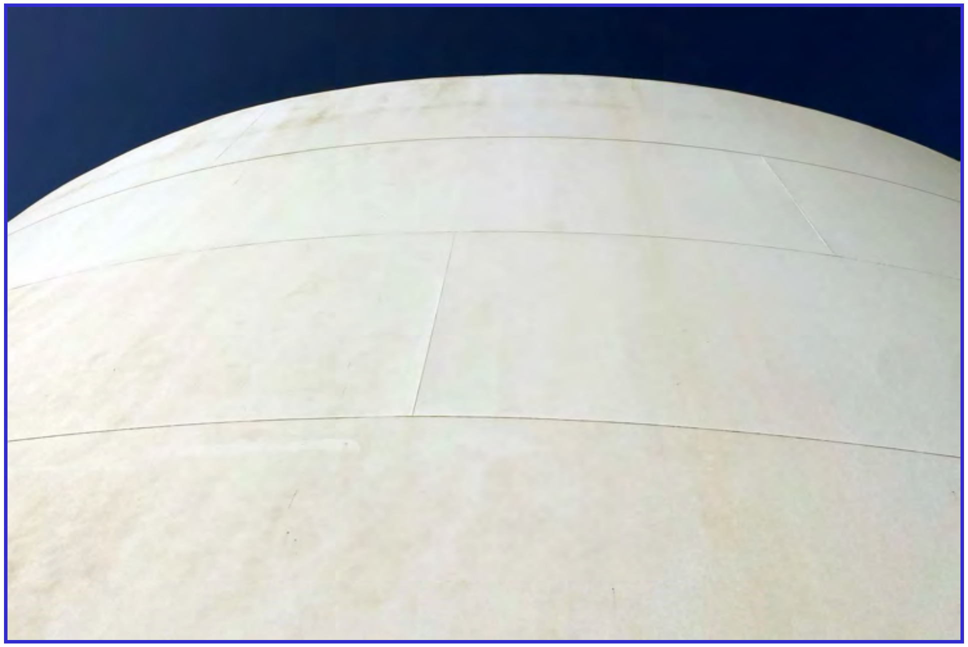
EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -121

EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -122

EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -123



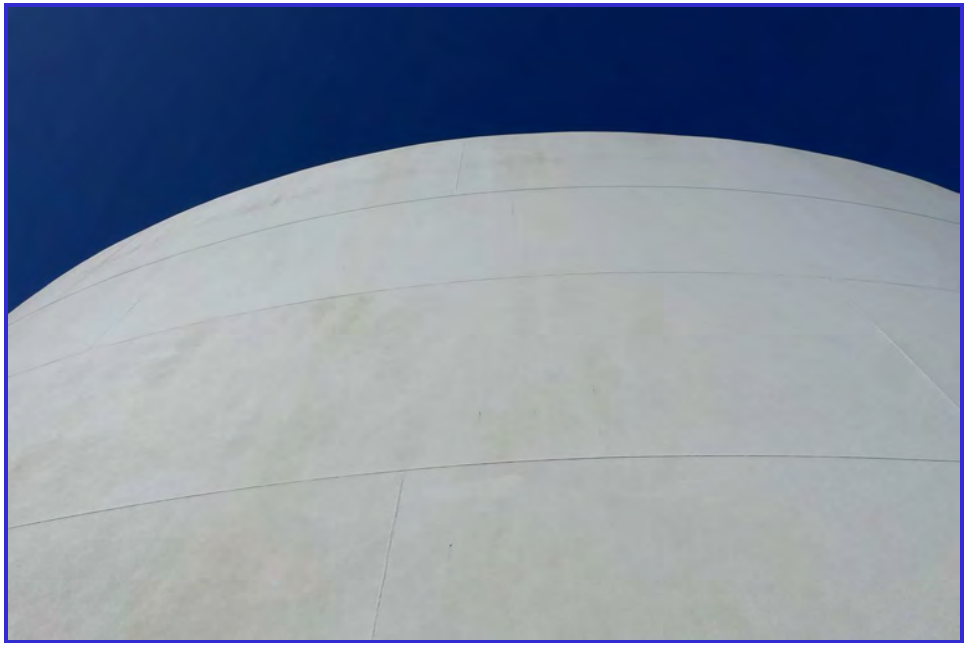
EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -124



EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -125

EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -126

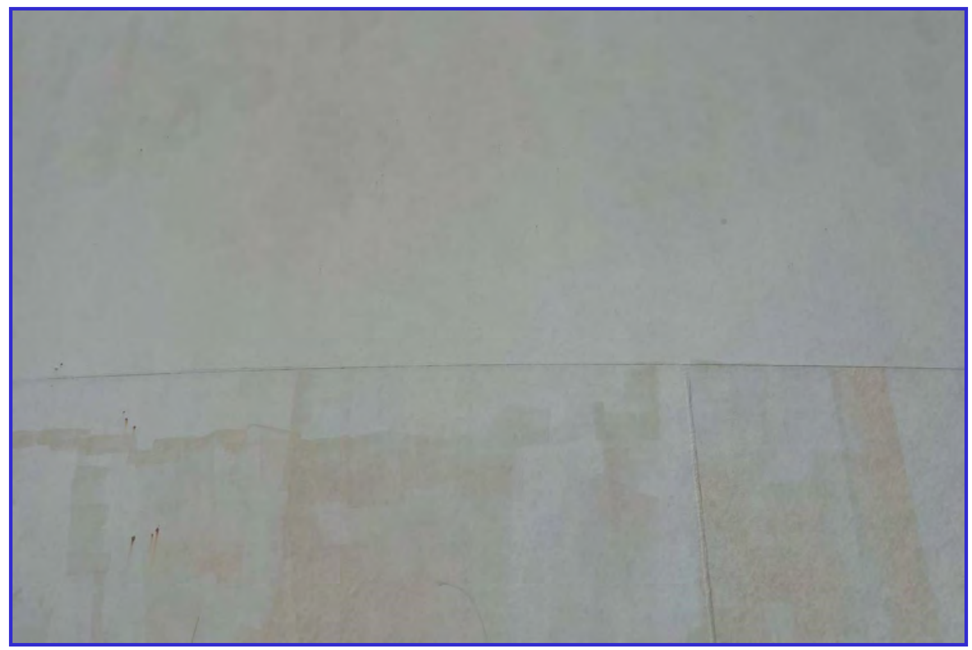
EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -127



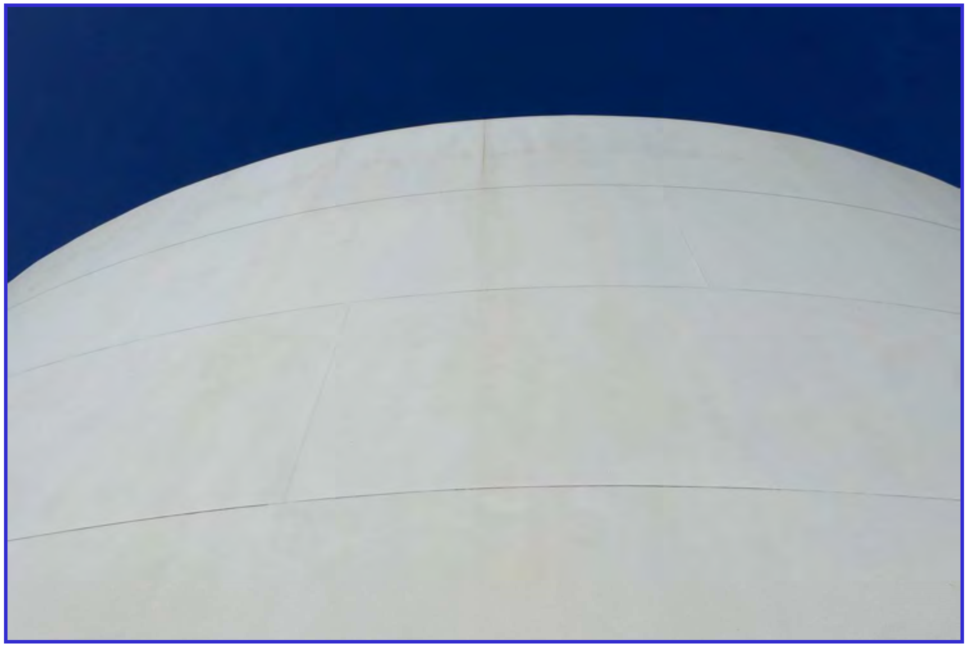
EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -128

EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -129

EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -130



EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -131



EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -132

EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -133

EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -134

EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -135

EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -136

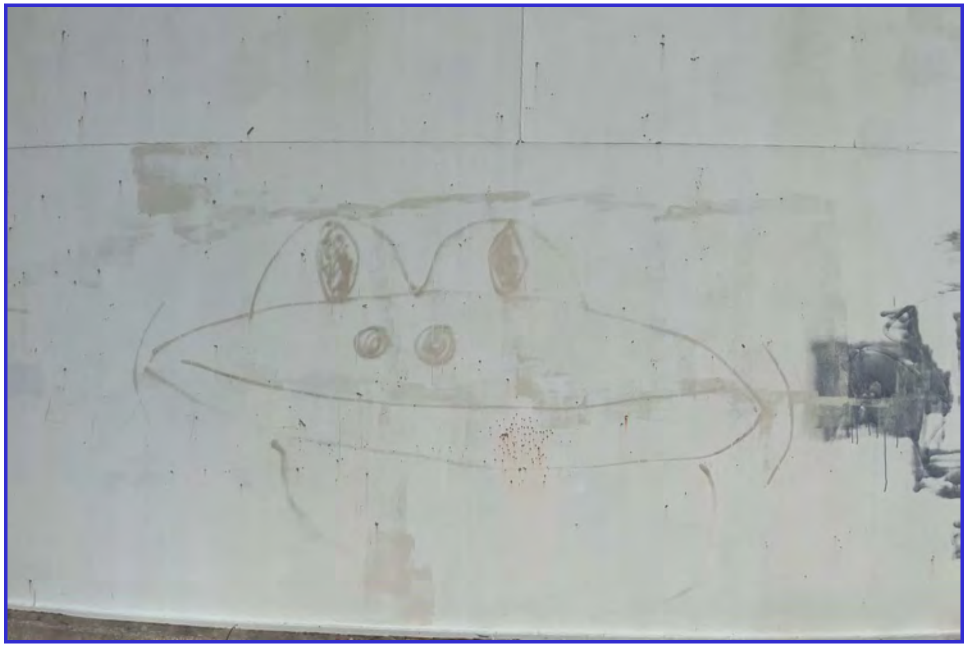
EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -137

EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -138

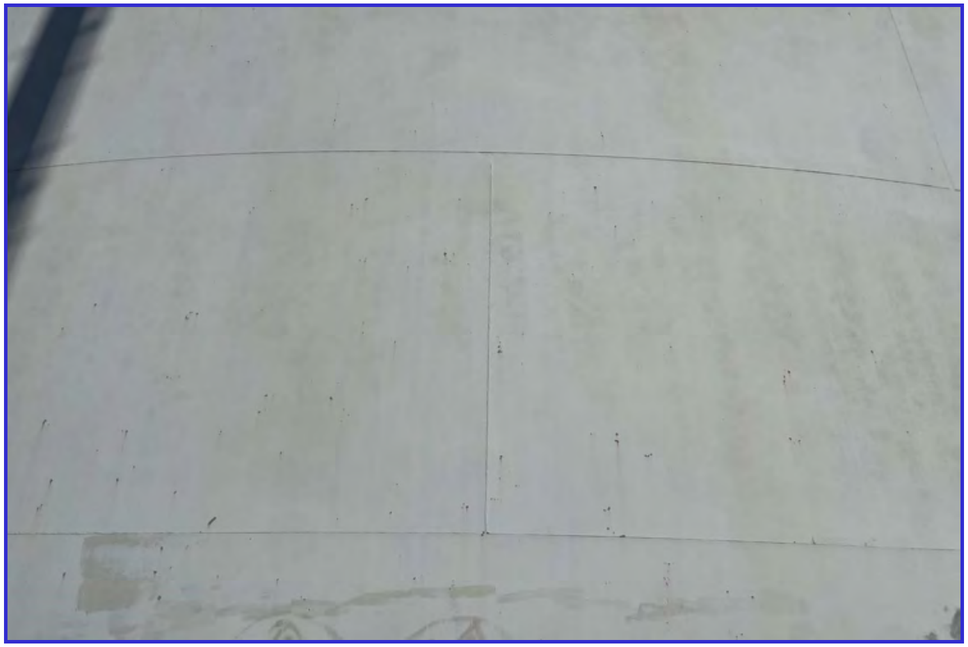
EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -139

EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -140

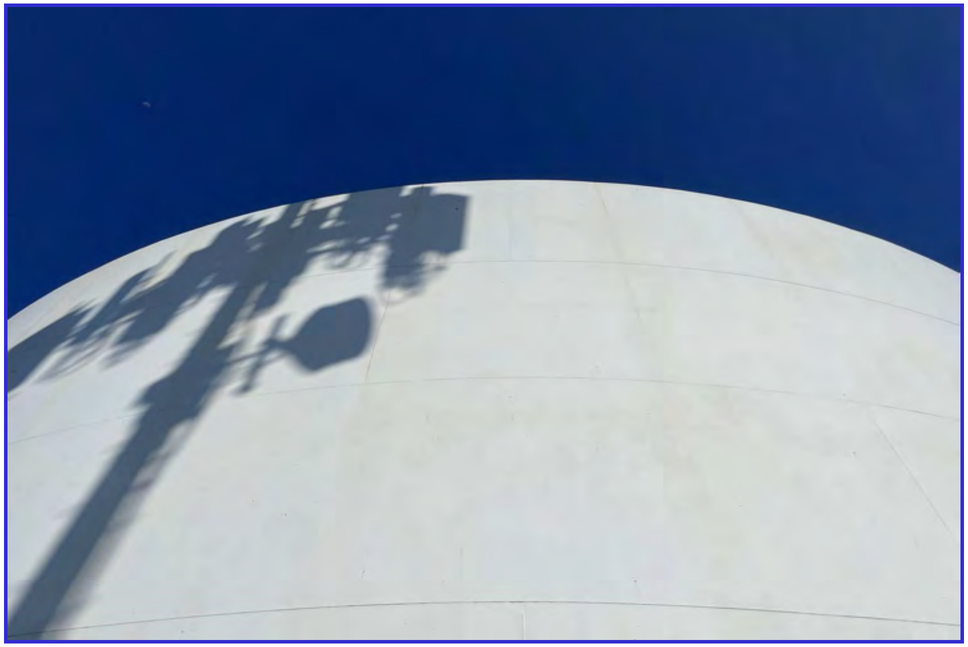
EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -141



EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -142



EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -143

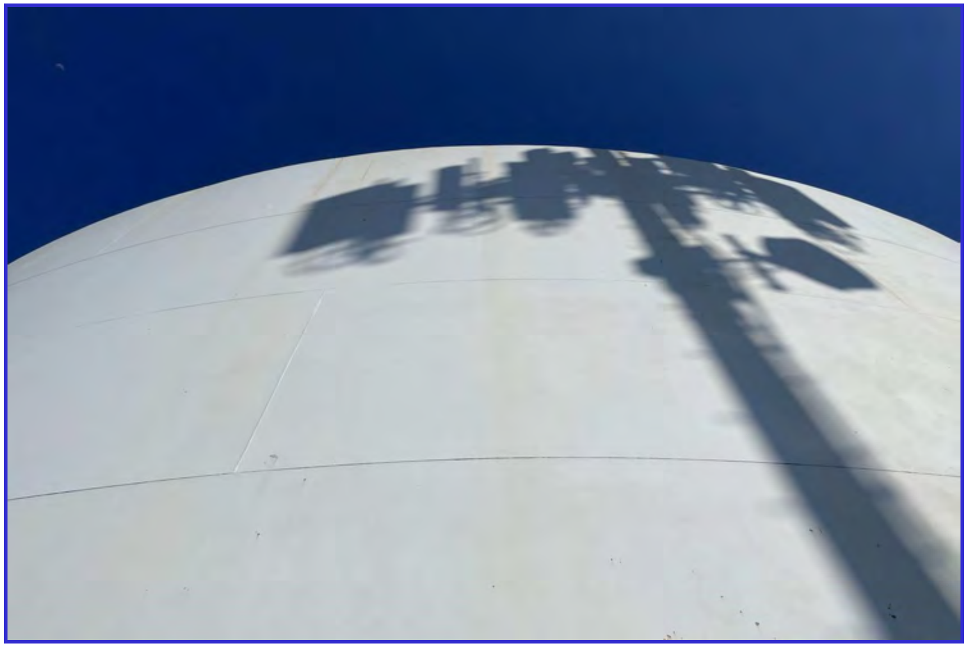


EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -144

EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -145

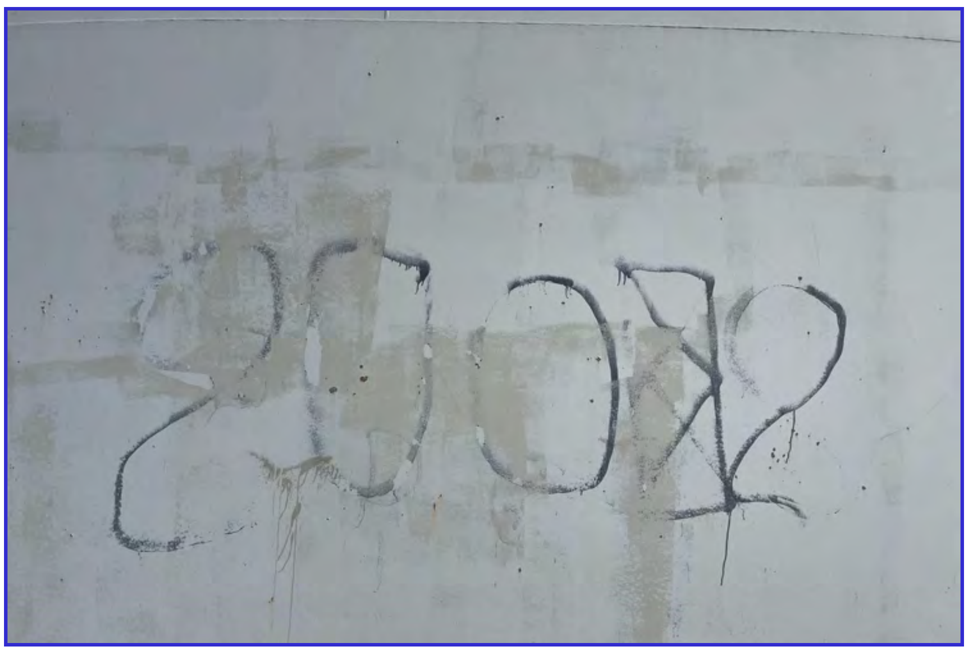
EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -146

EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -147



EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -148

EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -149



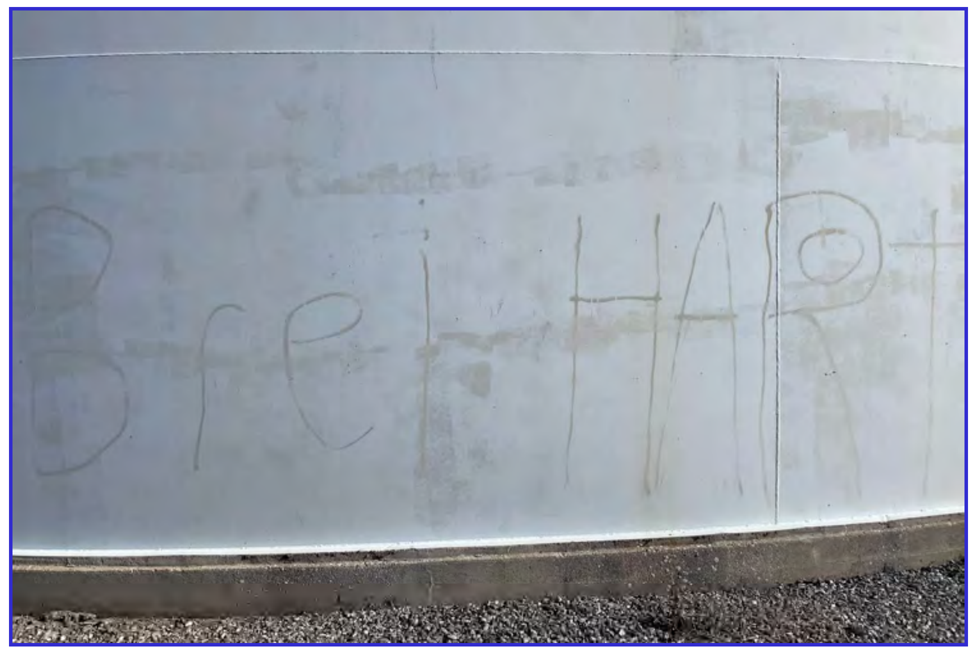
EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -150

EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -151

EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -152

EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -153

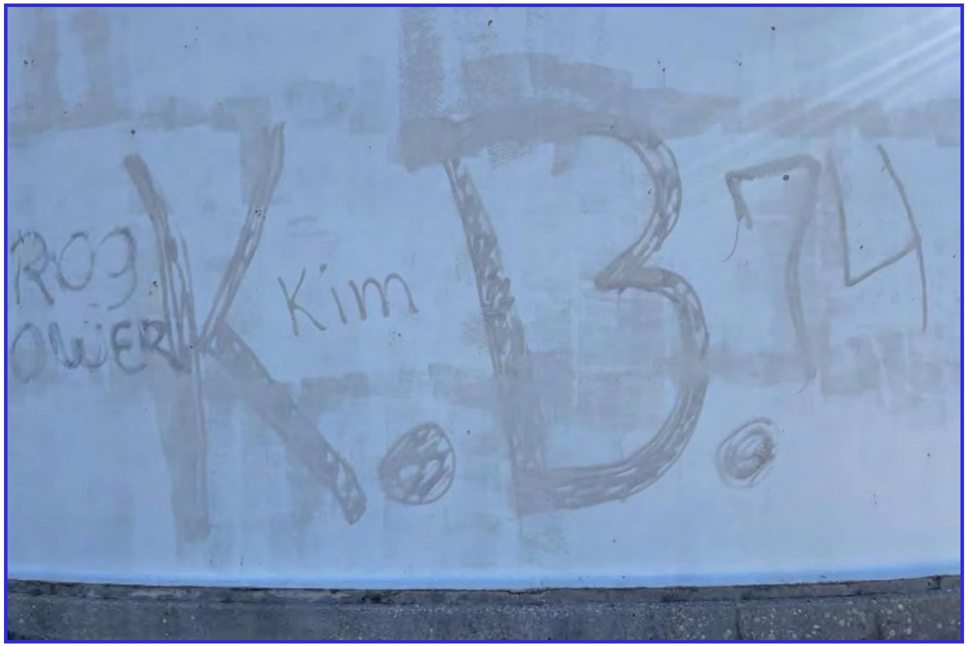
EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -154



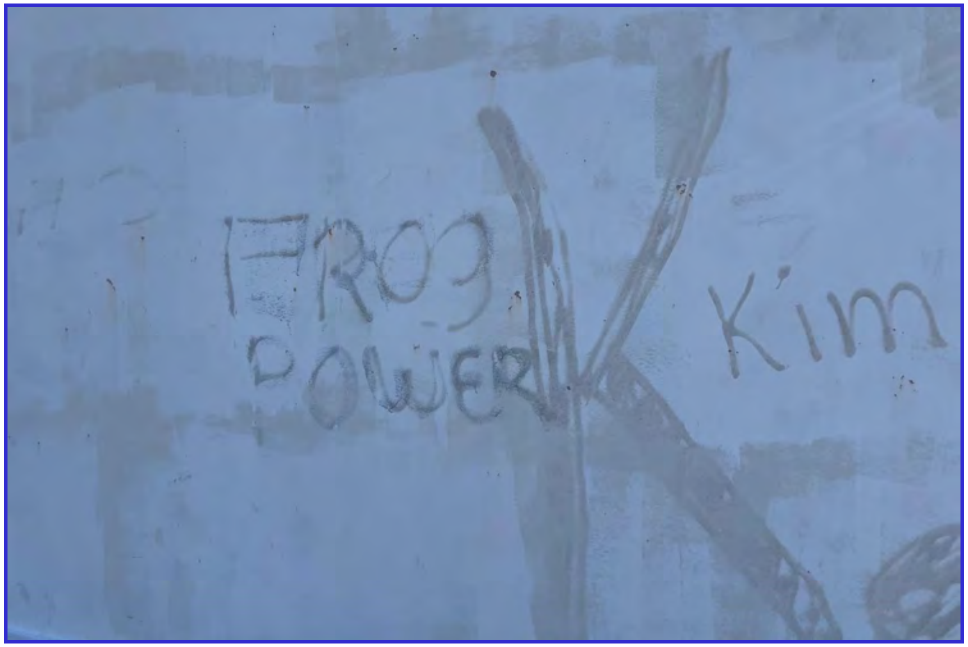
EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -155

EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -156

EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -157



EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -158



EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -159


EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -160


EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -161


EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -162


EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -163

EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -164

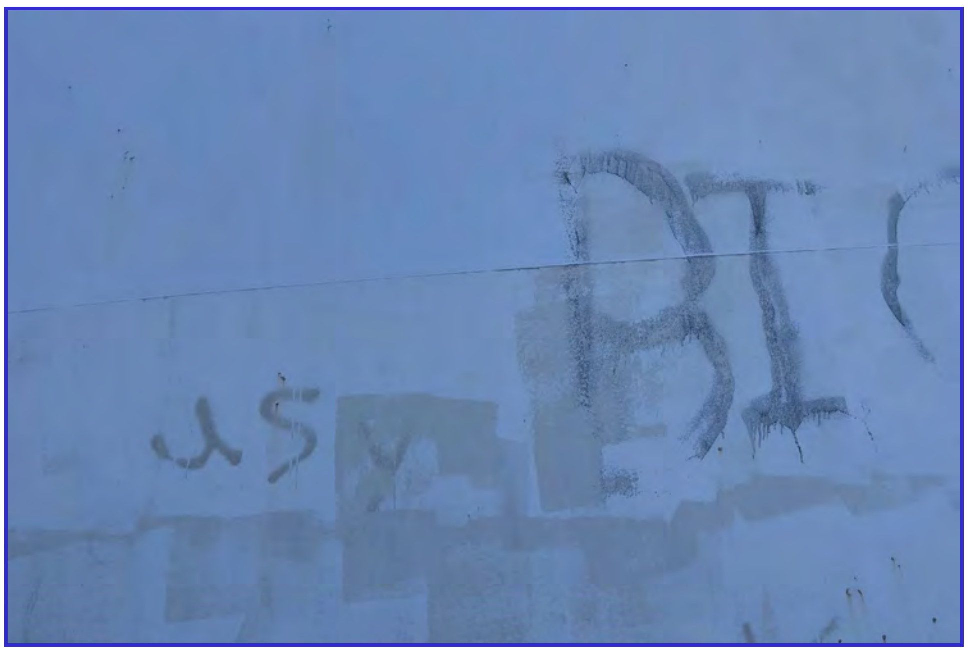
EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -165

EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -166

EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -167

EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -168

EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -169



EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -170

EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -171

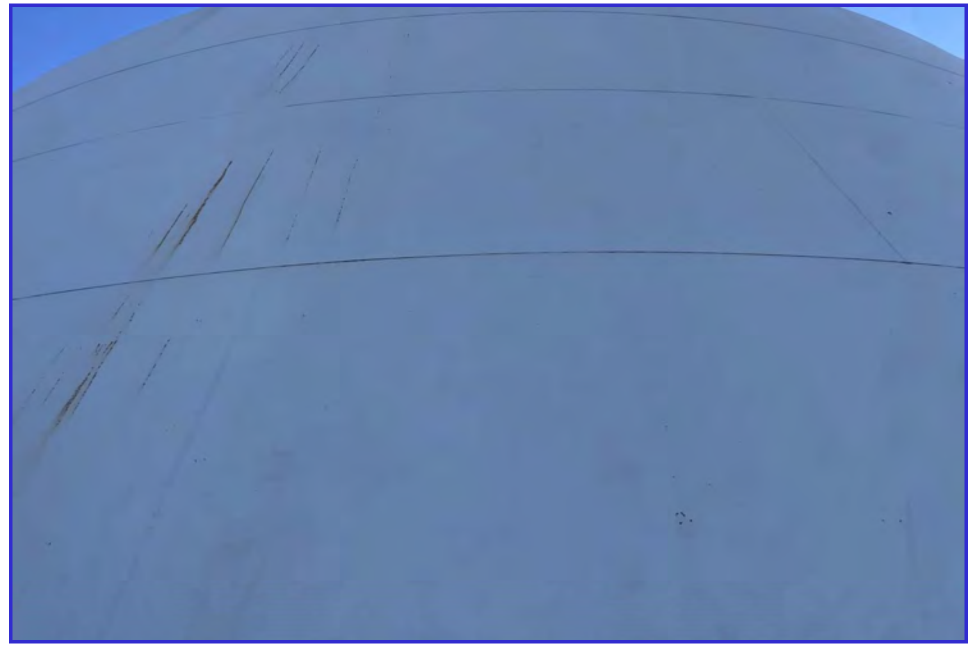
EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -172

EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -173

EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -174

EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -175

EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -176



EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -177

EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -178

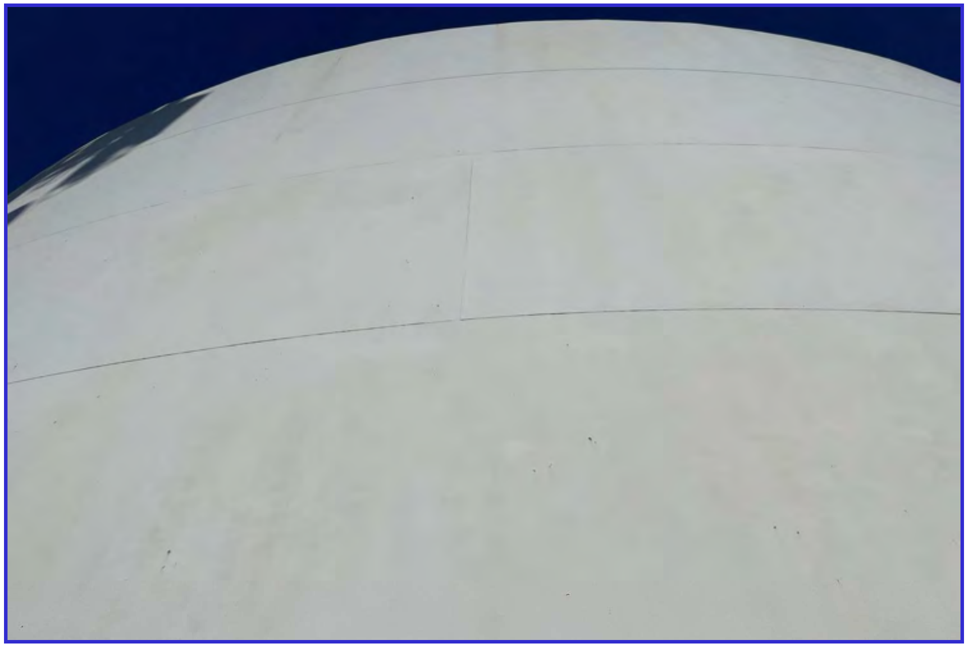
EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -179

EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -180

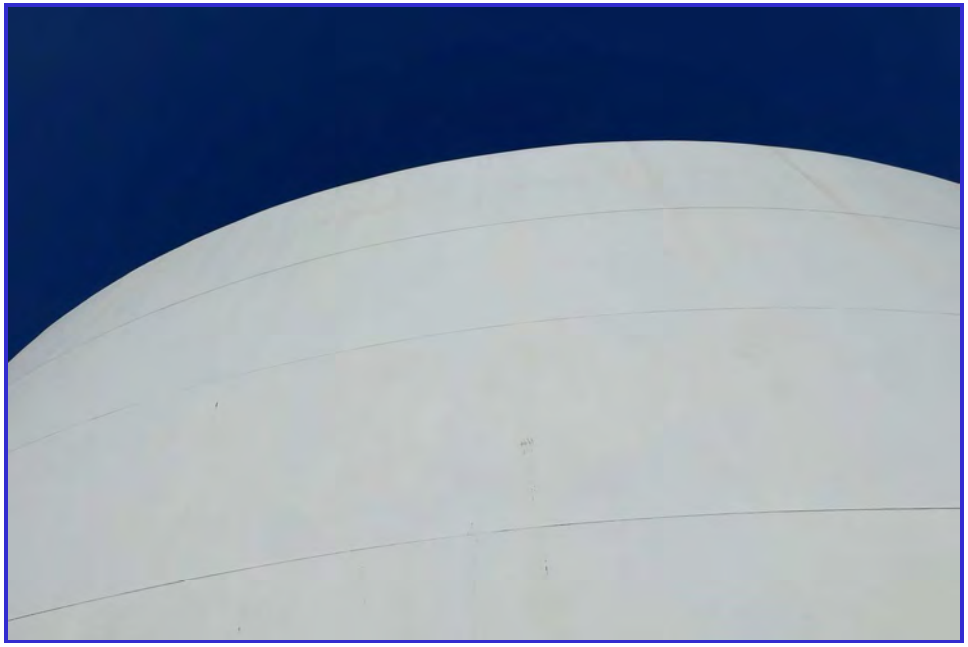
EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -181

EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -182

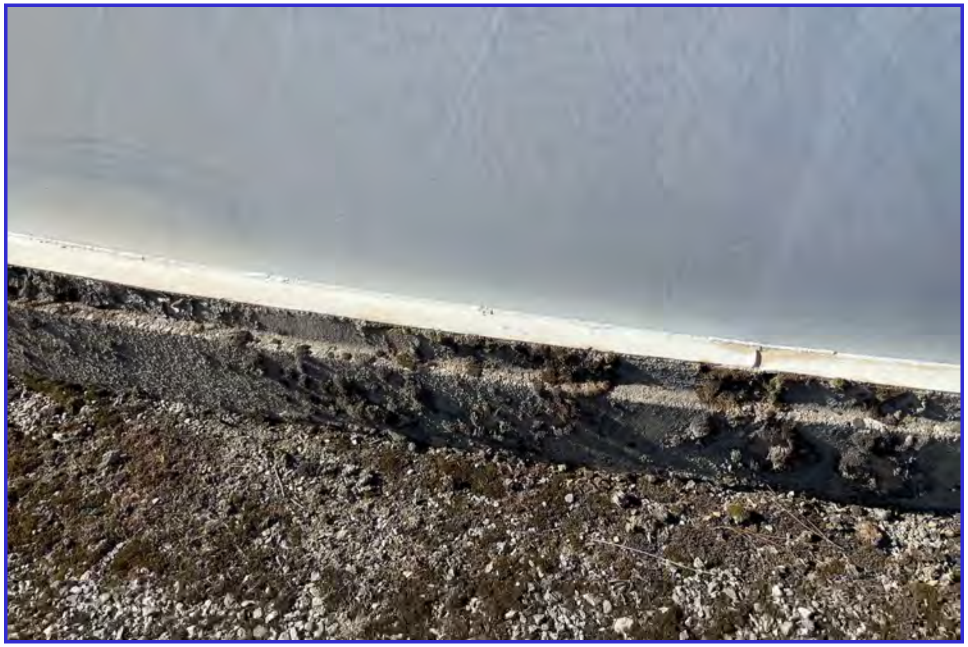
EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -183



EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -184



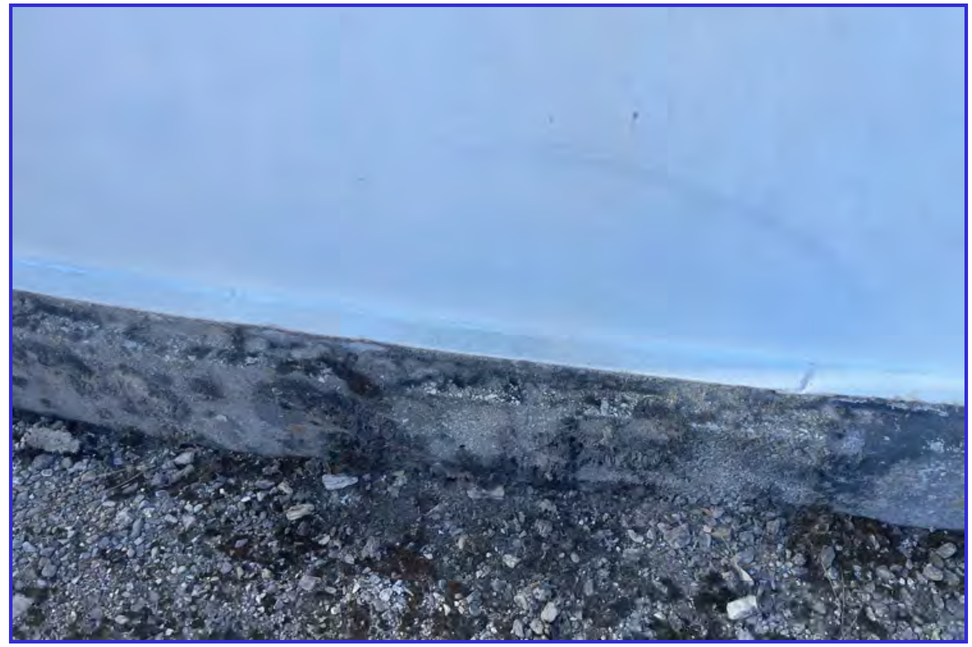
EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -185



EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -186

EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -187

EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -188



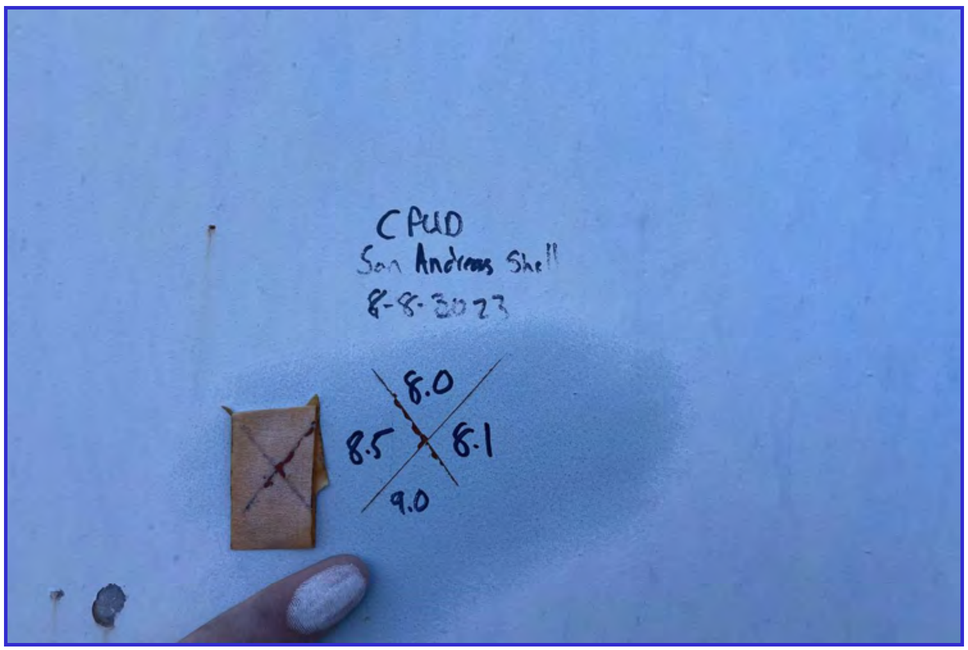
EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -189

EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -190

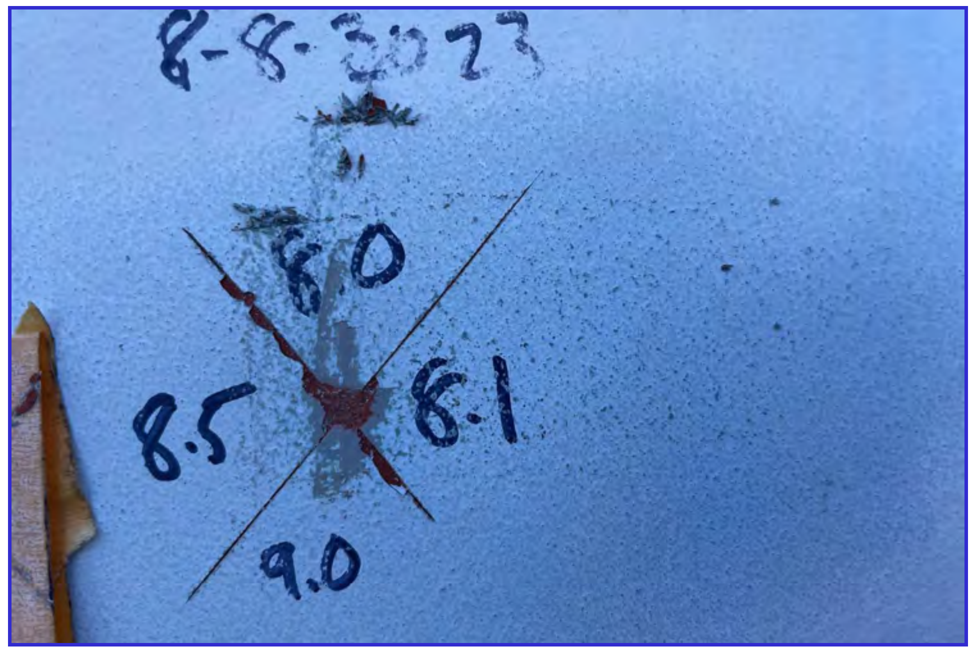
EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -191

EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -192

EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -193



EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -194



EXTERIOR - CPUD - San Andreas Reservoir - Maintenance Inspection -195


INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection


INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -001


INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -002


INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -003

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -004

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -005

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -006

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -007

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -008

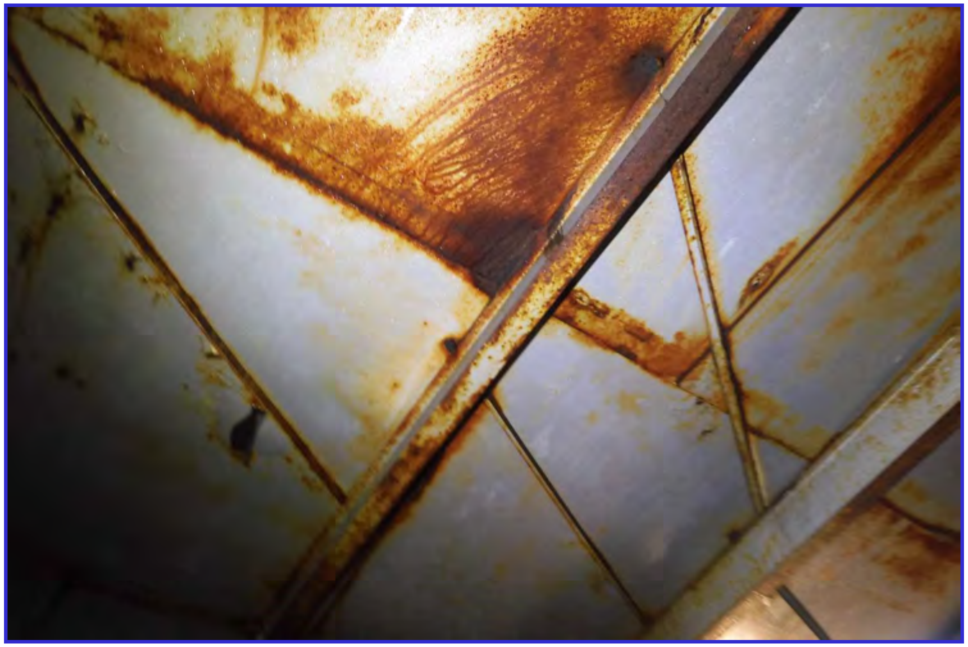
INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -009

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -010

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -011

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -012

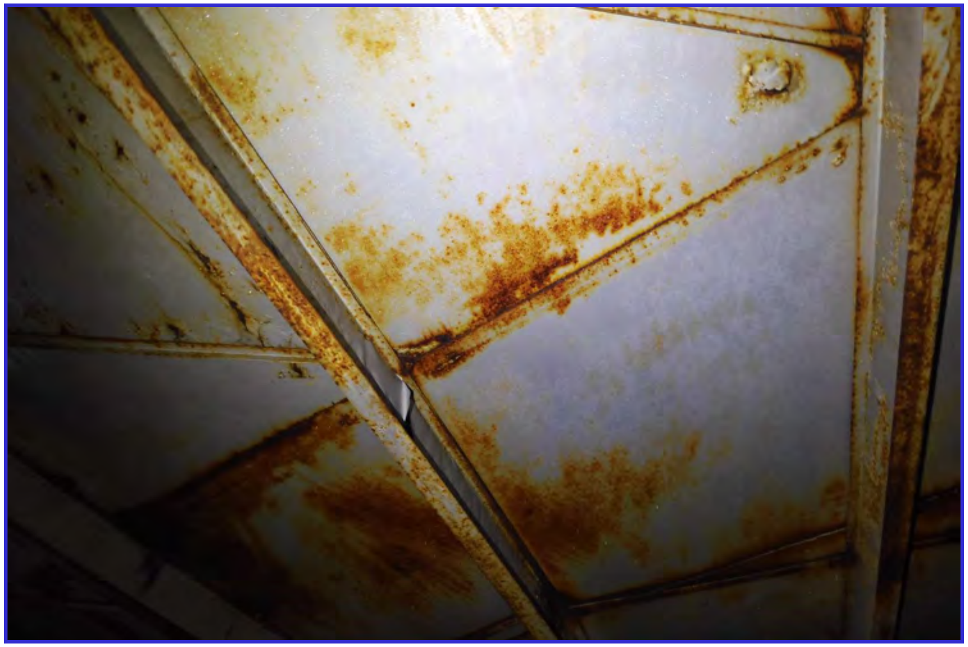
INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -013



INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -014

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -015

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -016



INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -017

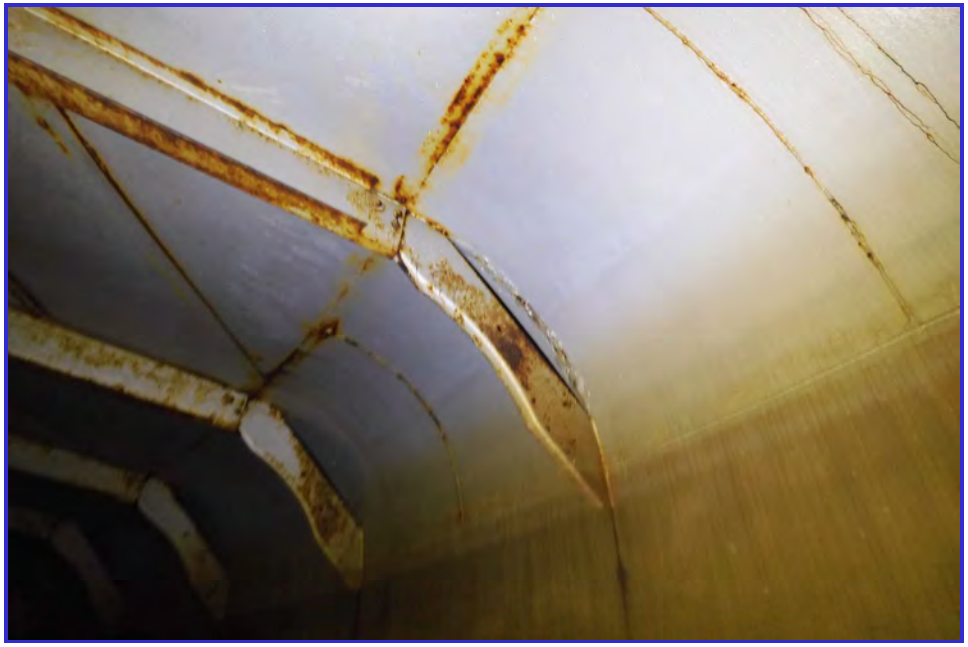
INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -018

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -019

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -020

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -021

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -022



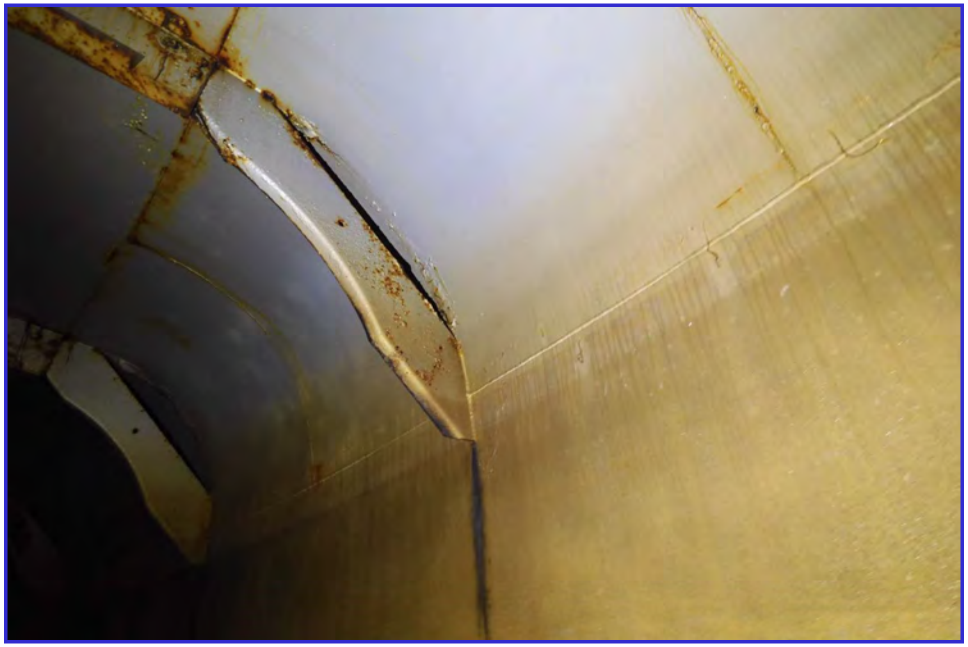
INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -023

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -024

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -025

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -026

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -027

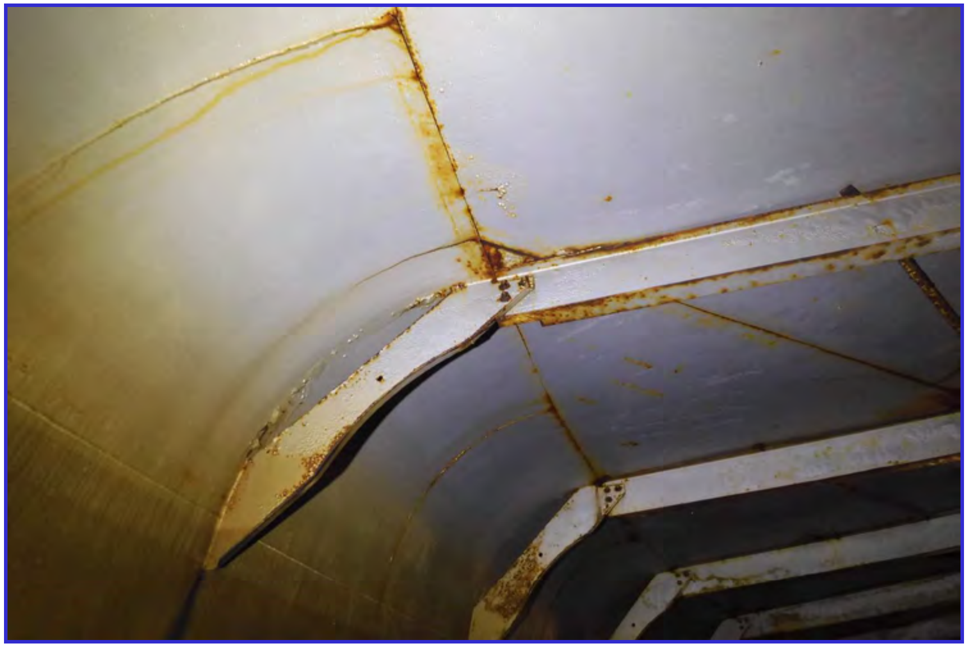


INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -028

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -029

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -030

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -031



INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -032

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -033

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -034

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -035

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -036

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -037

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -038

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -039

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -040

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -041

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -042

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -043

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -044

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -045

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -046

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -047

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -048

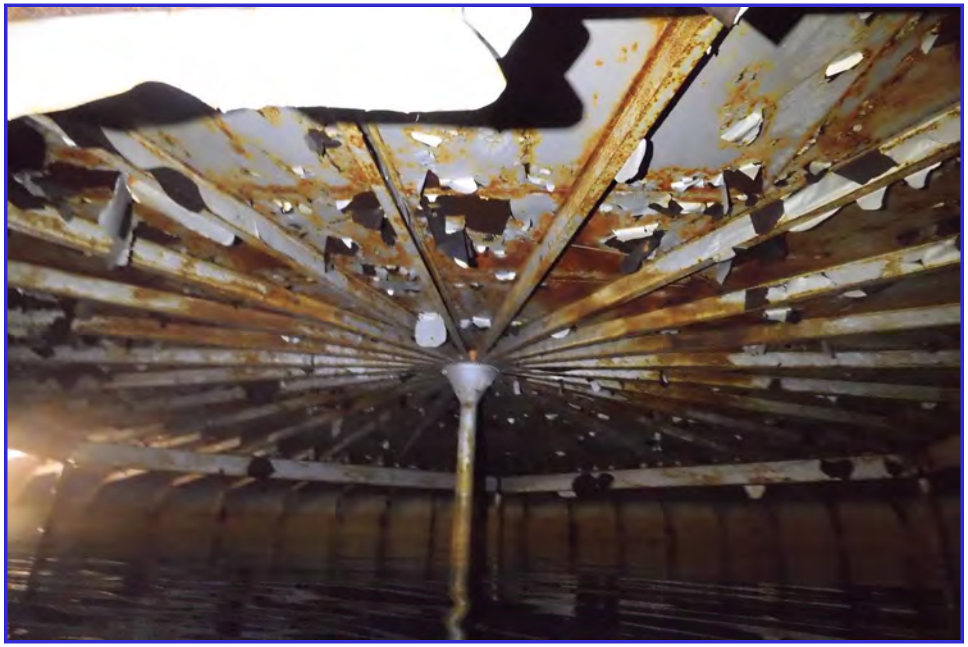
INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -049

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -050

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -051

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -052

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -053



INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -054

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -055

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -056

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -057

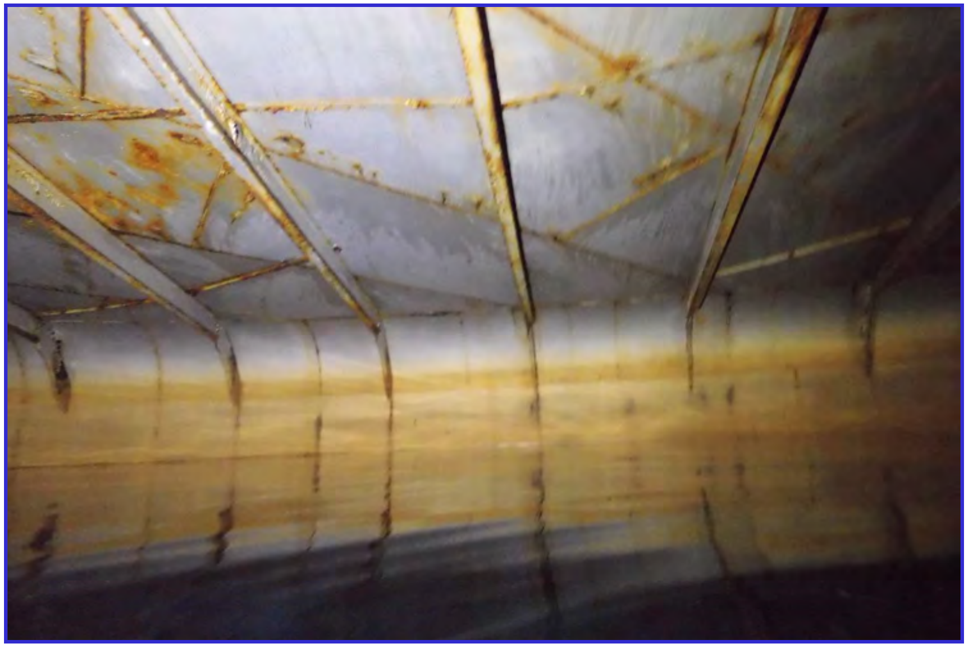
INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -058

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -059

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -060

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -061

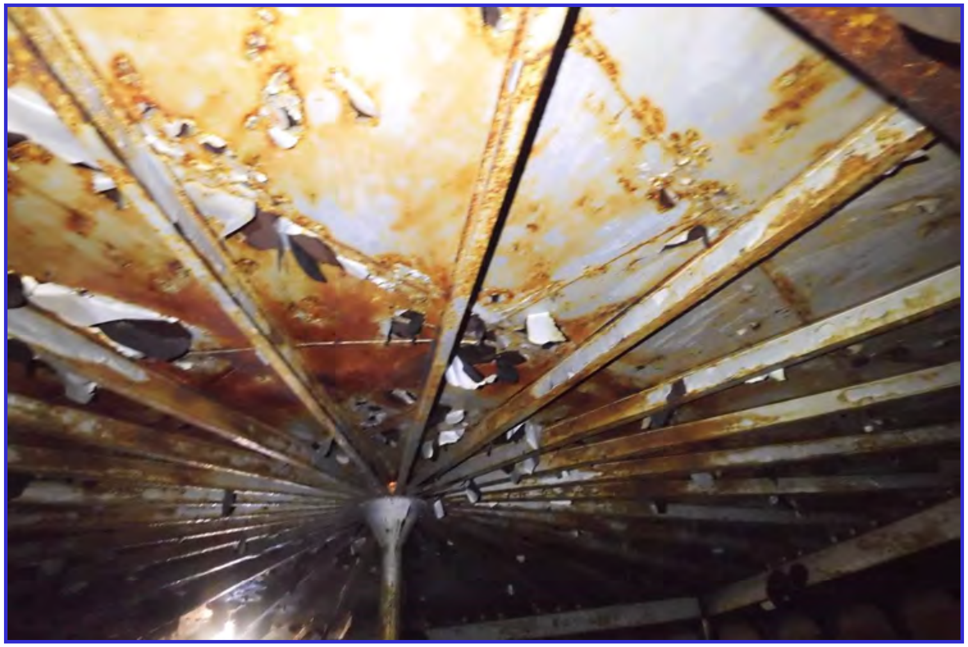
INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -062



INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -063

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -064

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -065



INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -066

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -067

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -068

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -069

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -070

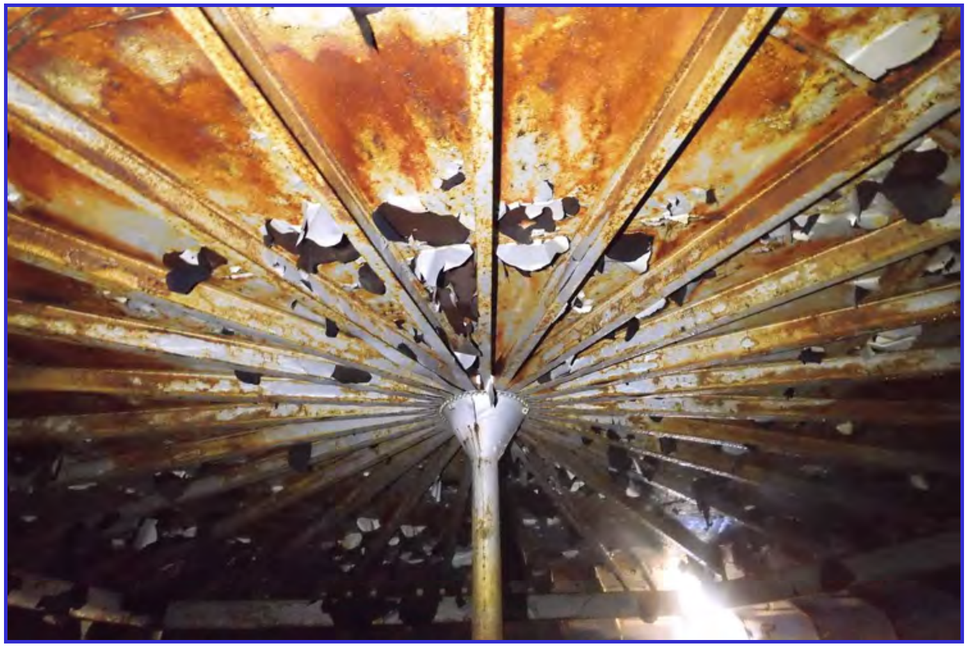
INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -071

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -072

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -073

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -074

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -075



INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -076

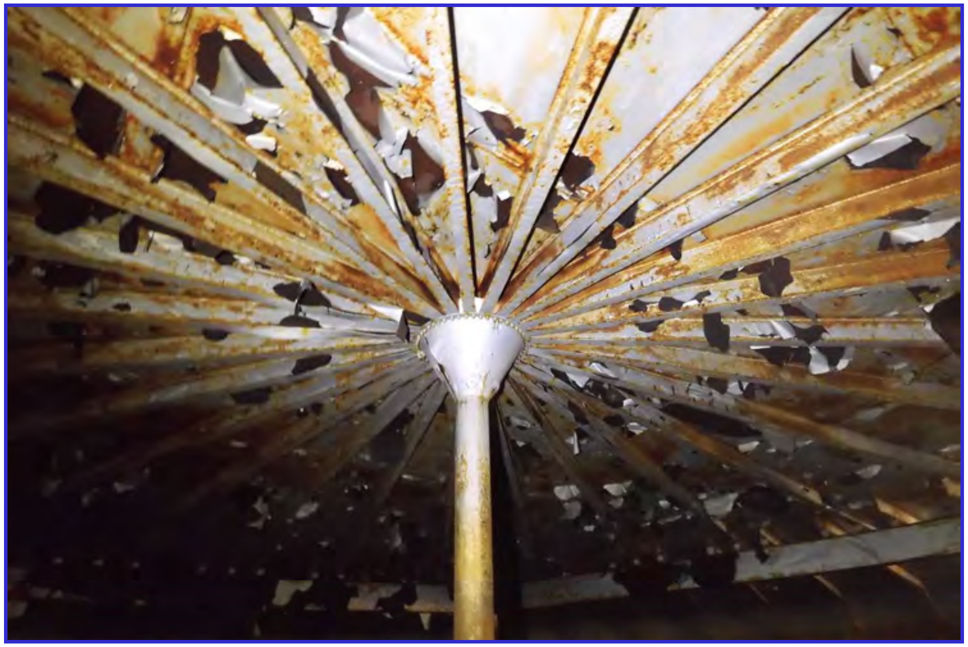
INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -077

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -078

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -079

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -080

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -081



INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -082

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -083

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -084

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -085

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -086

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -087

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -088

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -089

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -090

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -091

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -092

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -093

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -094

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -095

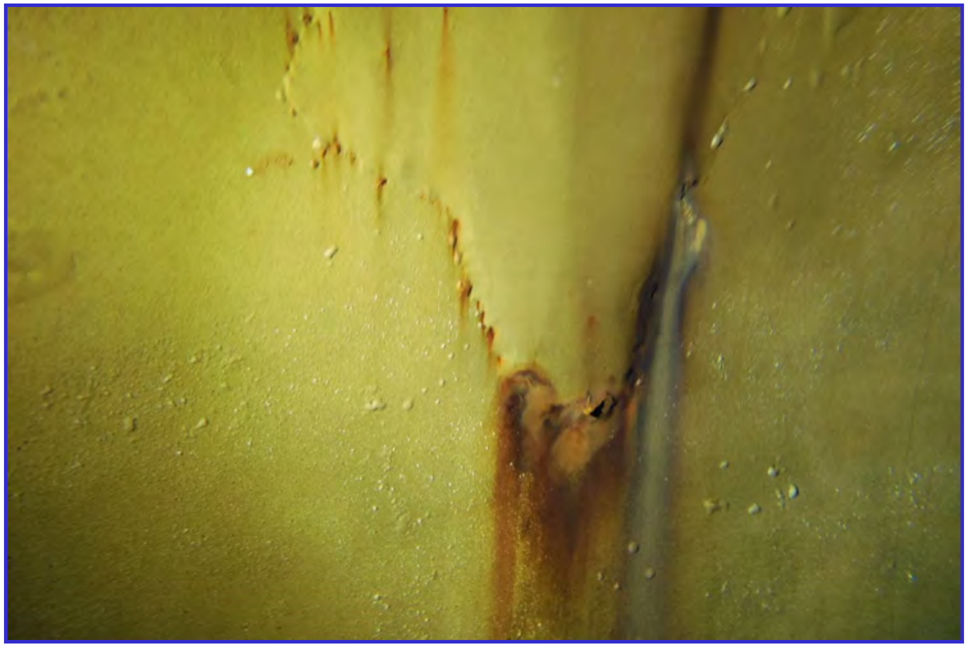
INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -096

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -097

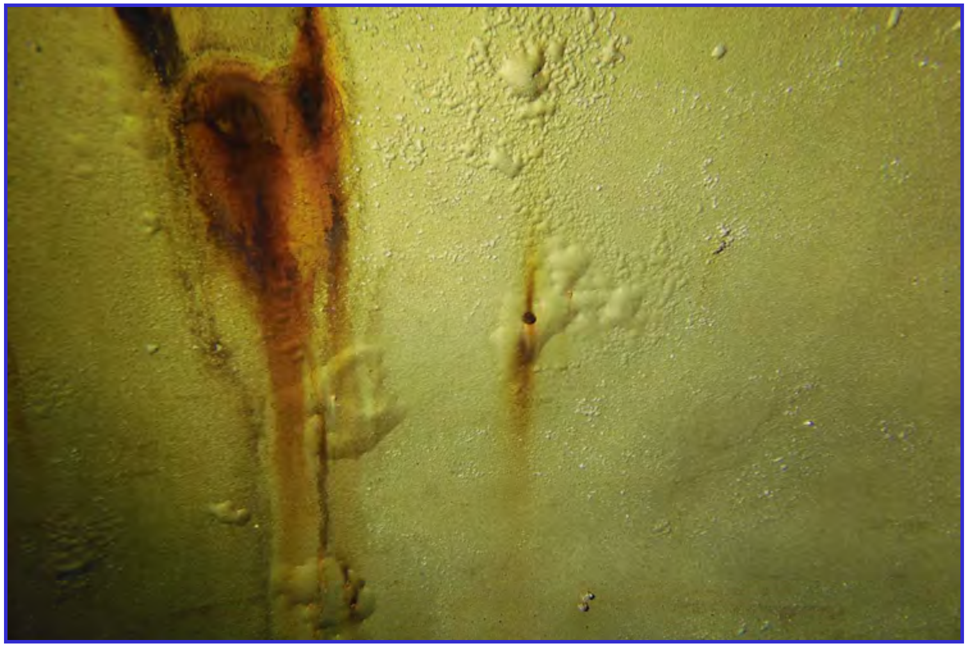
INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -098

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -099

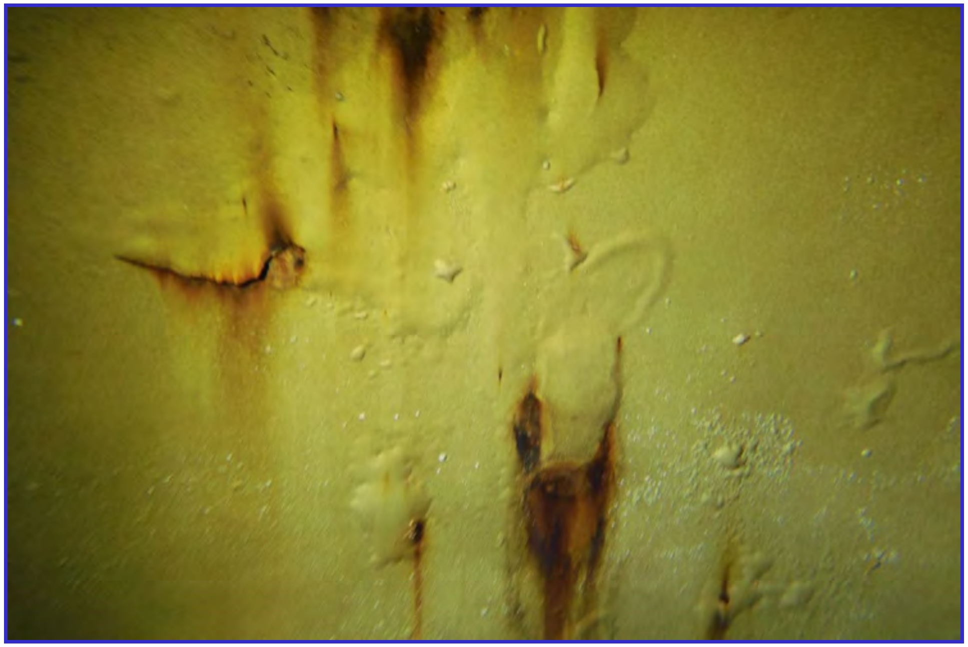
INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -100



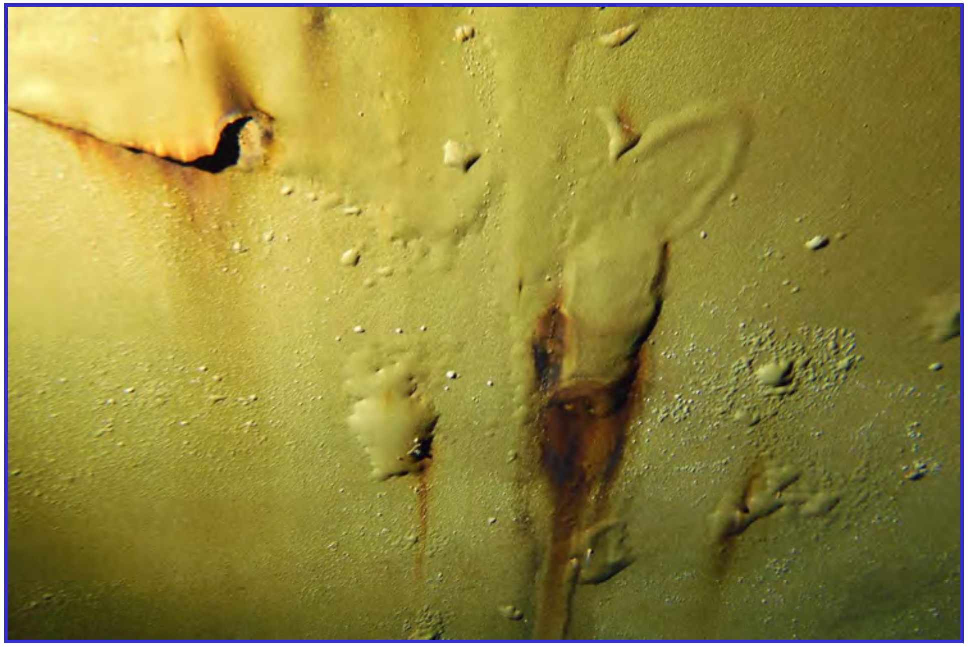
INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -101



INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -102



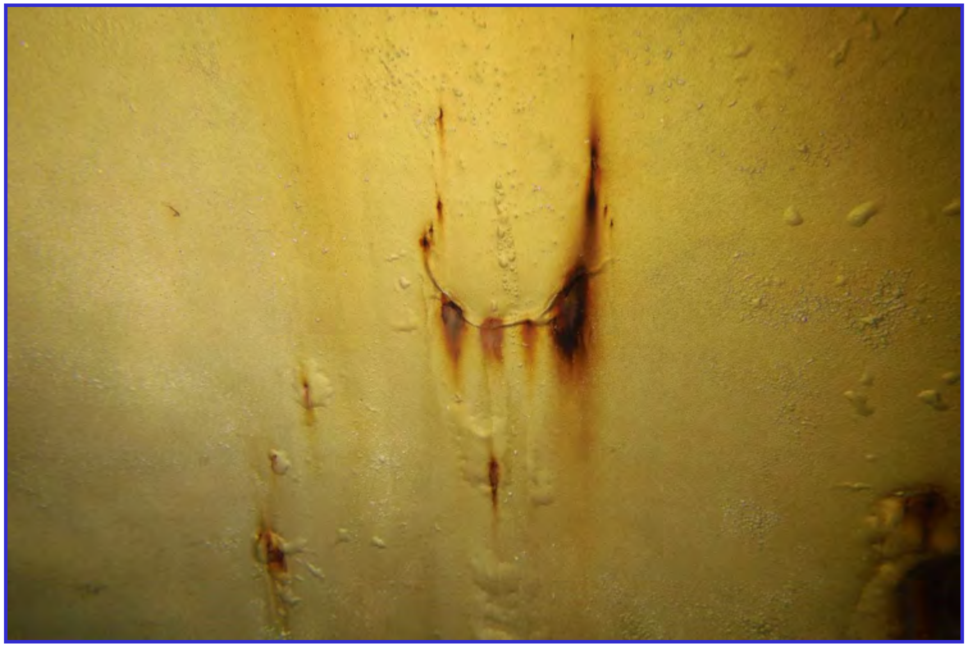
INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -103



INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -104

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -105

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -106



INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -107

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -108

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -109

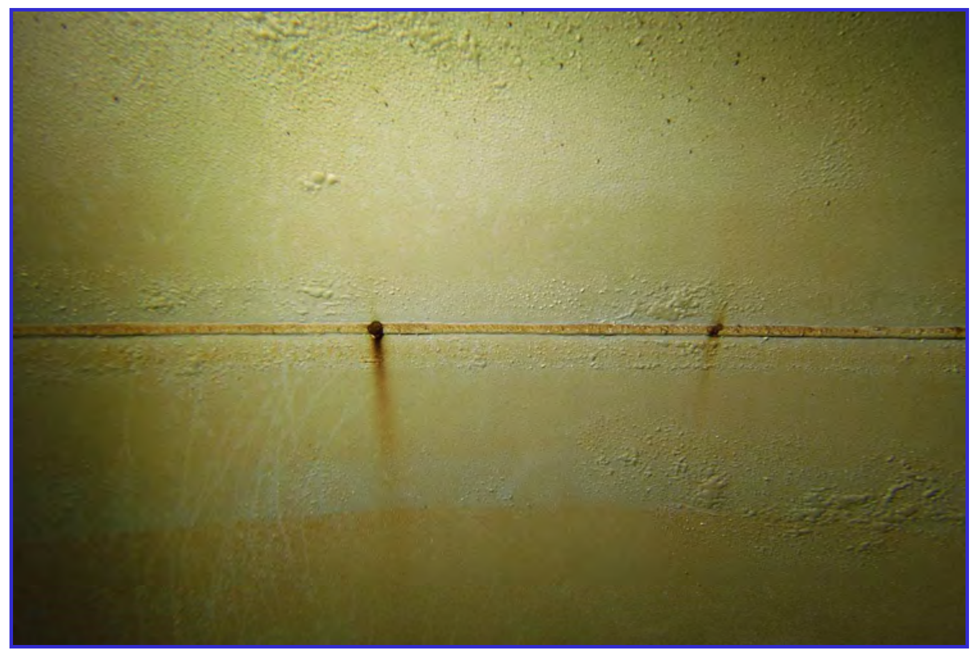
INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -110

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -111

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -112

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -113

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -114



INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -115

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -116

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -117

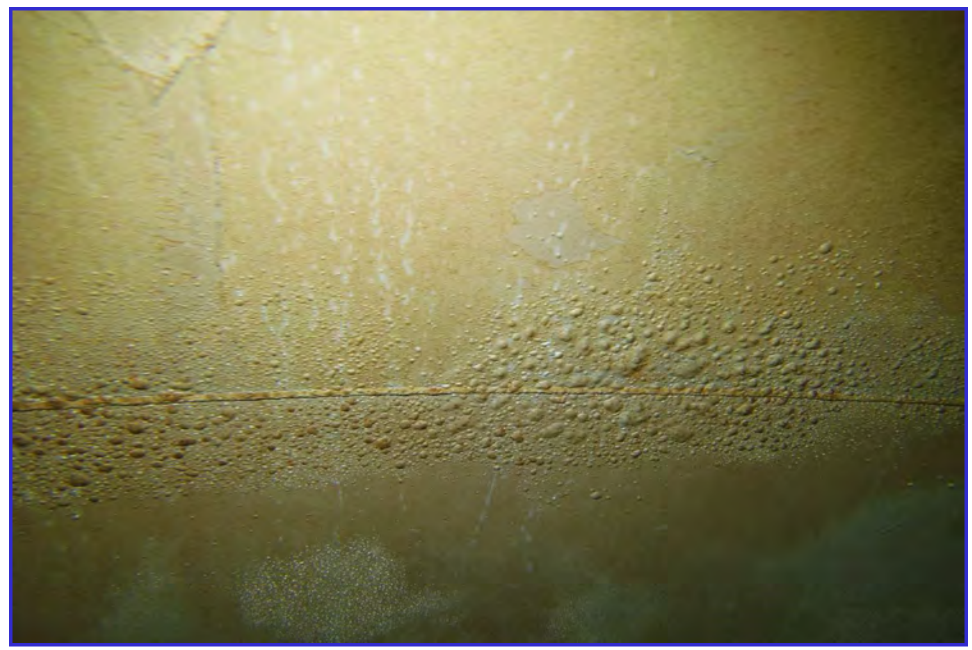
INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -118

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -119

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -120

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -121

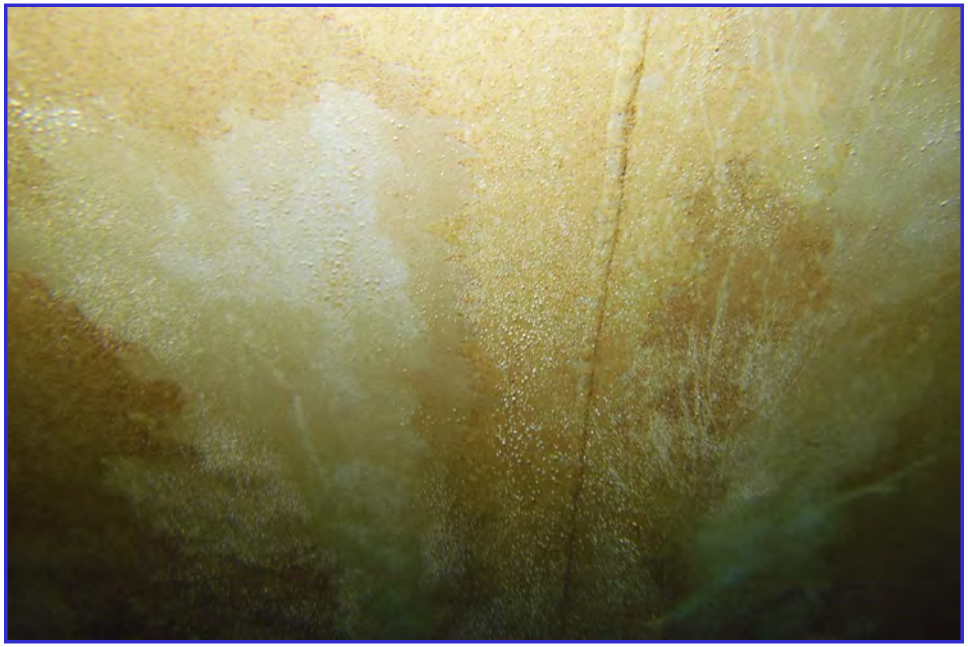
INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -122



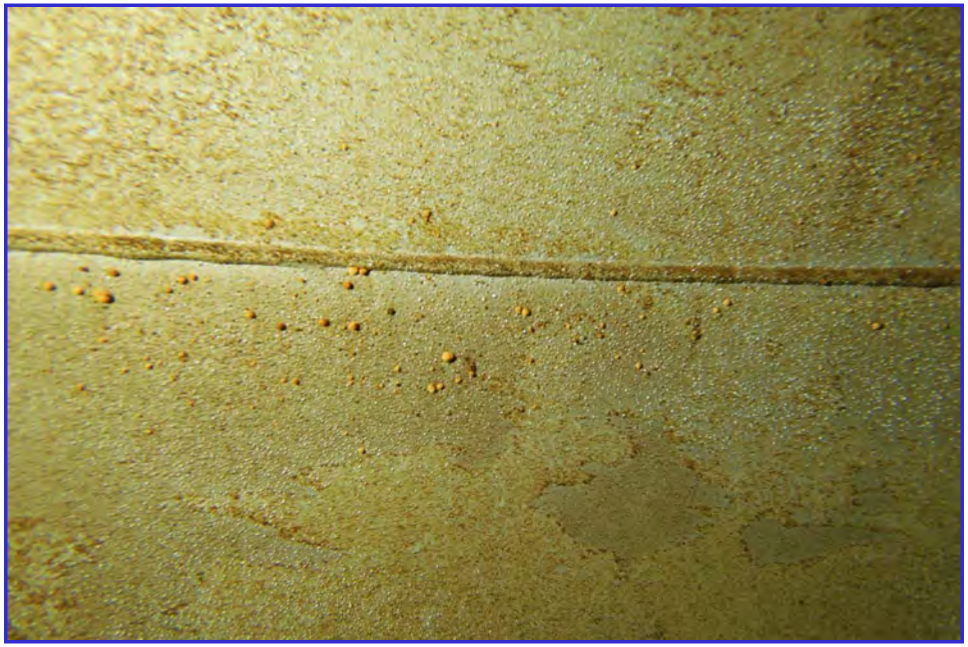
INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -123

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -124

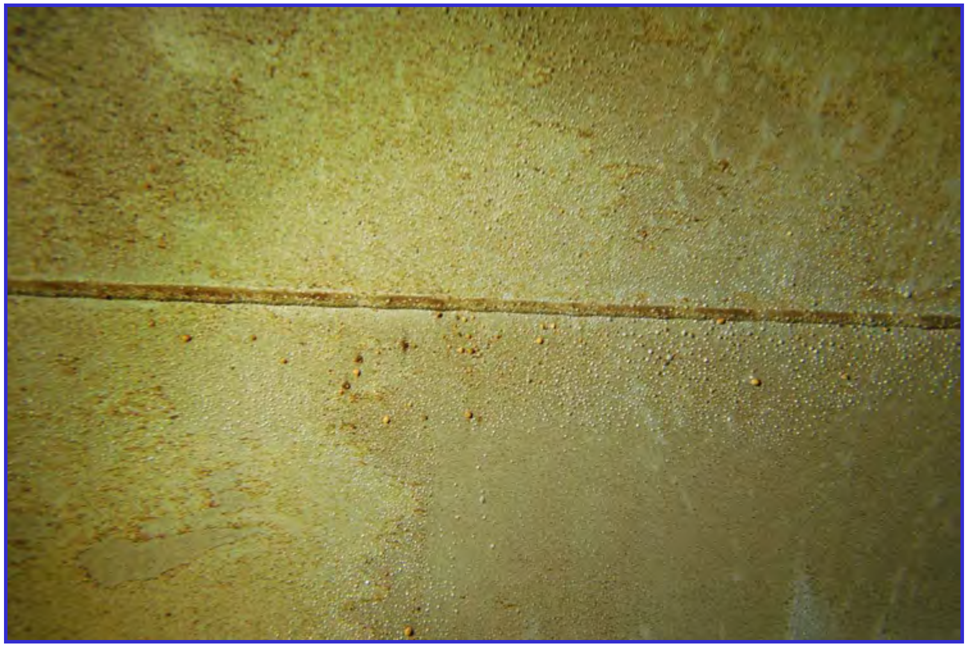
INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -125



INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -126



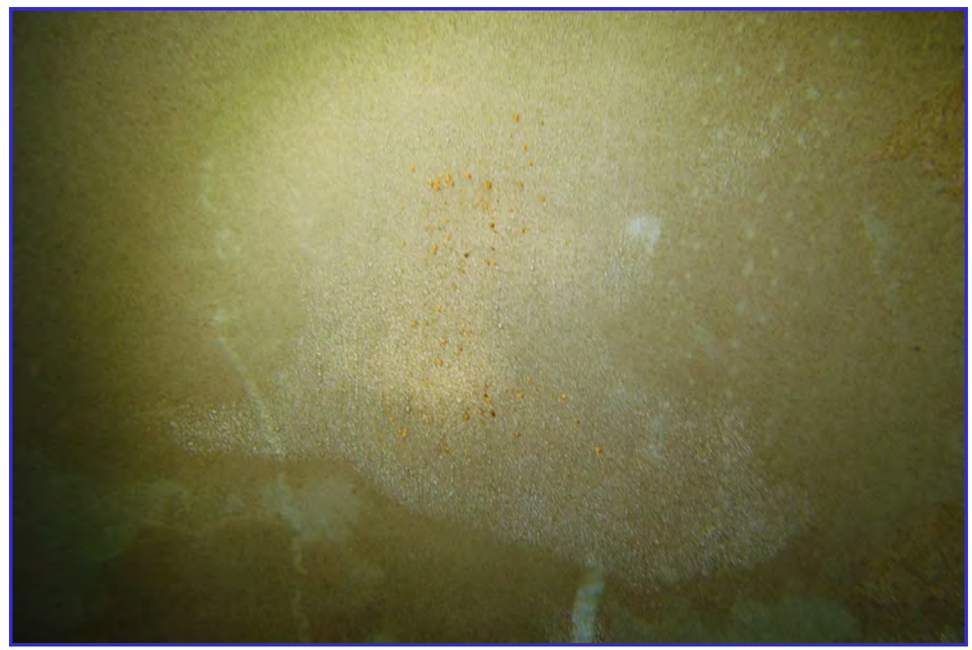
INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -127



INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -128

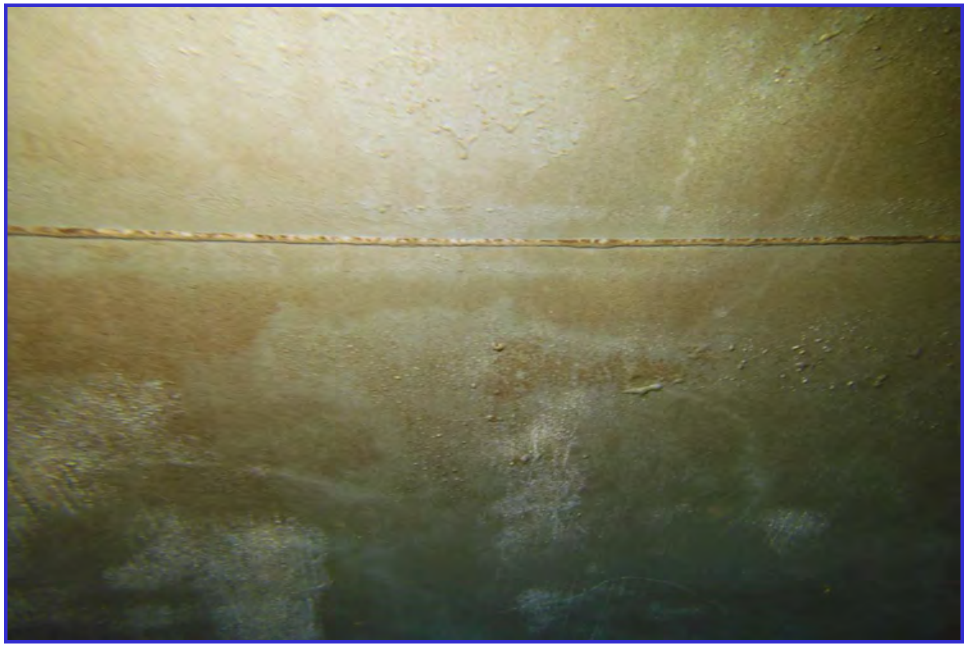
INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -129

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -130



INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -131

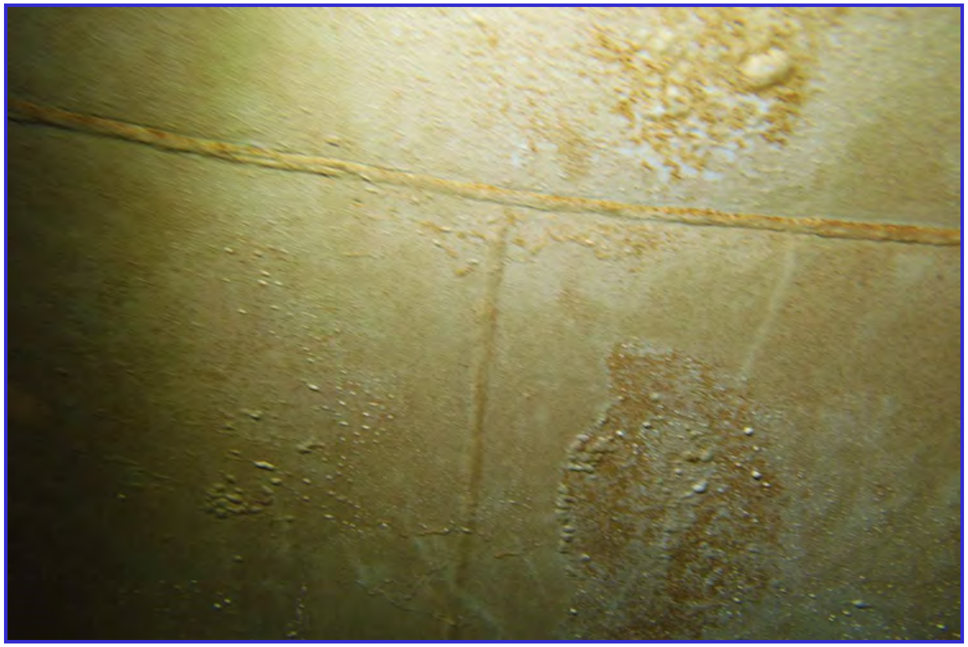
INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -132



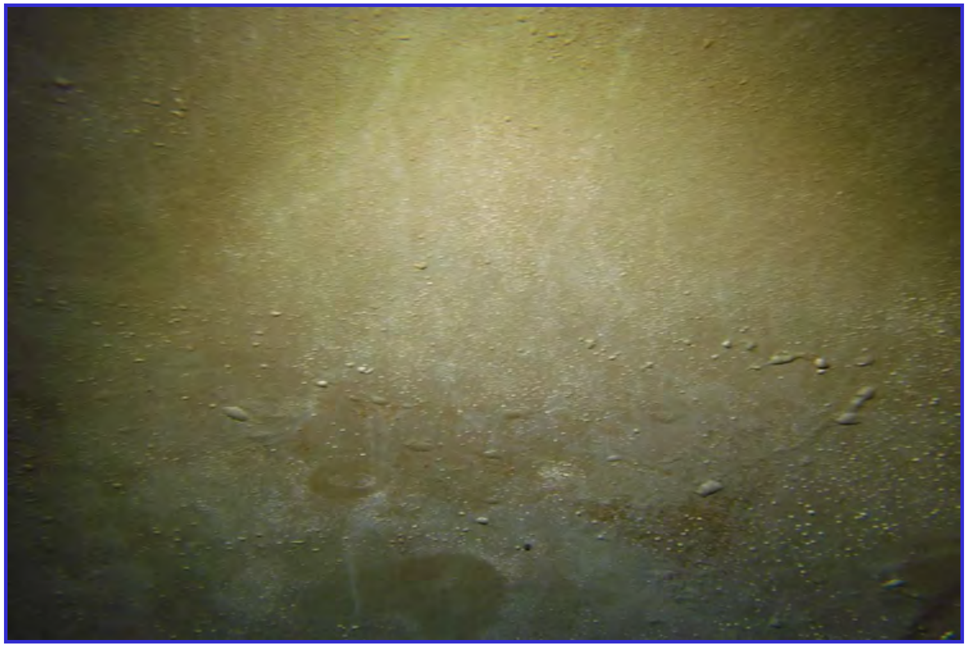
INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -133

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -134

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -135



INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -136

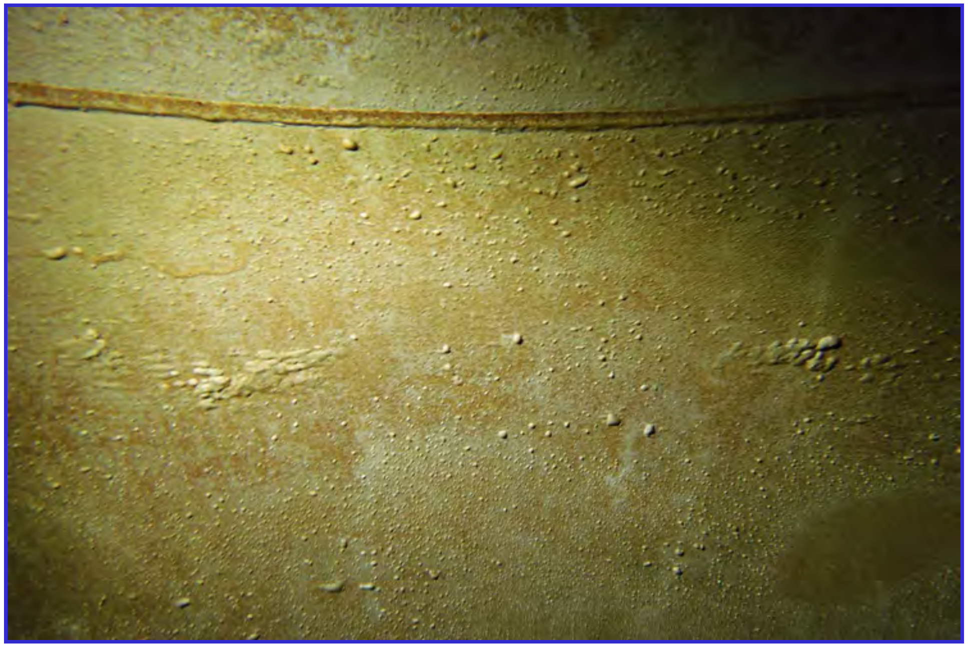


INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -137

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -138

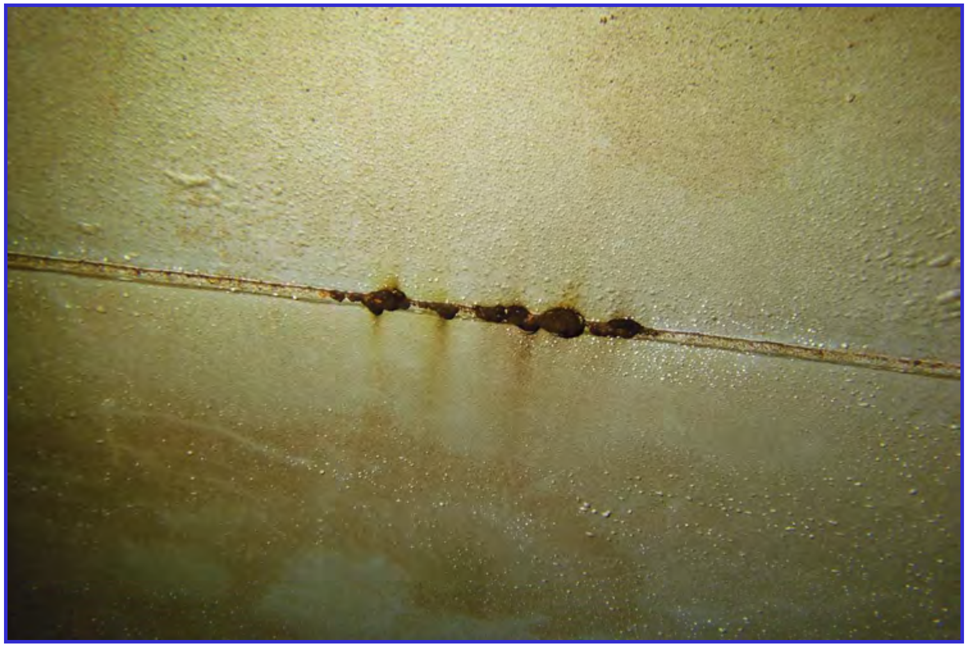
INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -139

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -140



INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -141

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -142



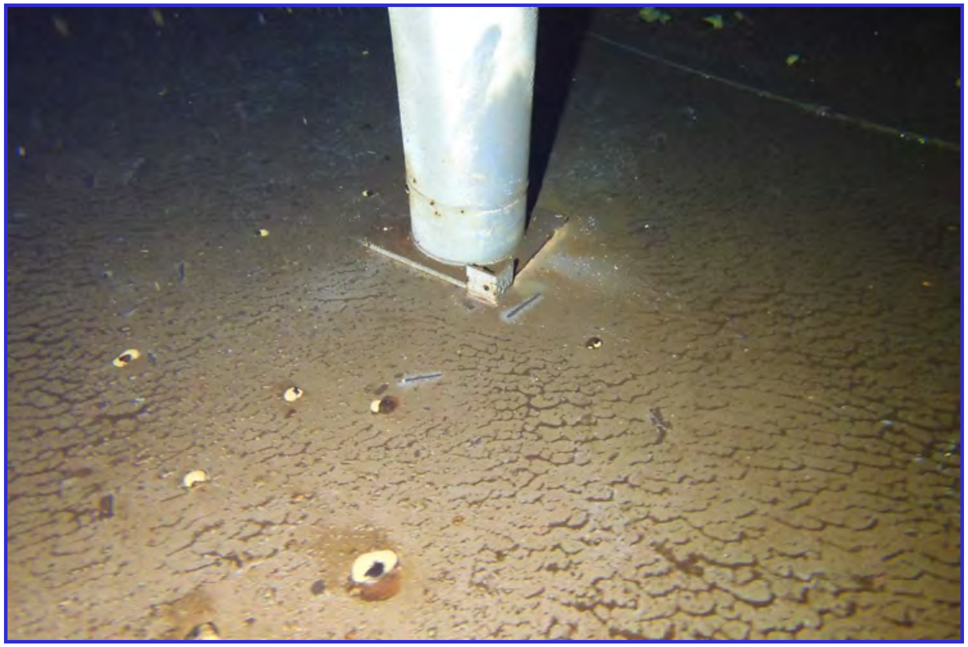
INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -143

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -144

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -145

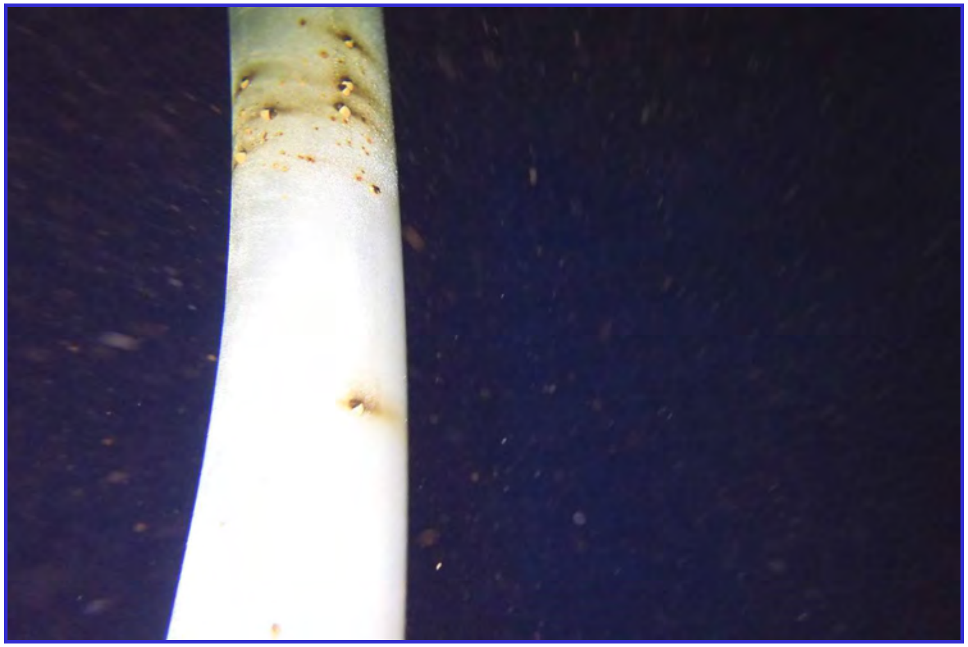
INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -146

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -147



INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -148

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -149



INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -150

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -151

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -152

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -153

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -154

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -155

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -156

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -157

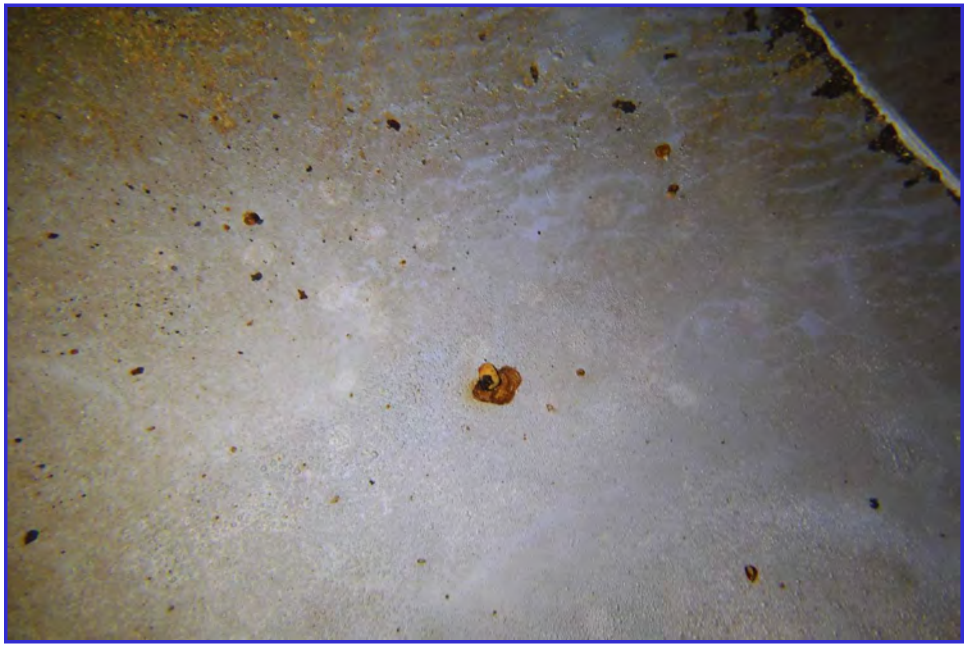
INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -158

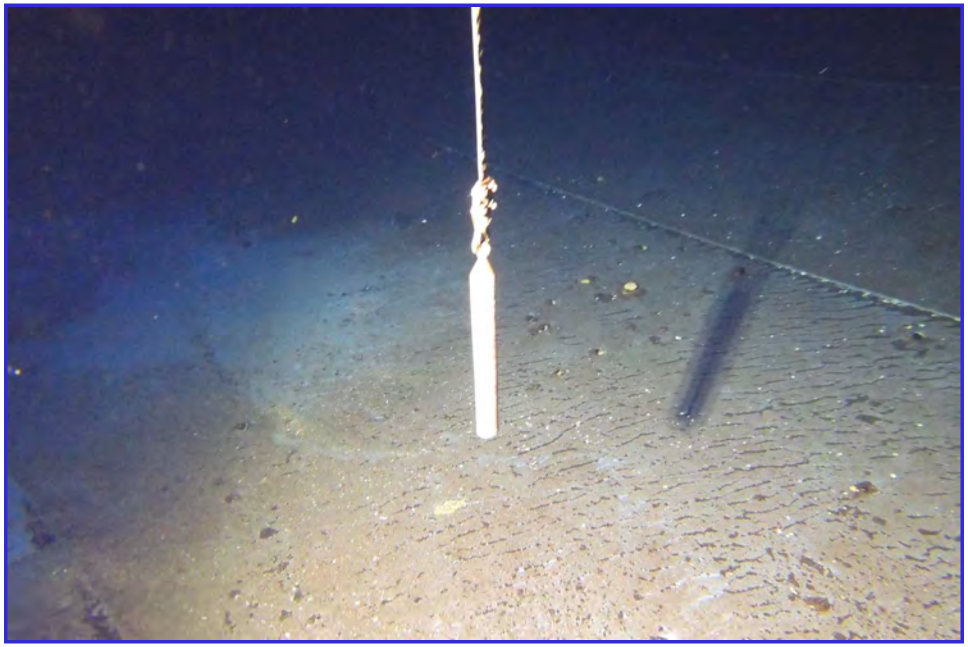
INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -159


INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -160


INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -161


INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -162


INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -163



INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -164

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -165

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -166

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -167

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -168

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -169

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -170

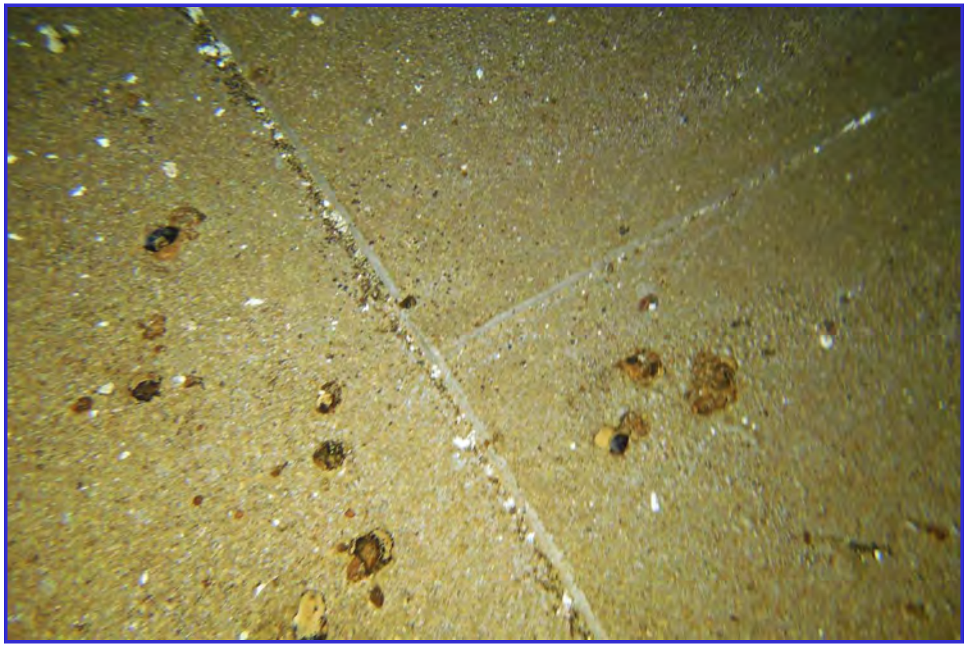
INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -171

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -172

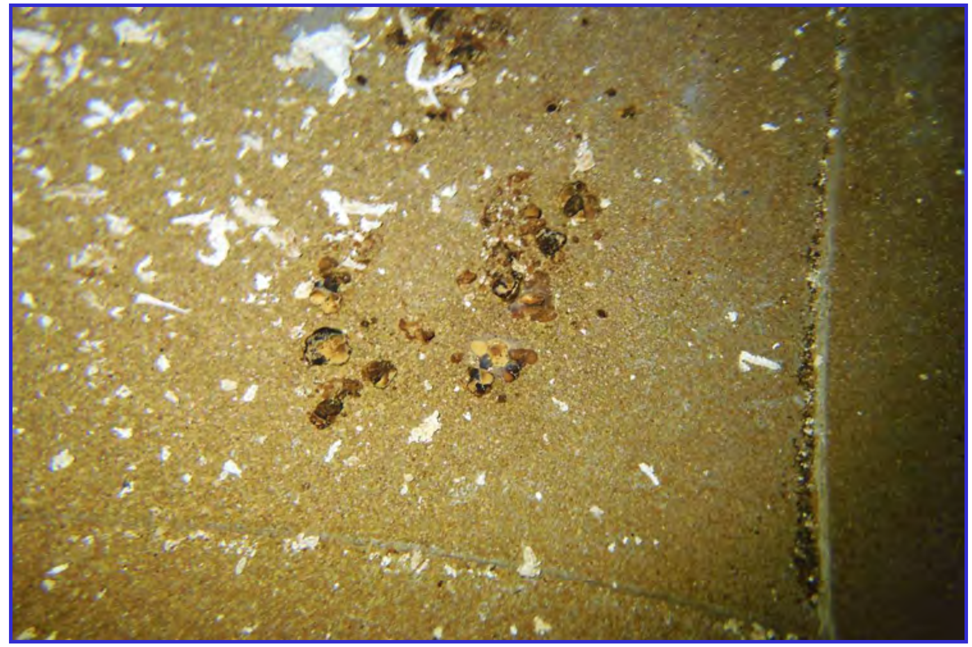
INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -173

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -174

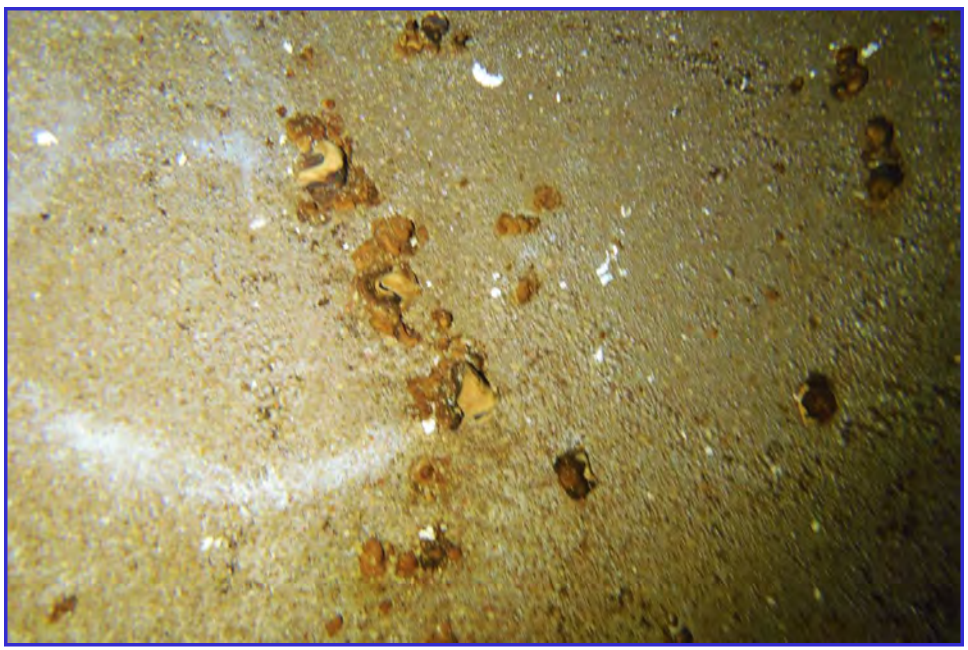
INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -175



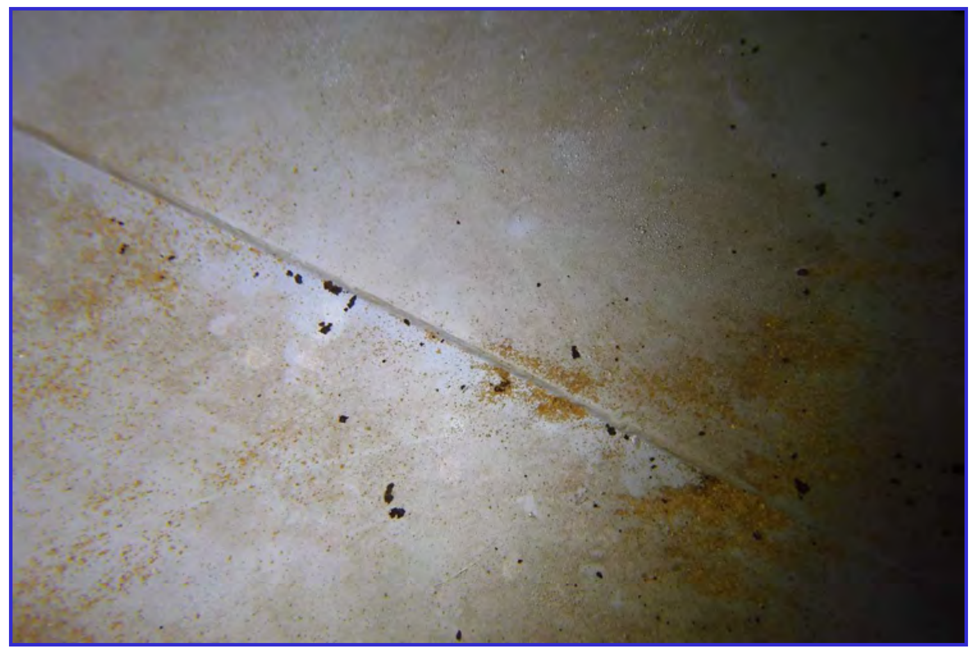
INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -176



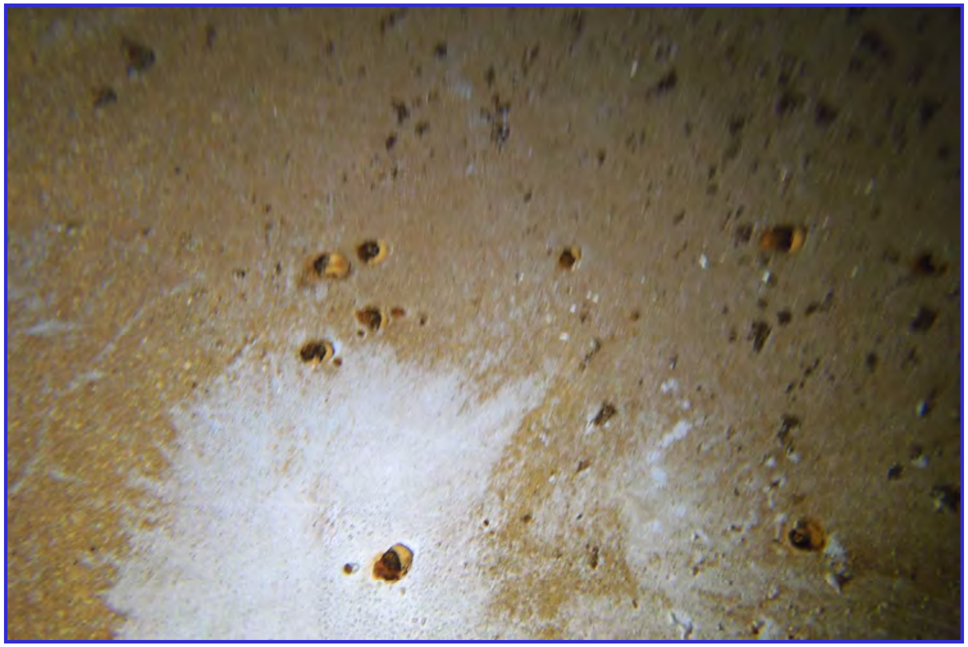
INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -177



INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -178



INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -179

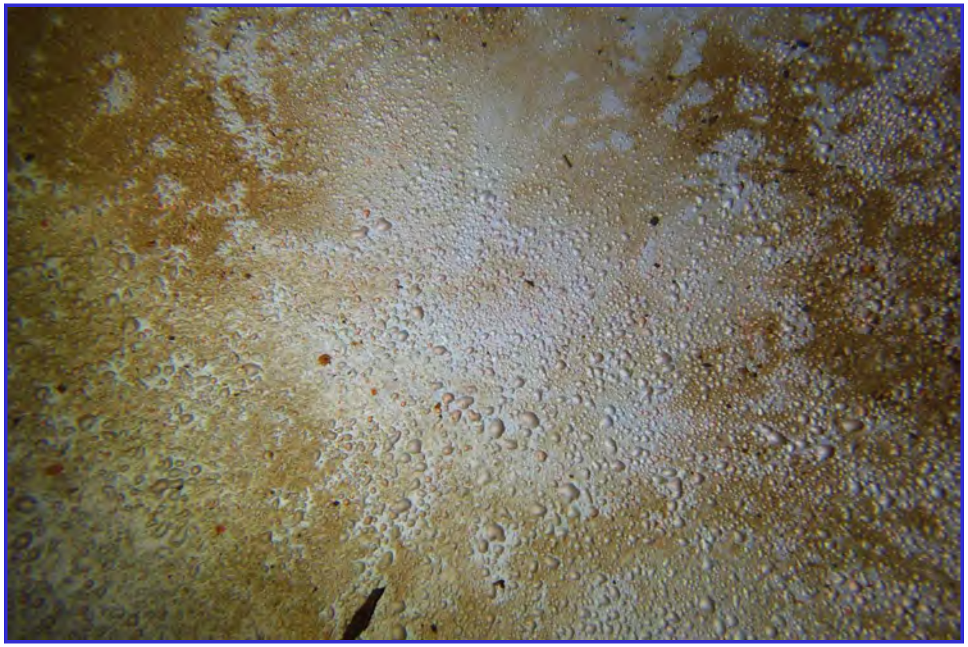


INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -180

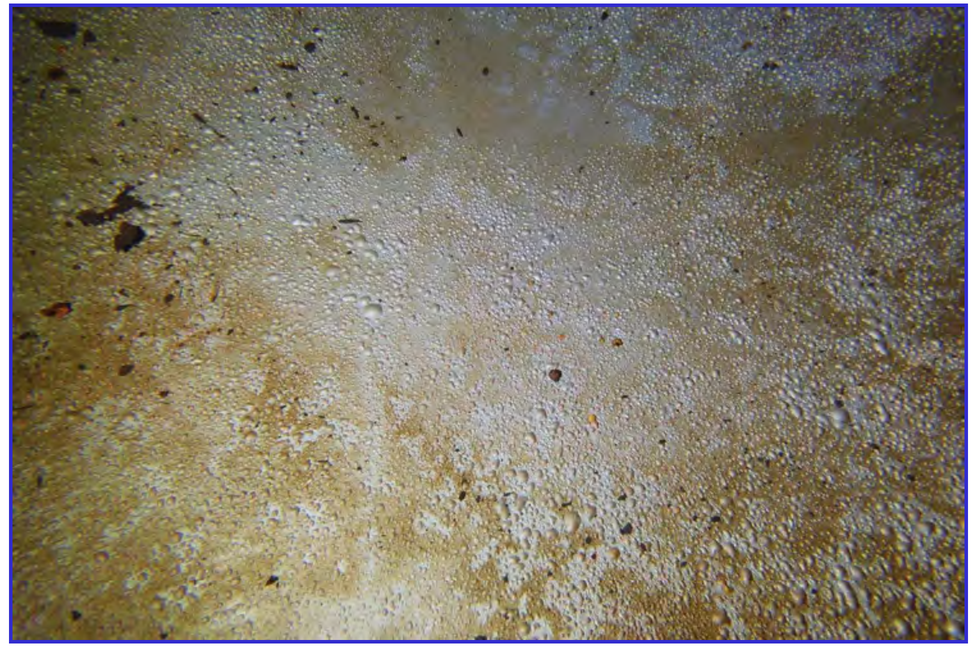
INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -181

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -182

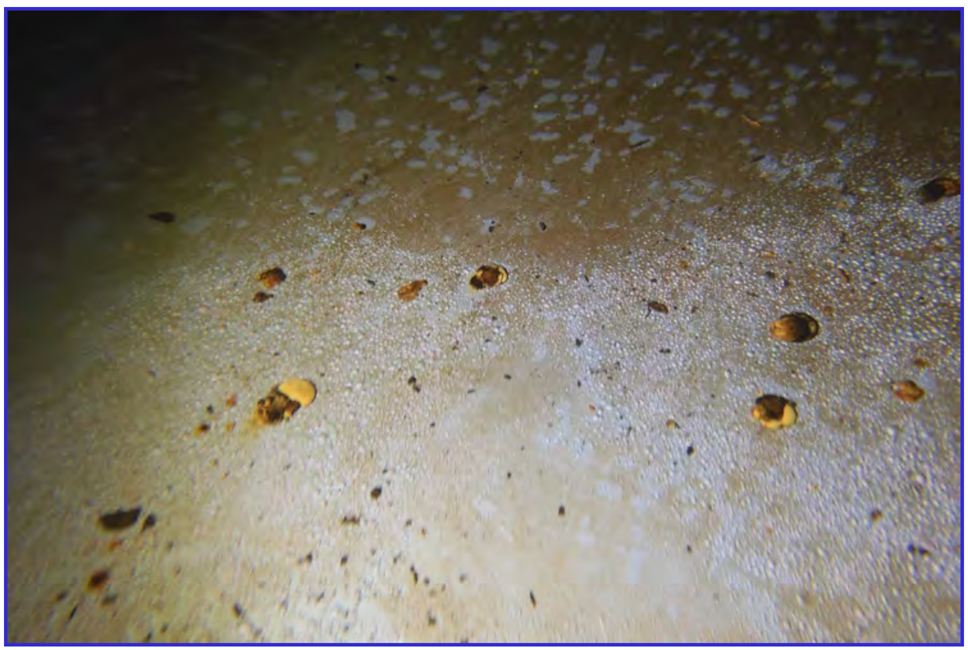
INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -183



INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -184



INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -185



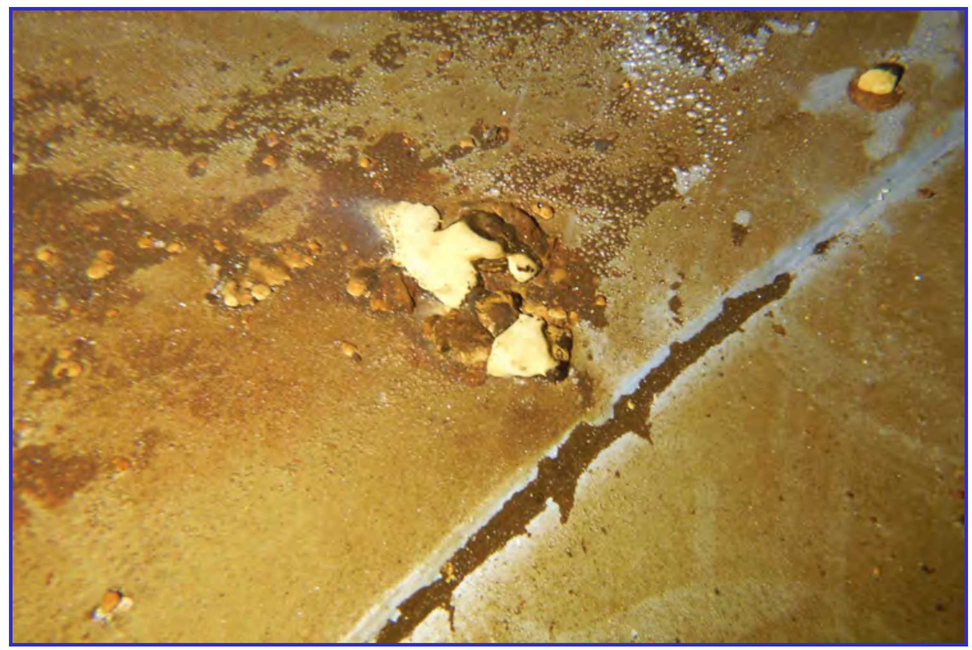
INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -186

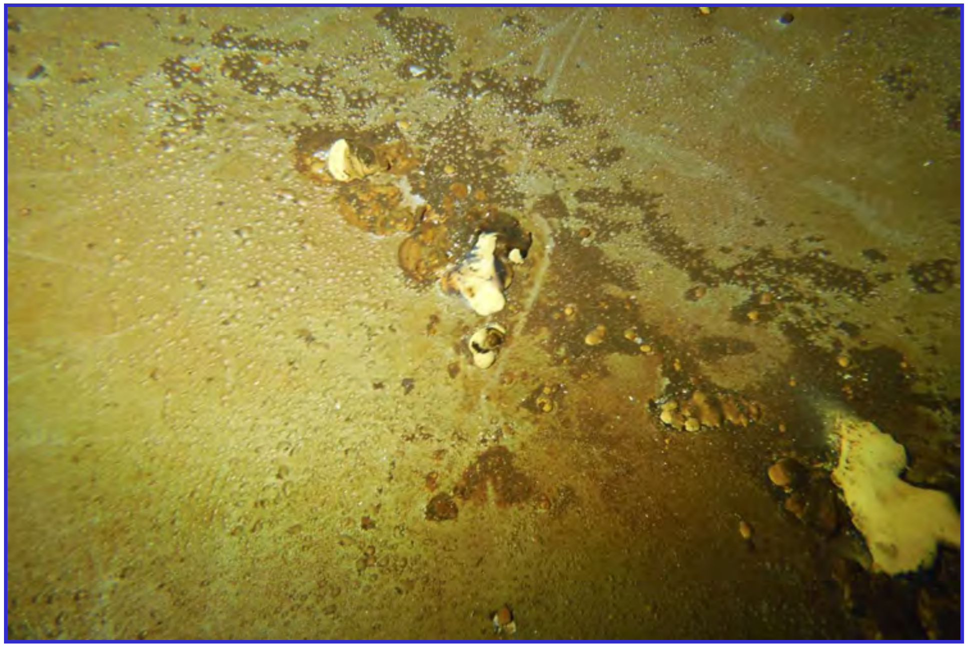
INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -187


INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -188

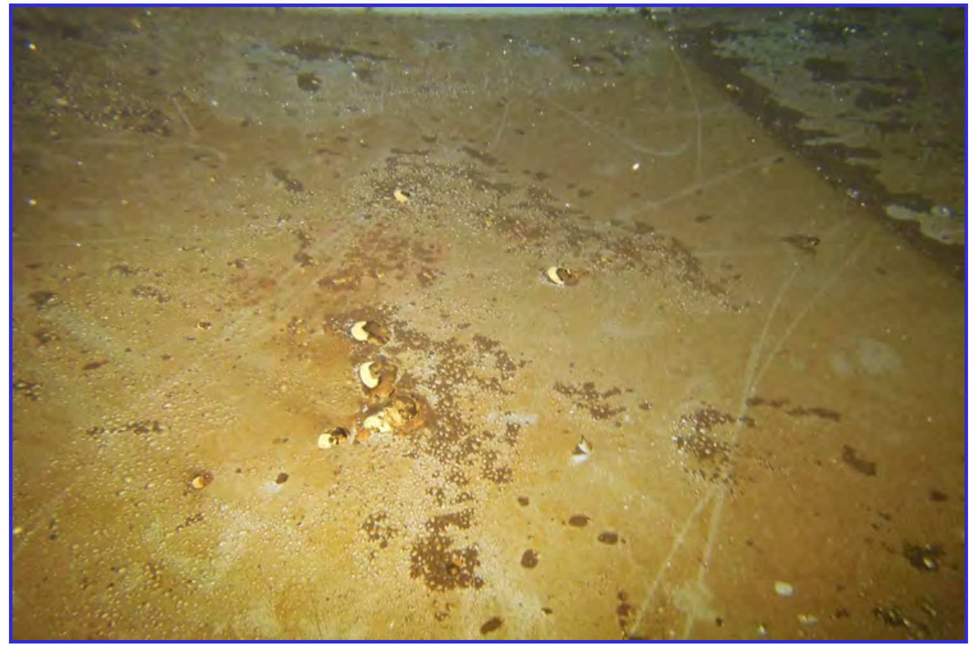

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -189


INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -190

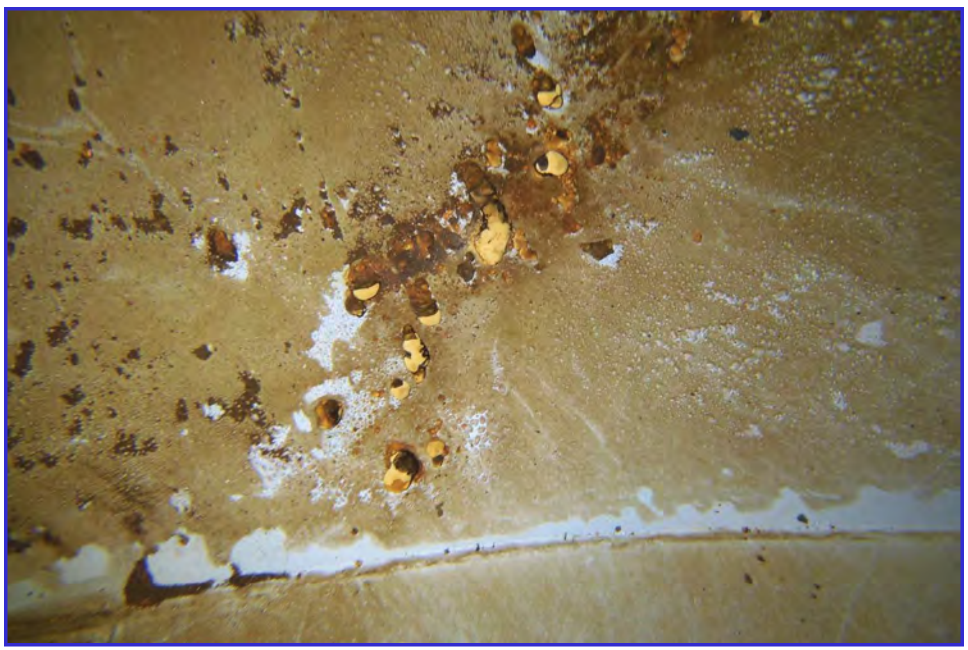

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -191



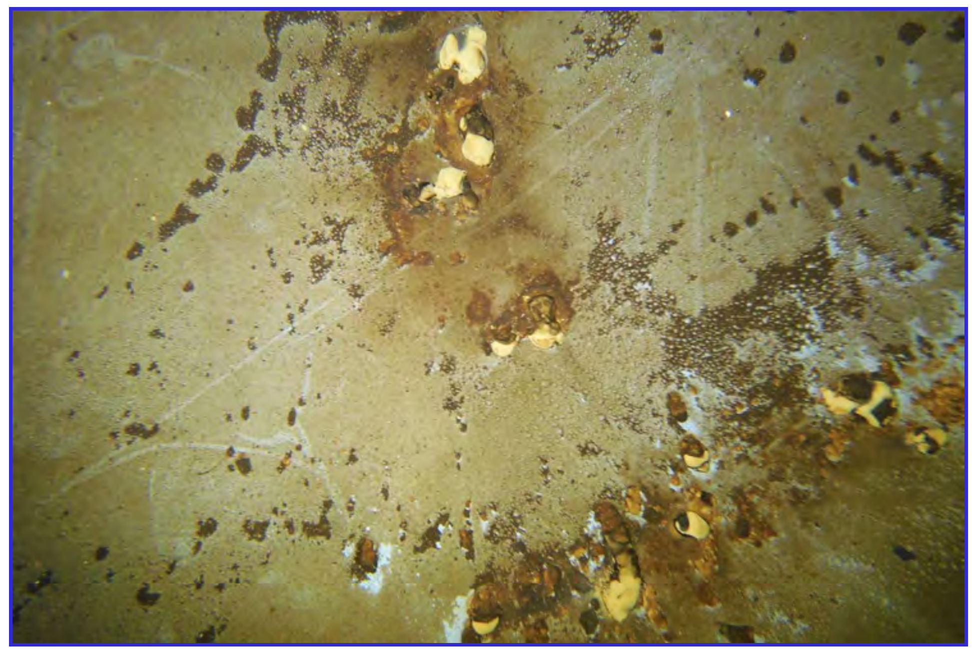
INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -192



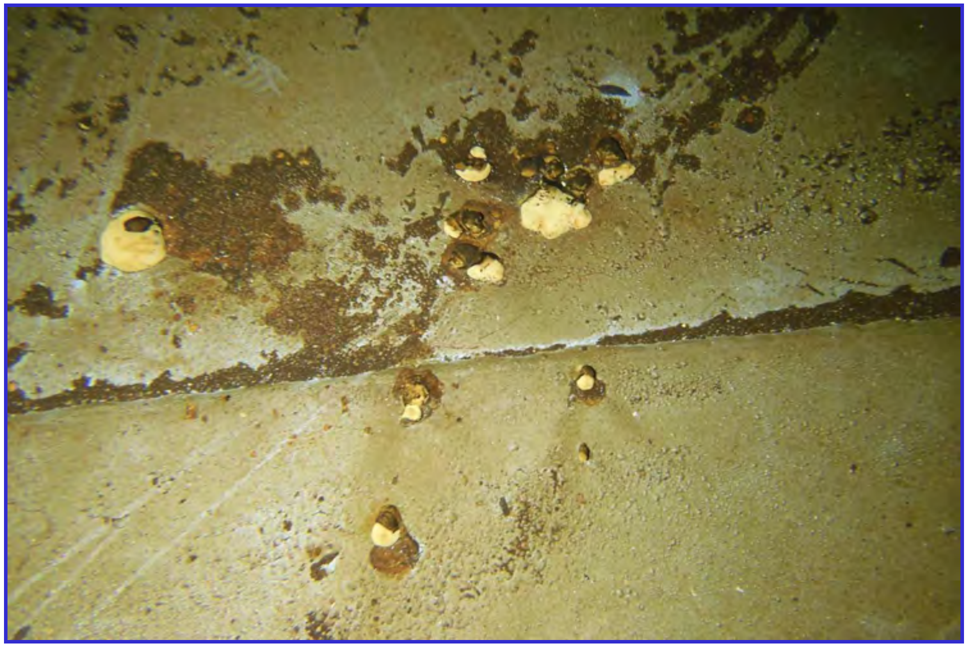
INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -193



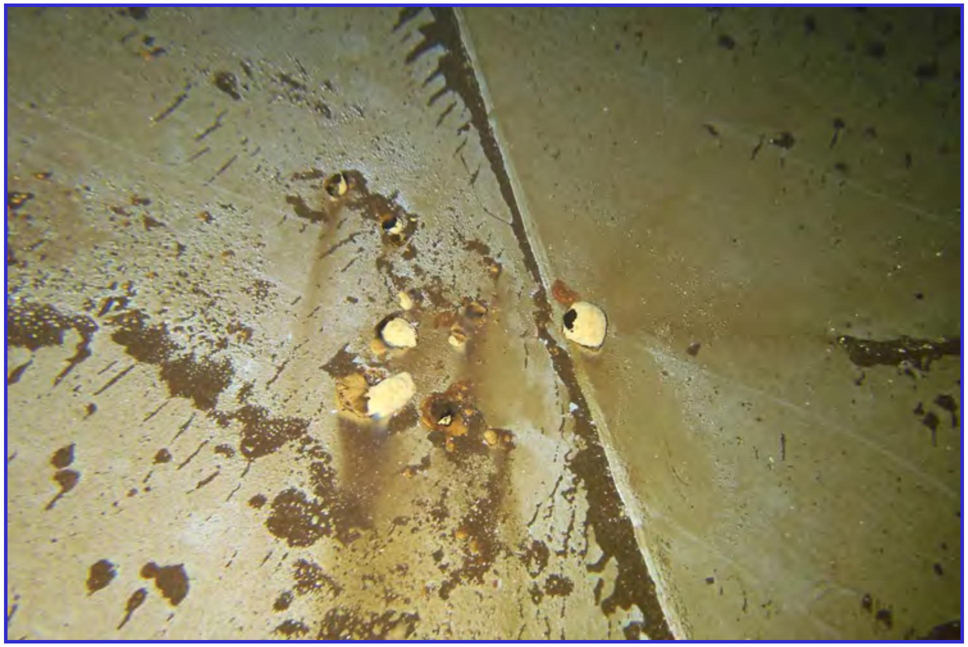
INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -194



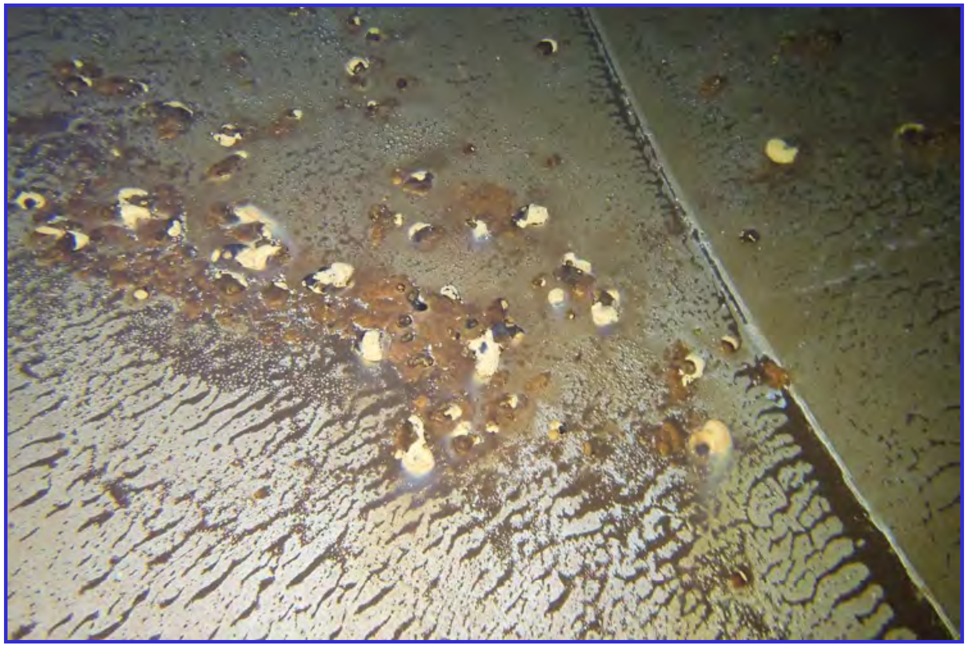
INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -195



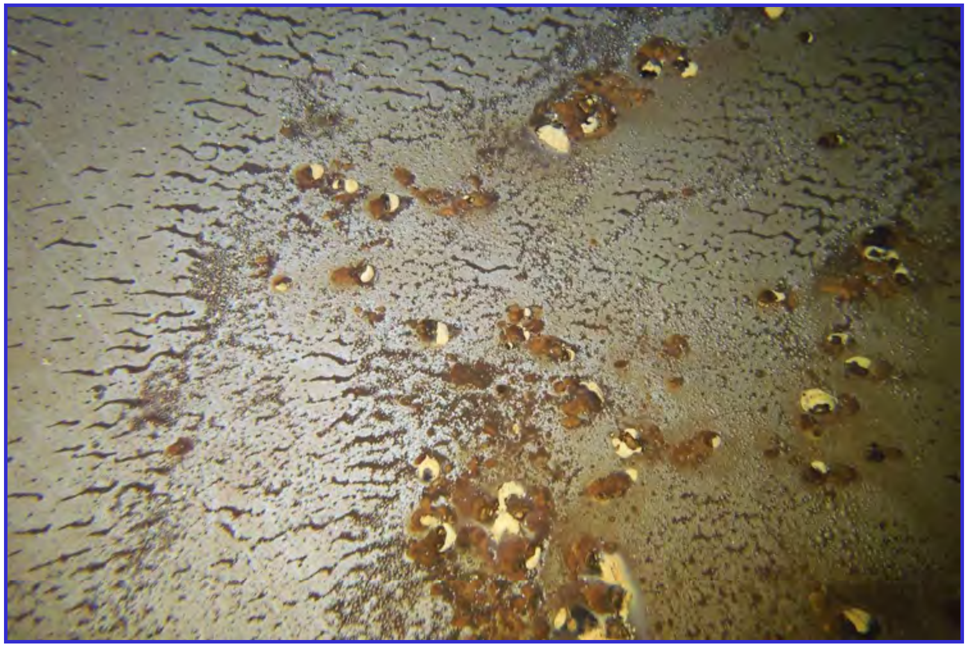
INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -196



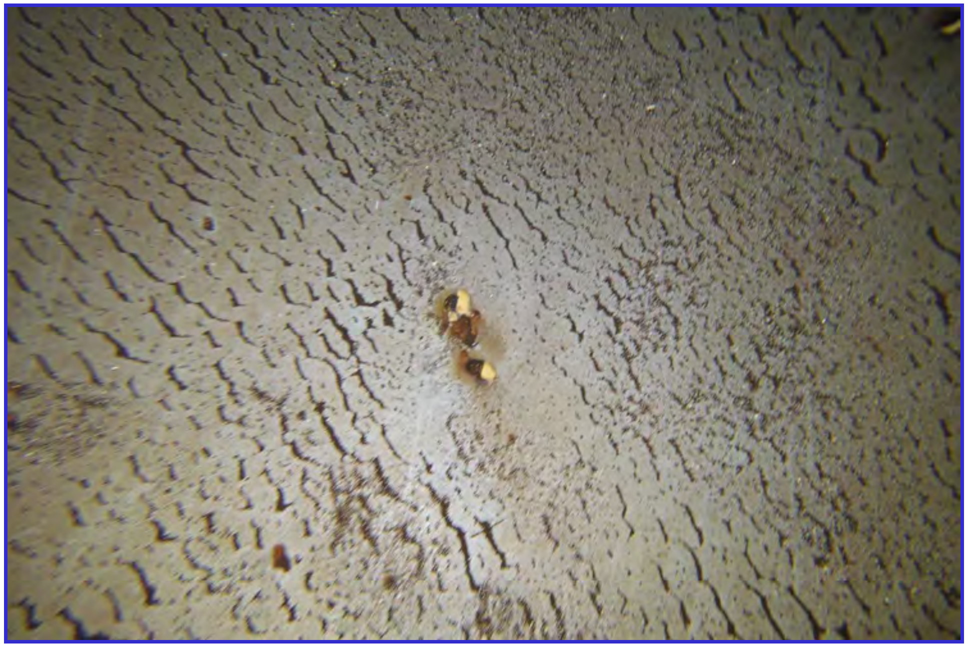
INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -197



INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -198

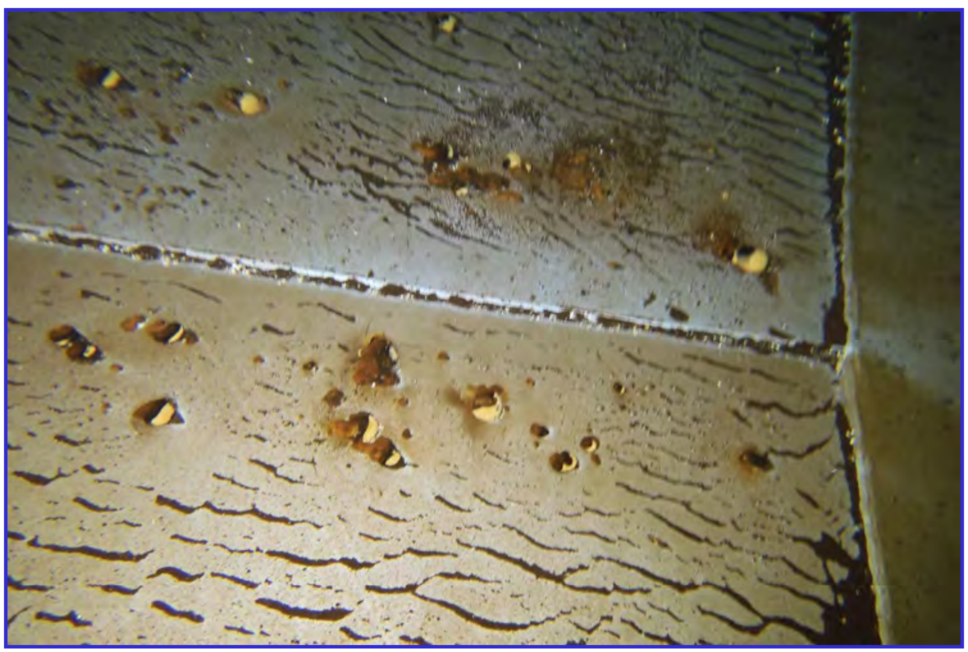


INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -199



INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -200

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -201



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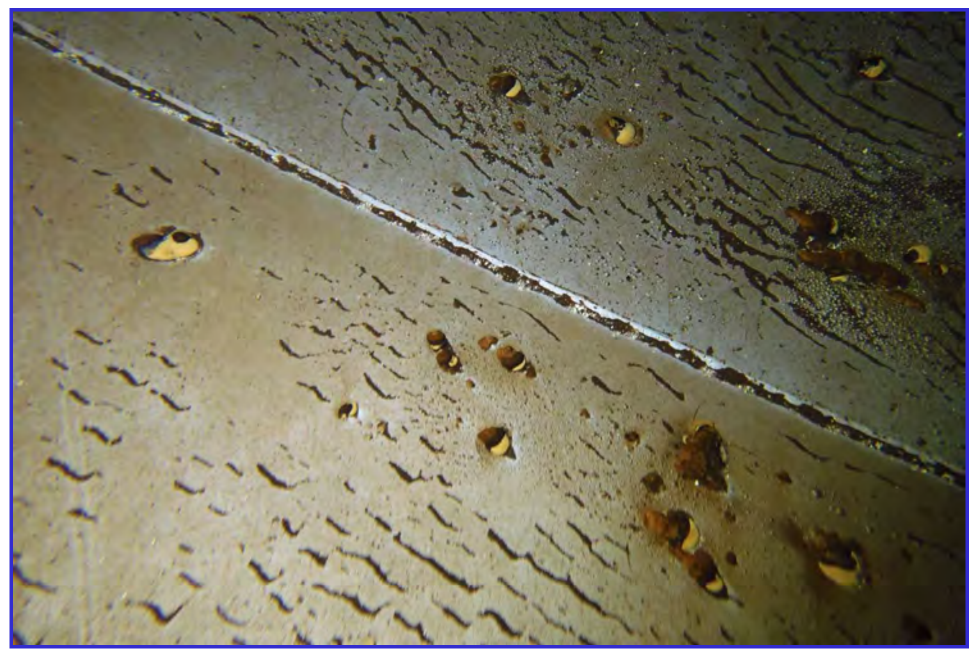

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -203

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -204

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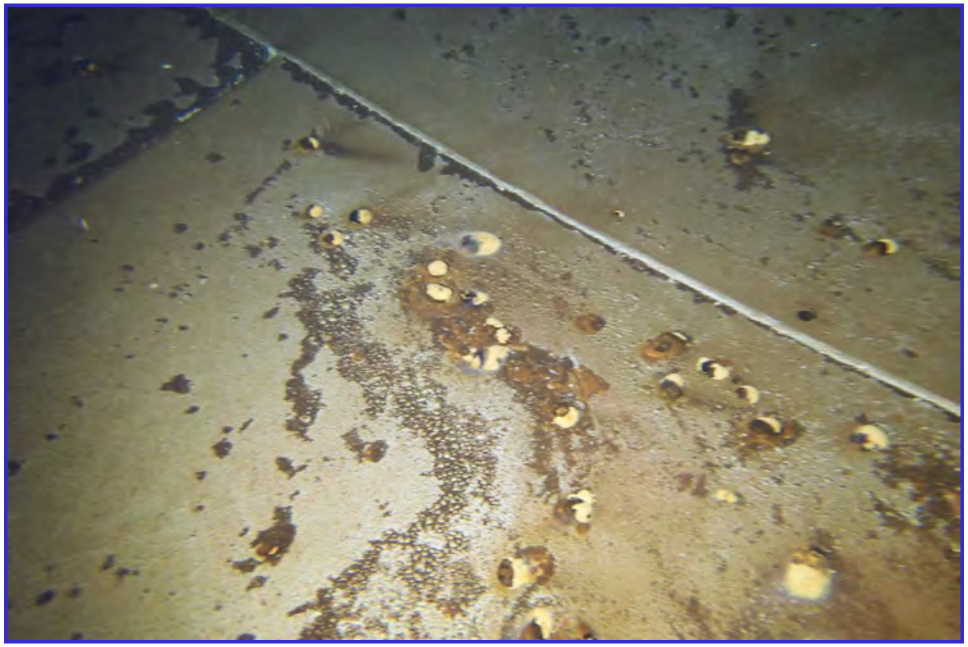
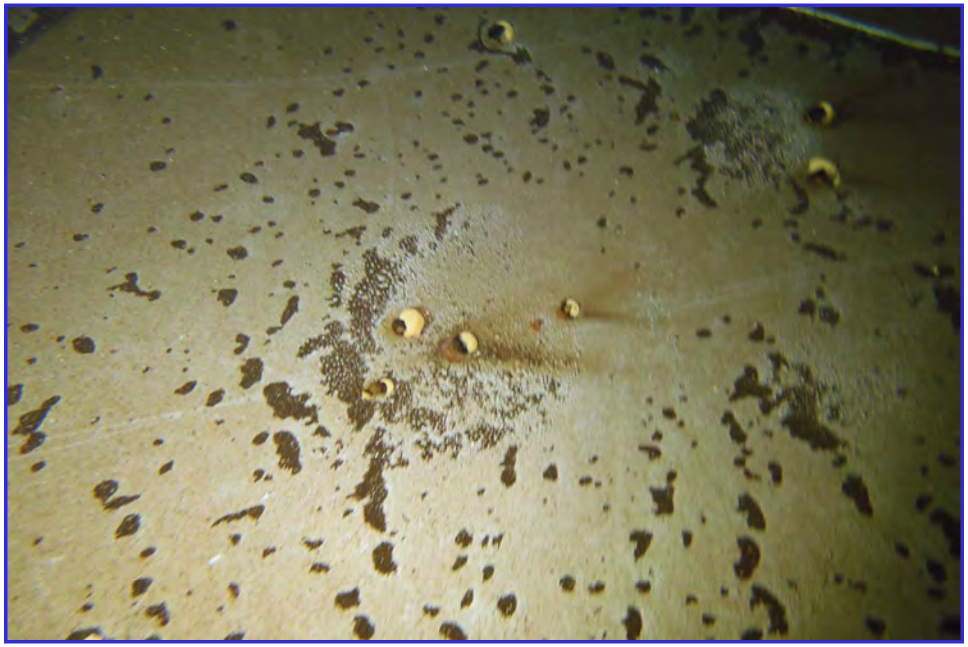
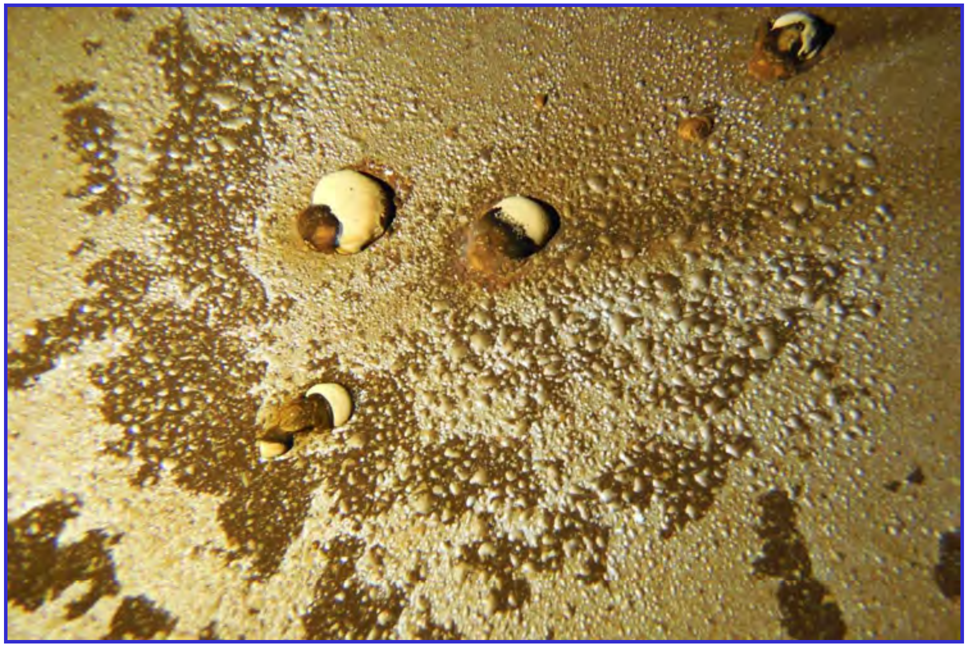
INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -206



INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -207

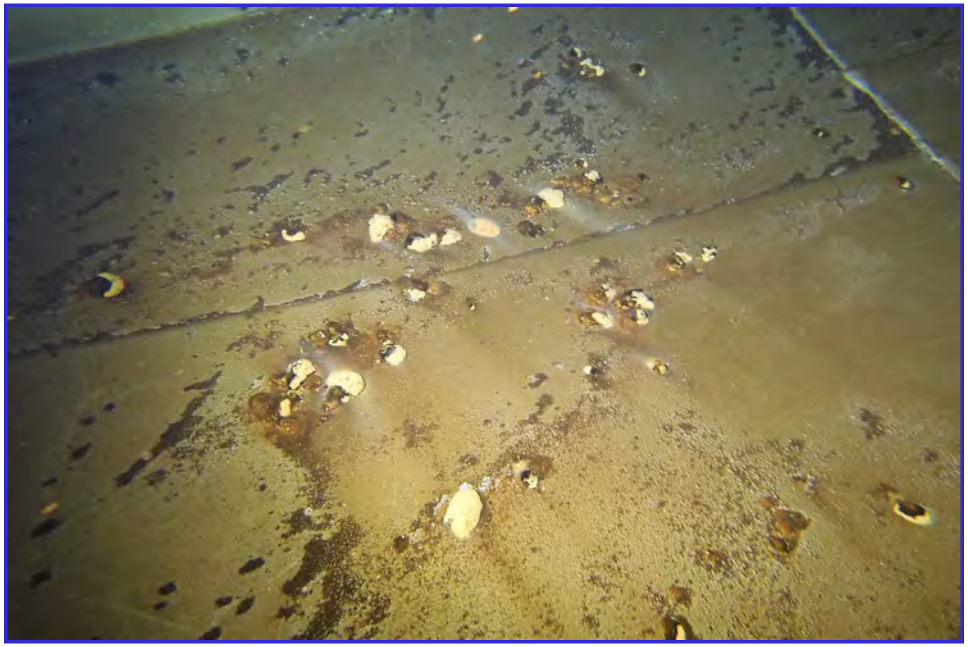


INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -208



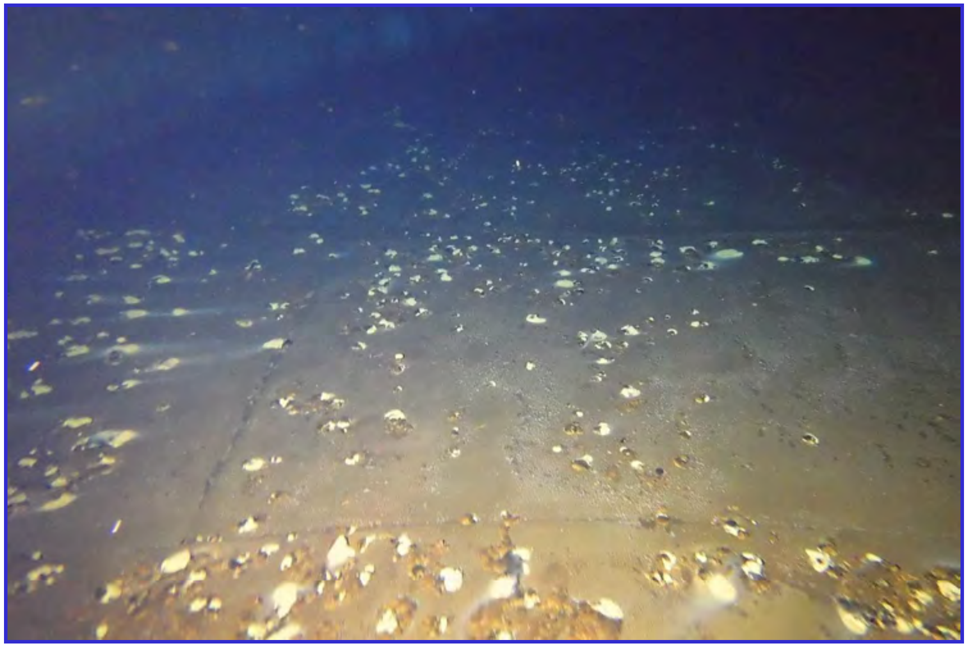
INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -209

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -210

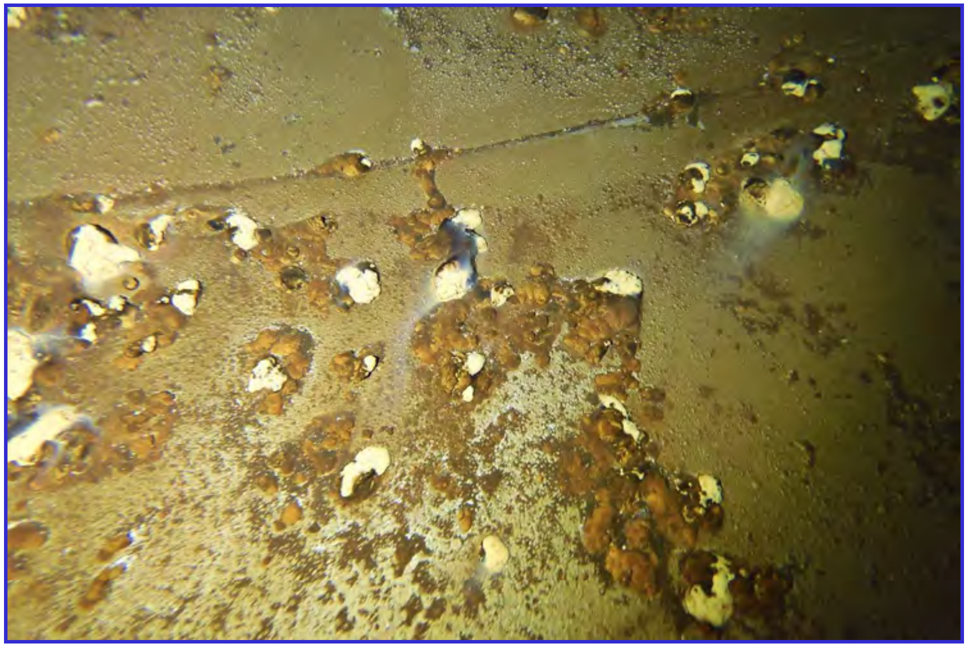


INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -211

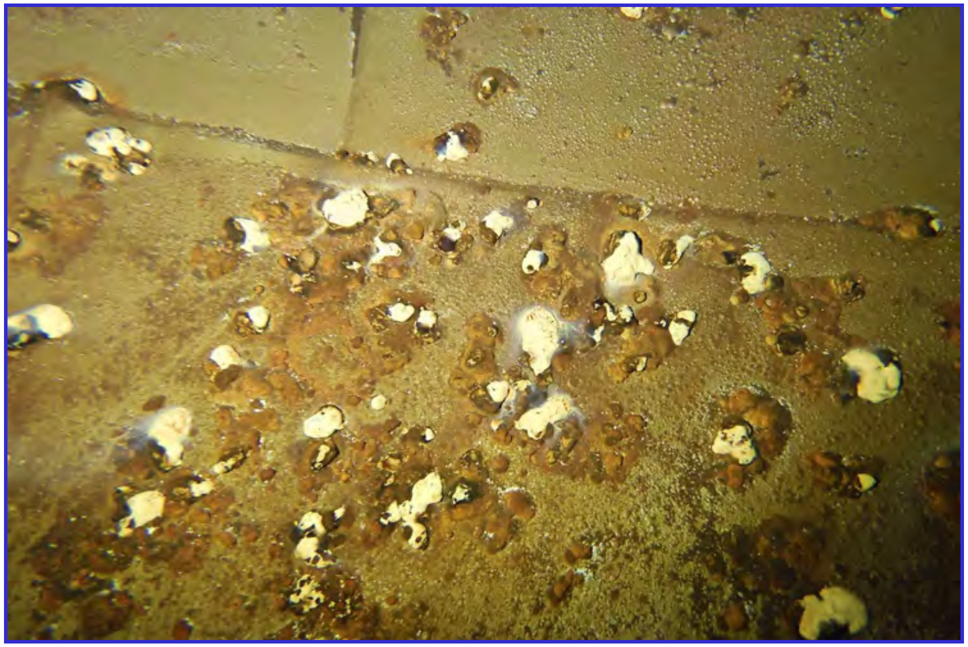
INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -212



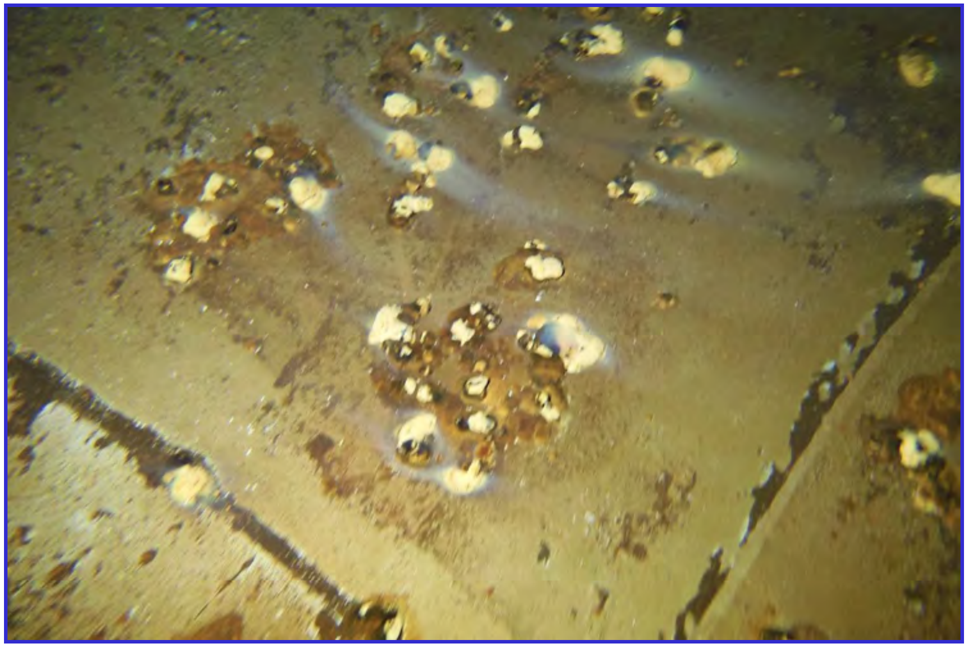
INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -213



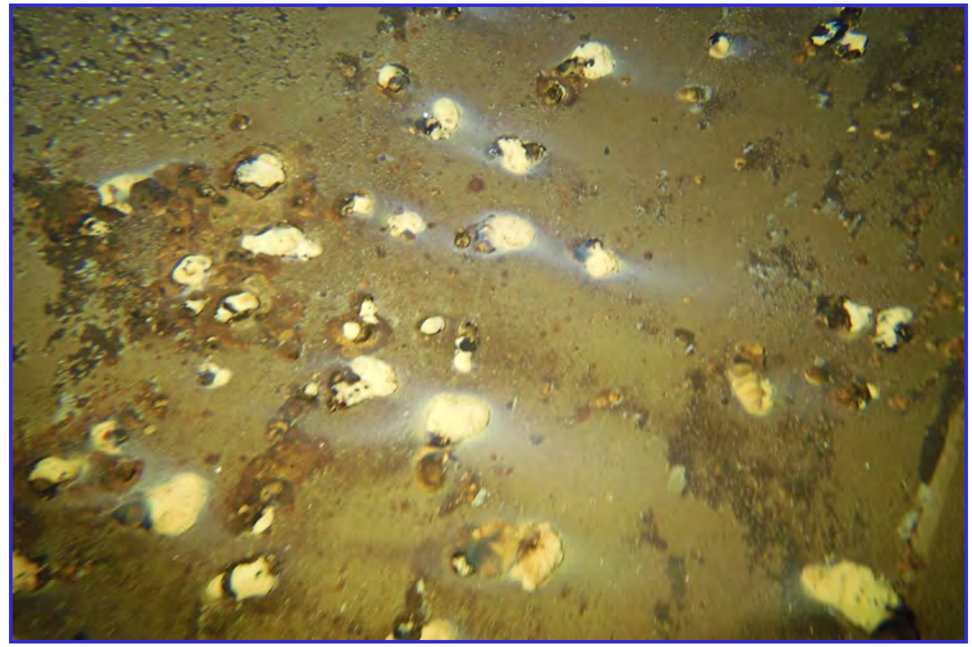
INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -214



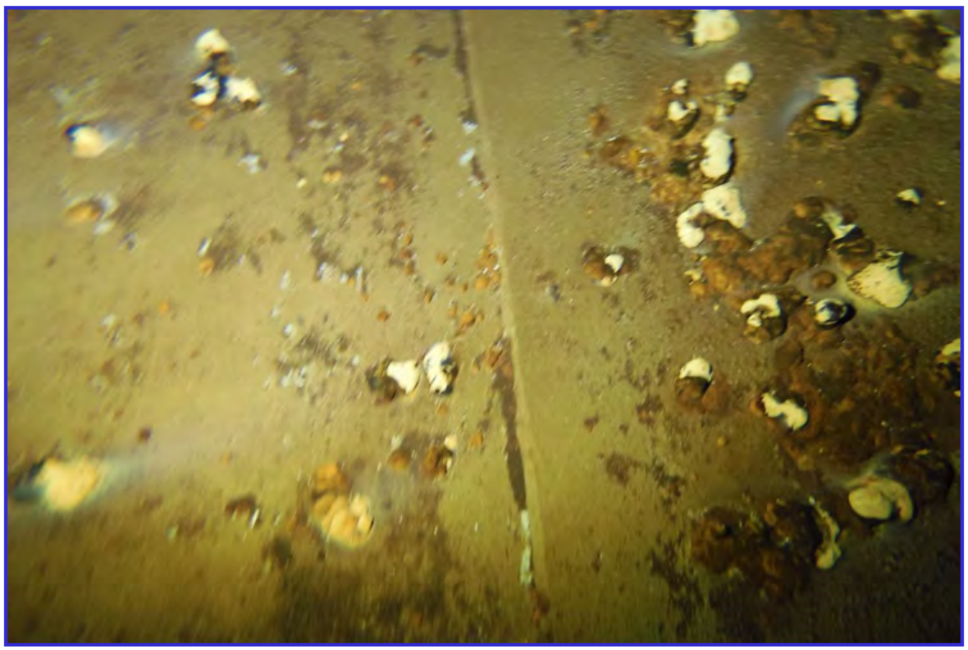
INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -215



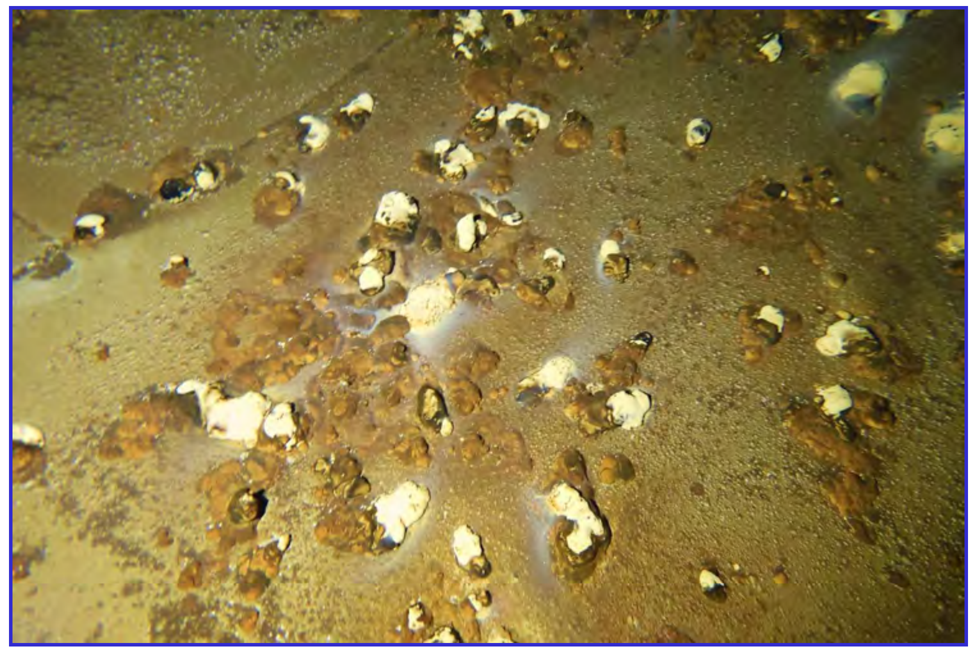
INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -216



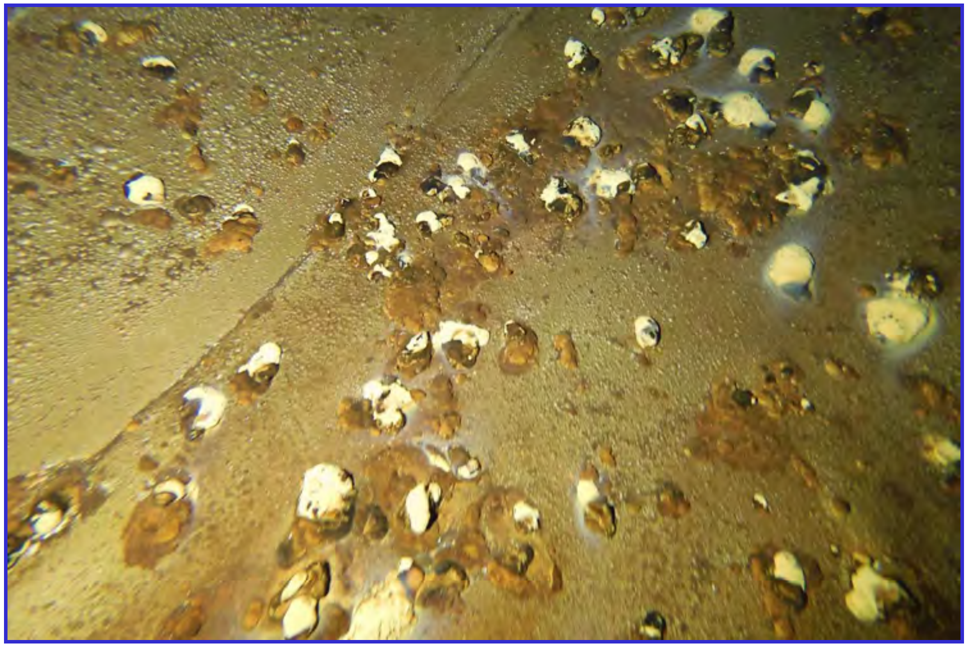
INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -217



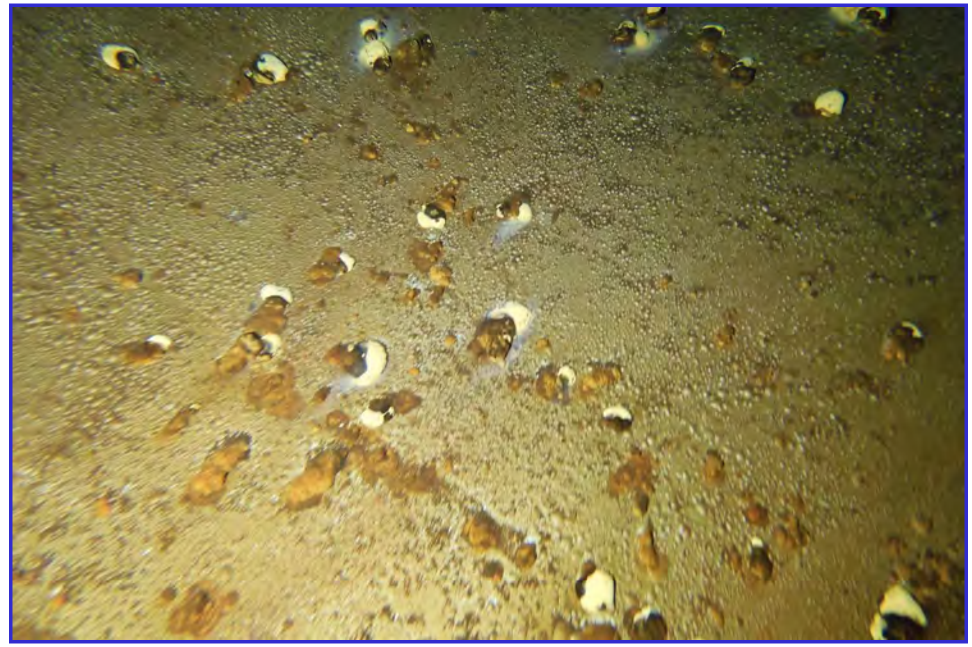
INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -218



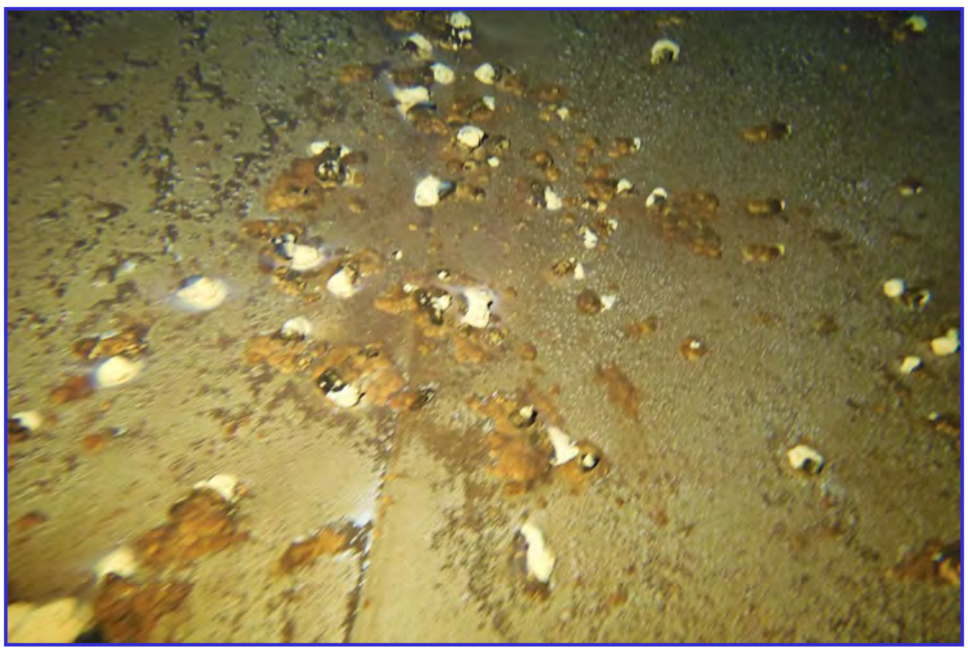
INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -219



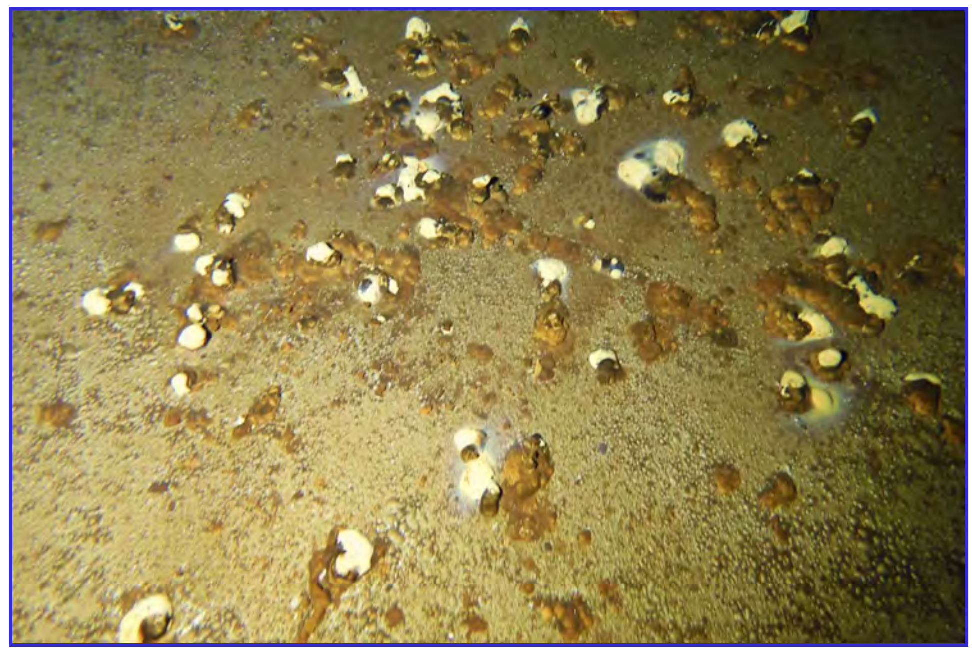
INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -220



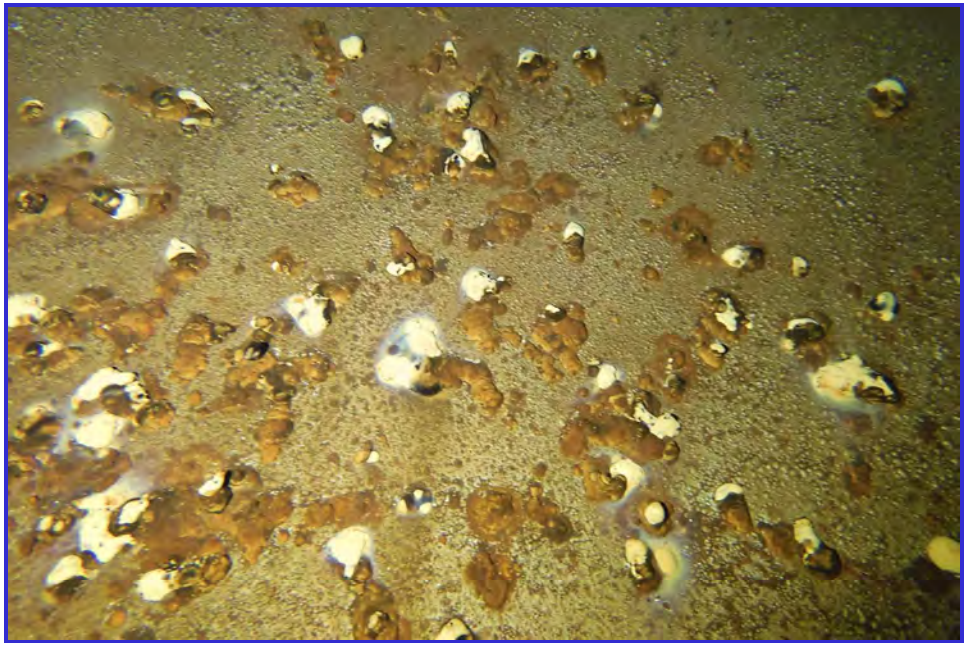
INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -221



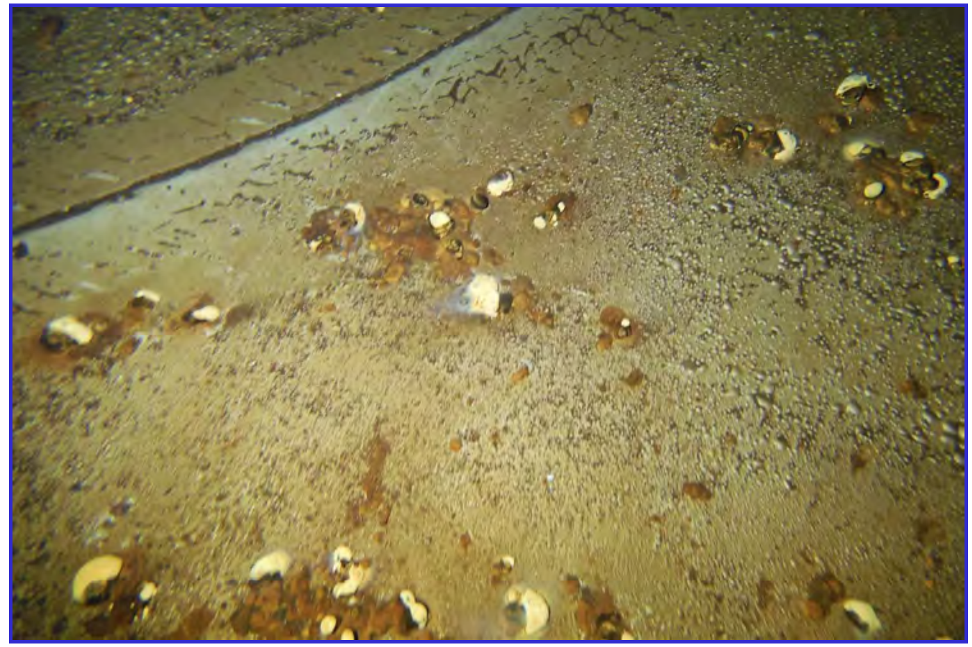
INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -222



INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -223

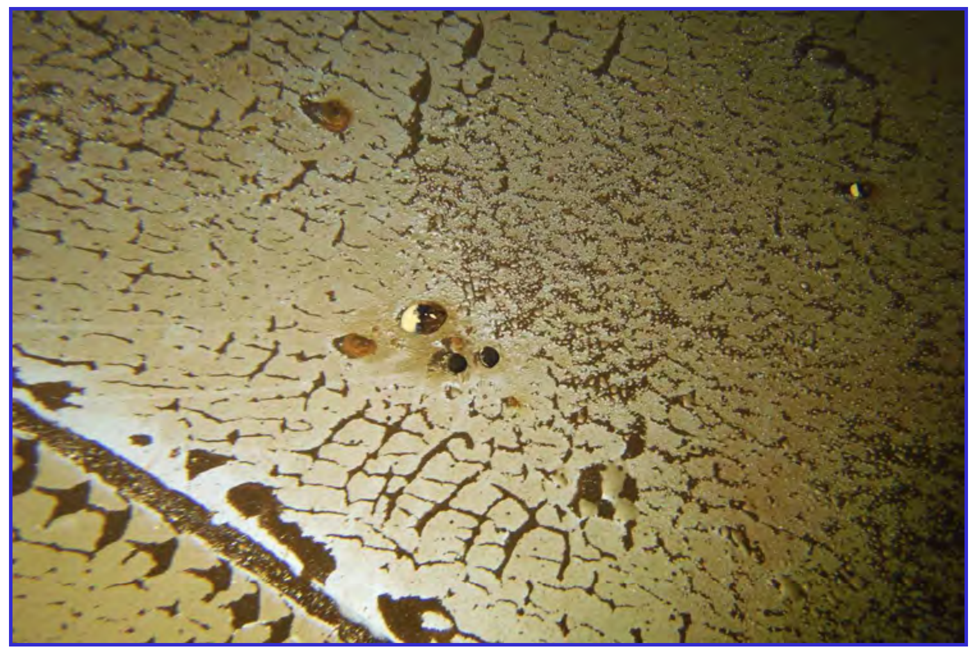


INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -224



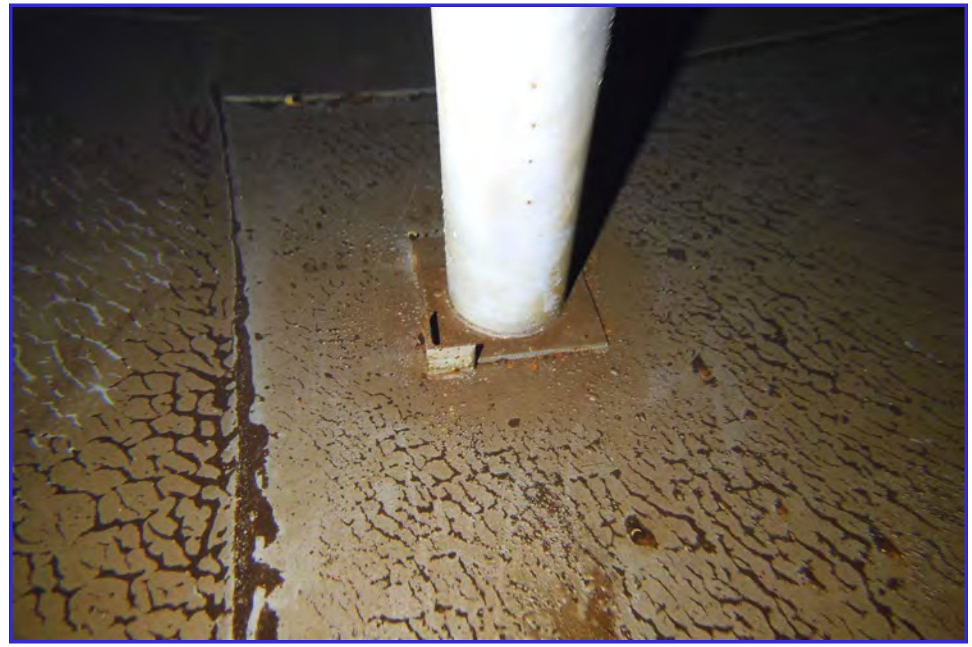
INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -225

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -226

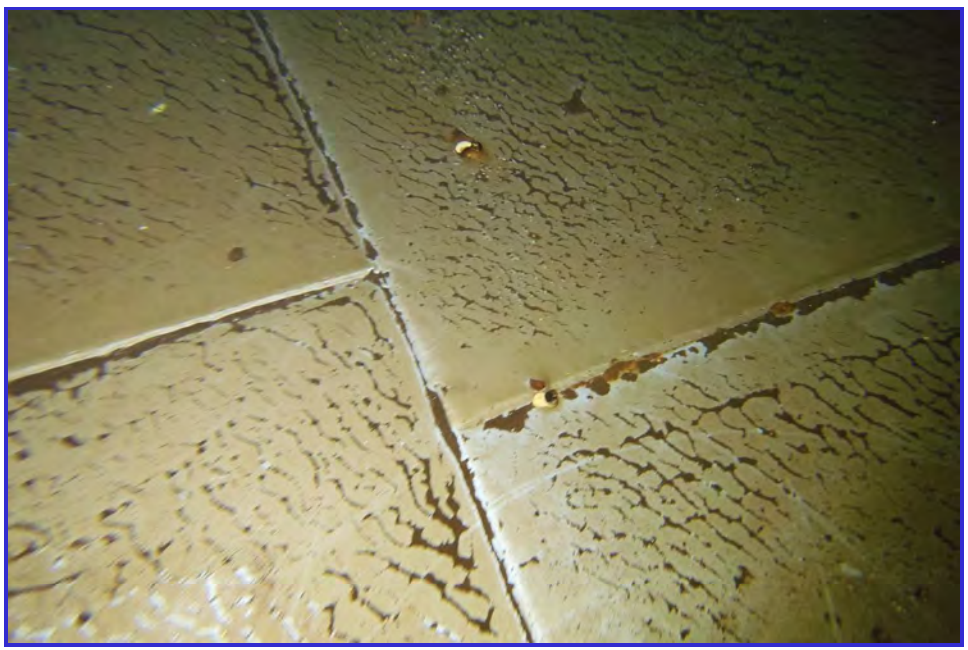


INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -227

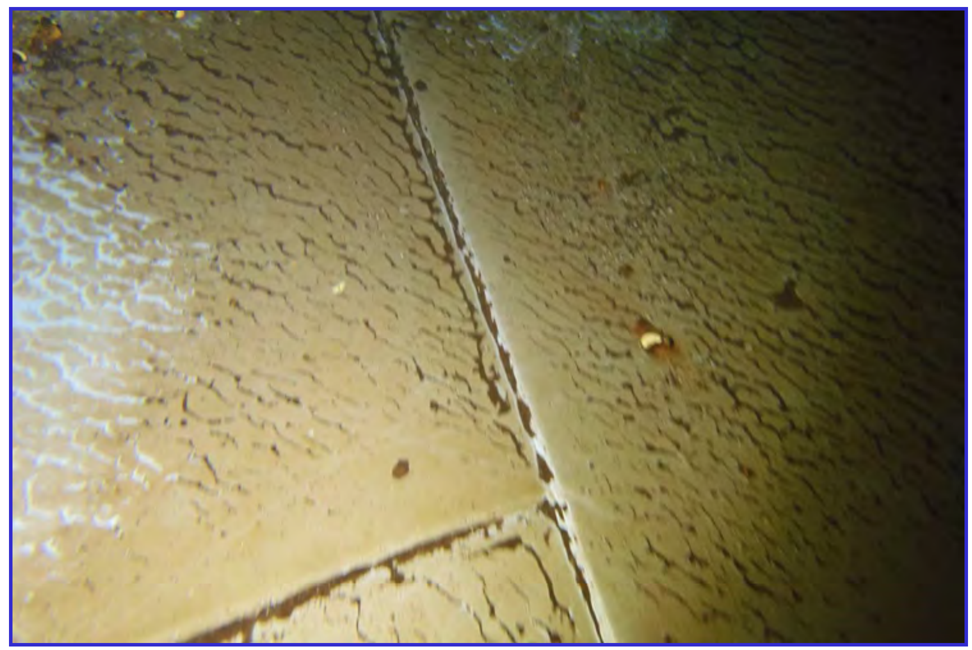
INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -228



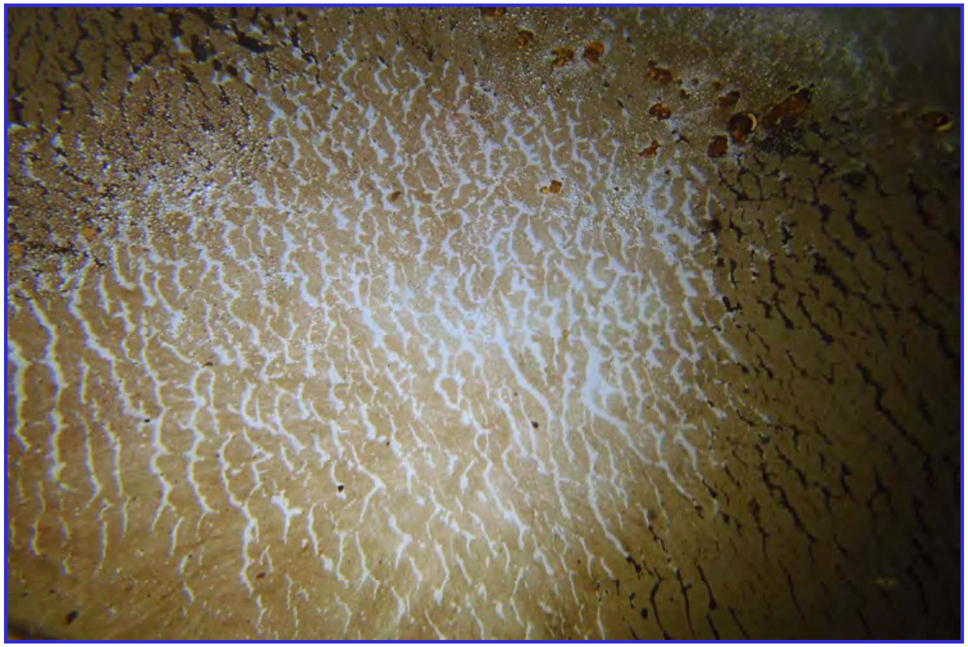
INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -229



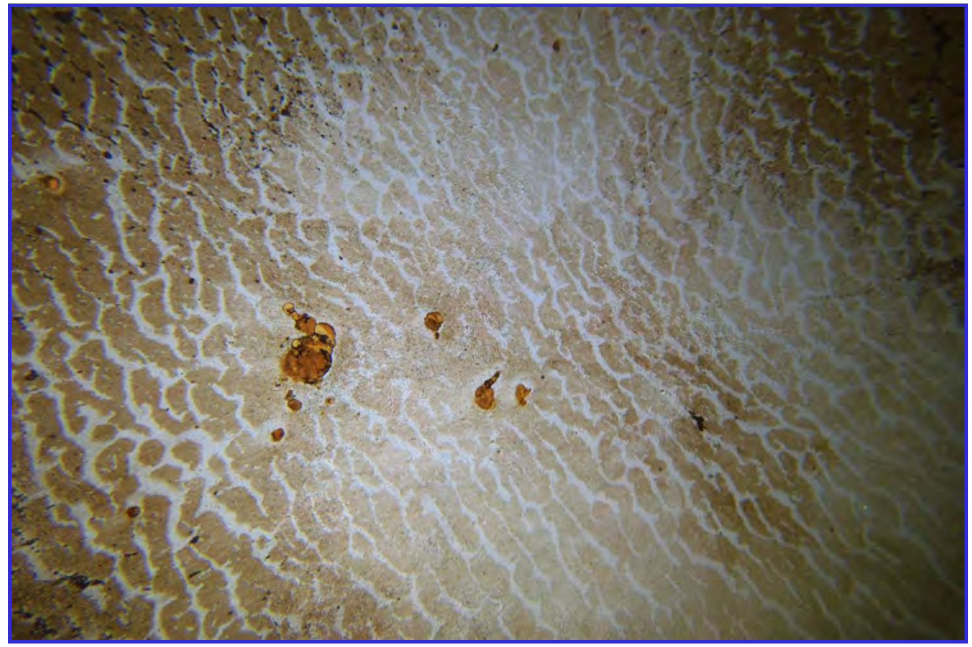
INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -230



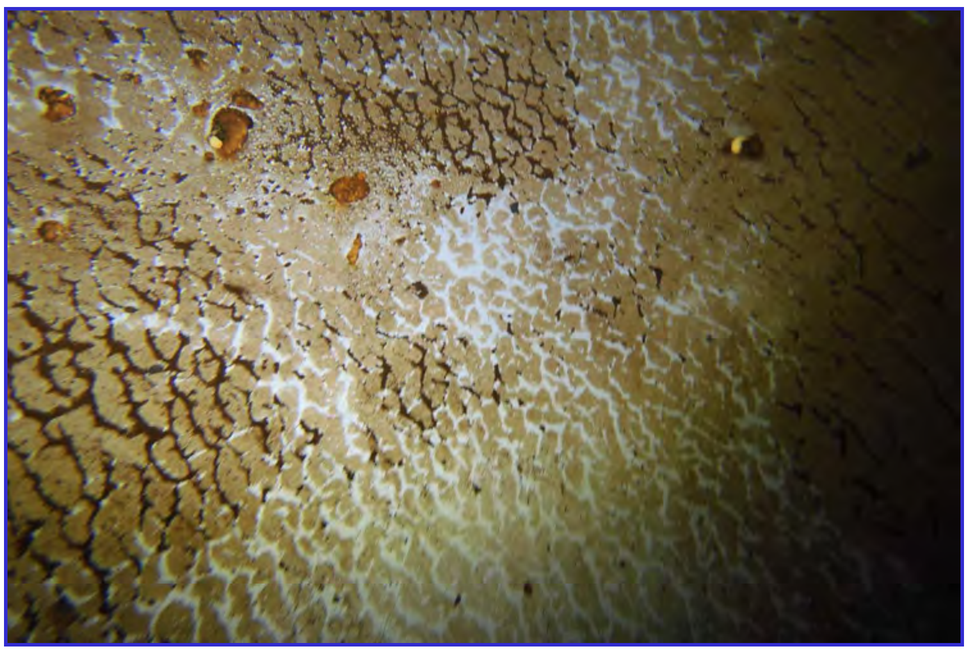
INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -231



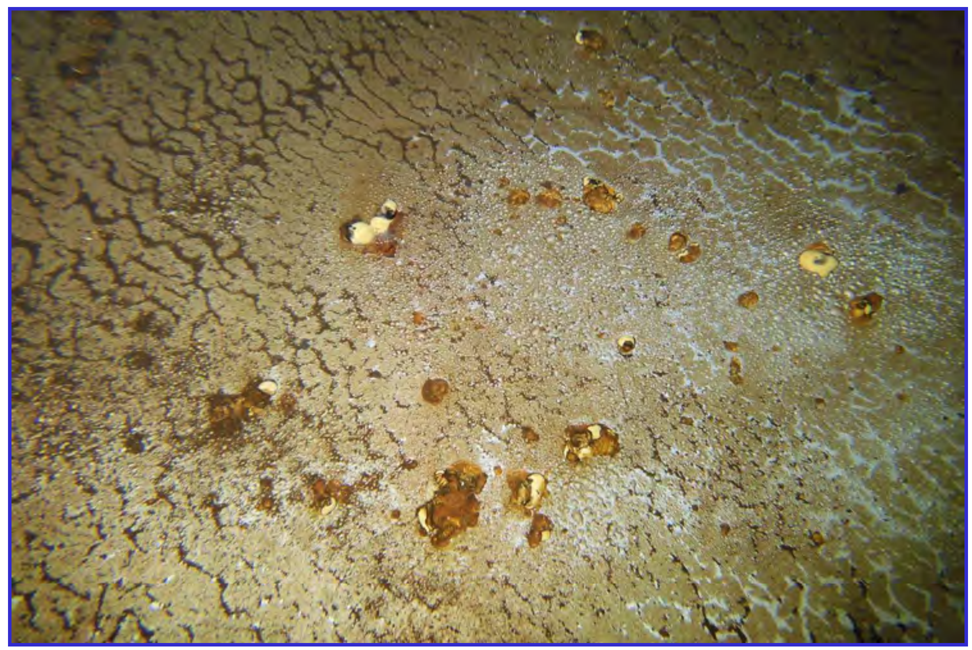
INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -232



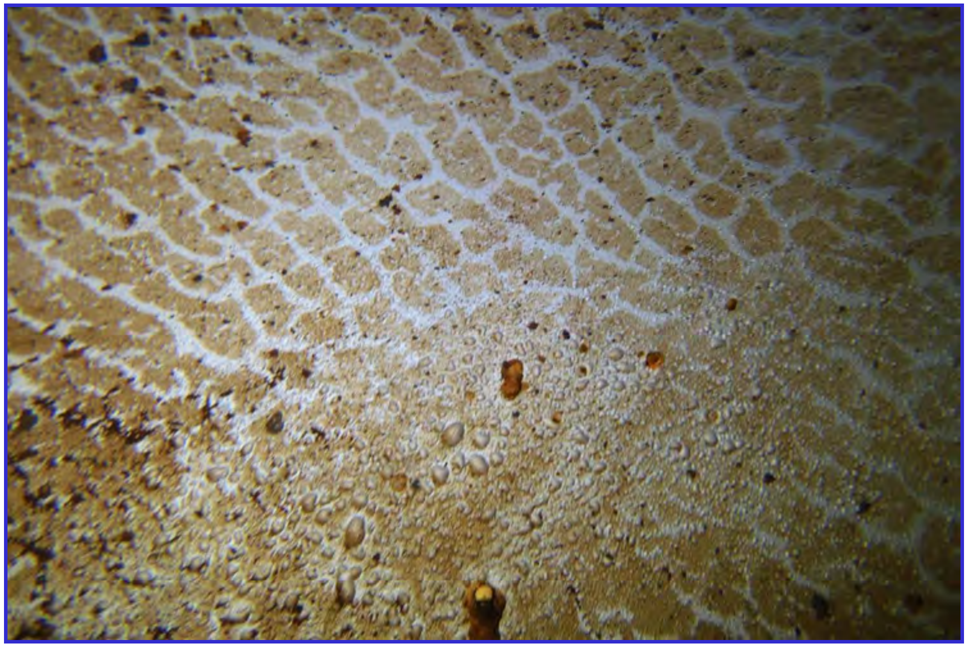
INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -233



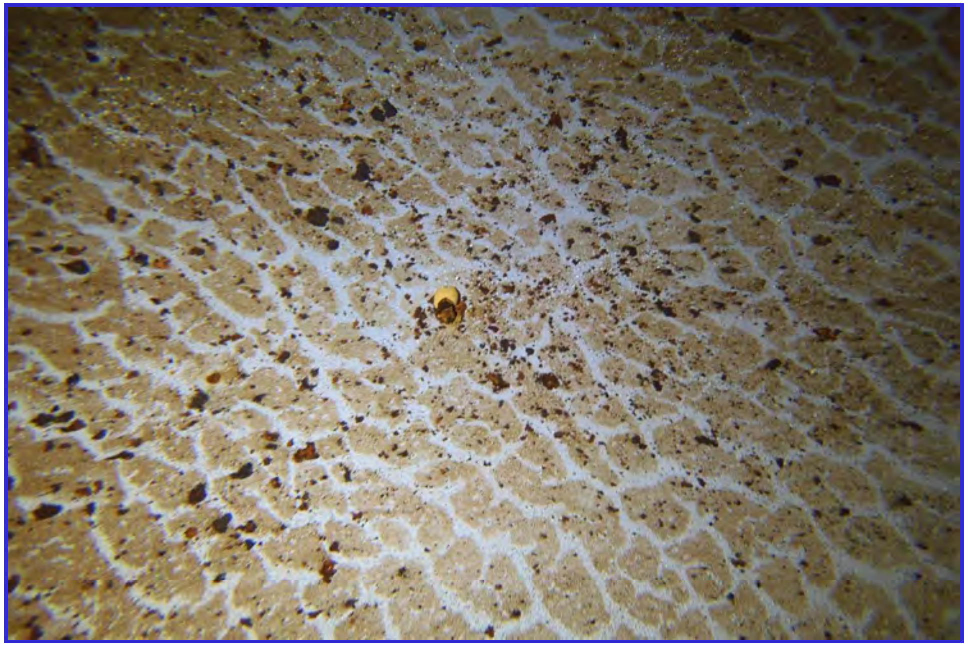
INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -234



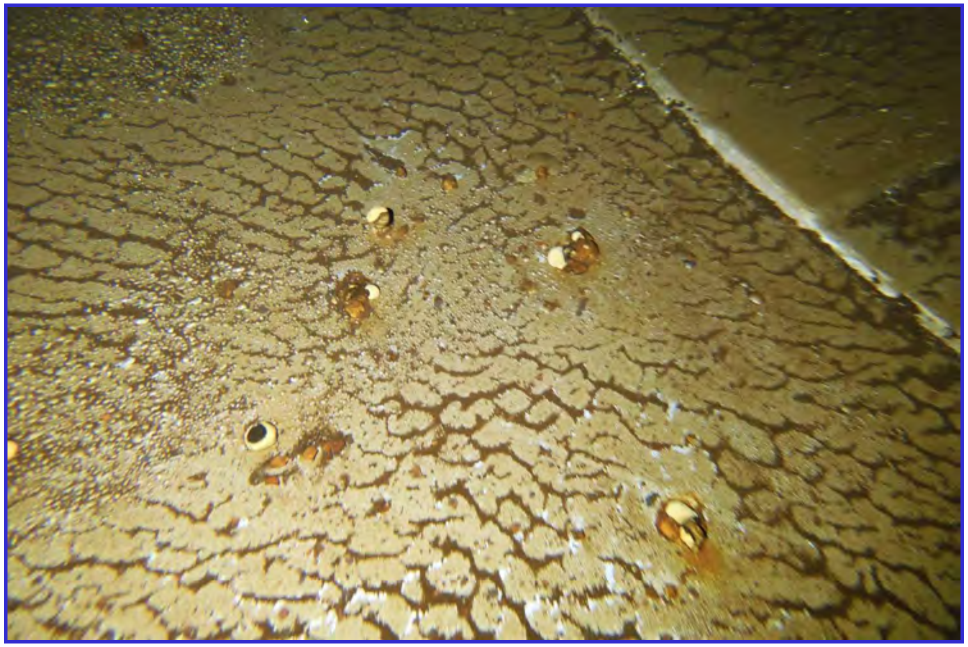
INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -235



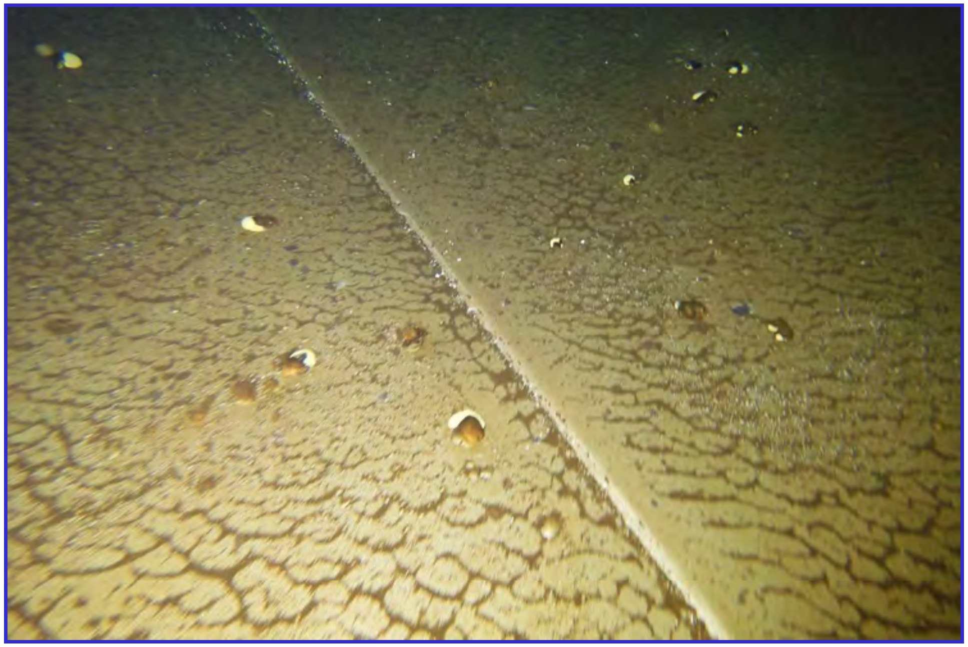
INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -236



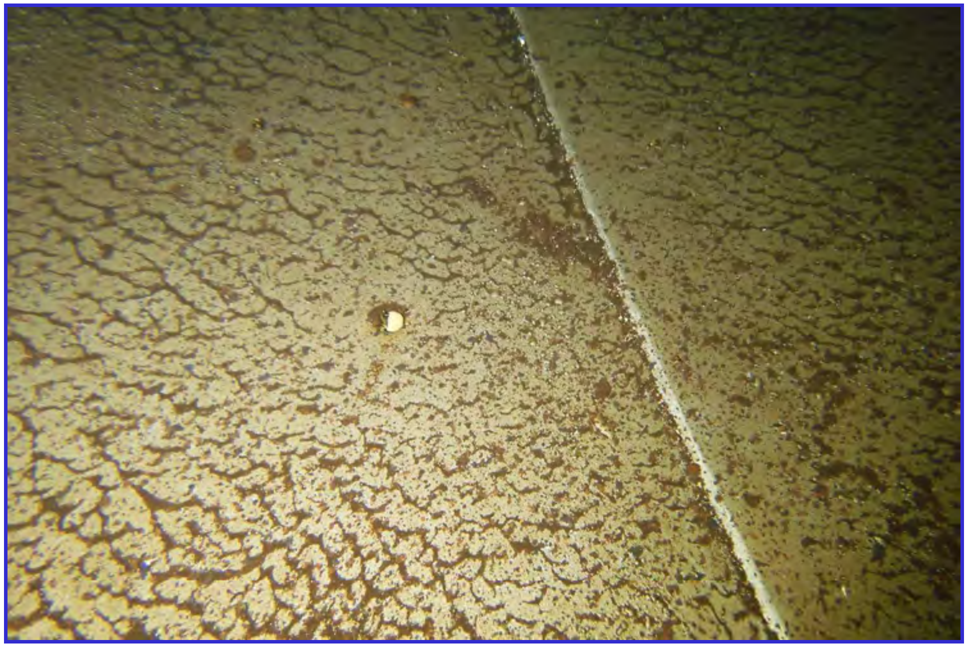
INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -237



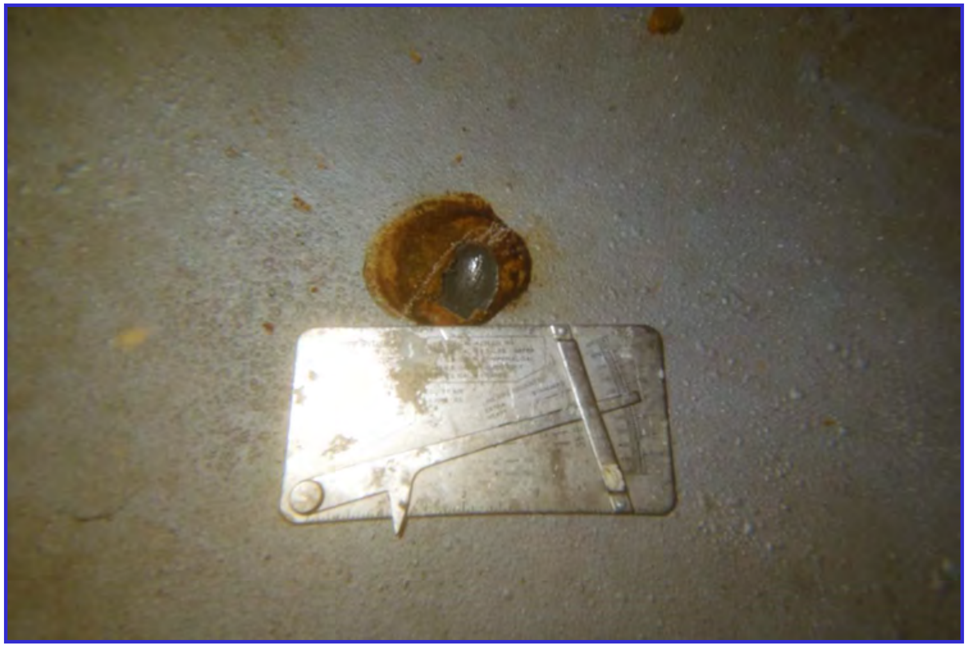
INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -238



INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -239



INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -240



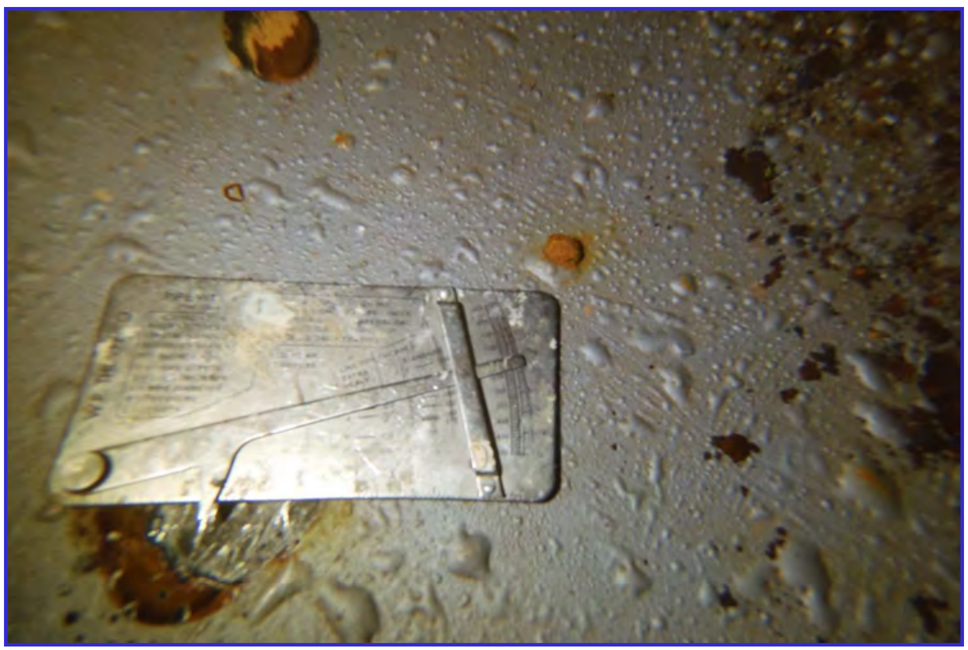
INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -241

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -242

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -243

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -244

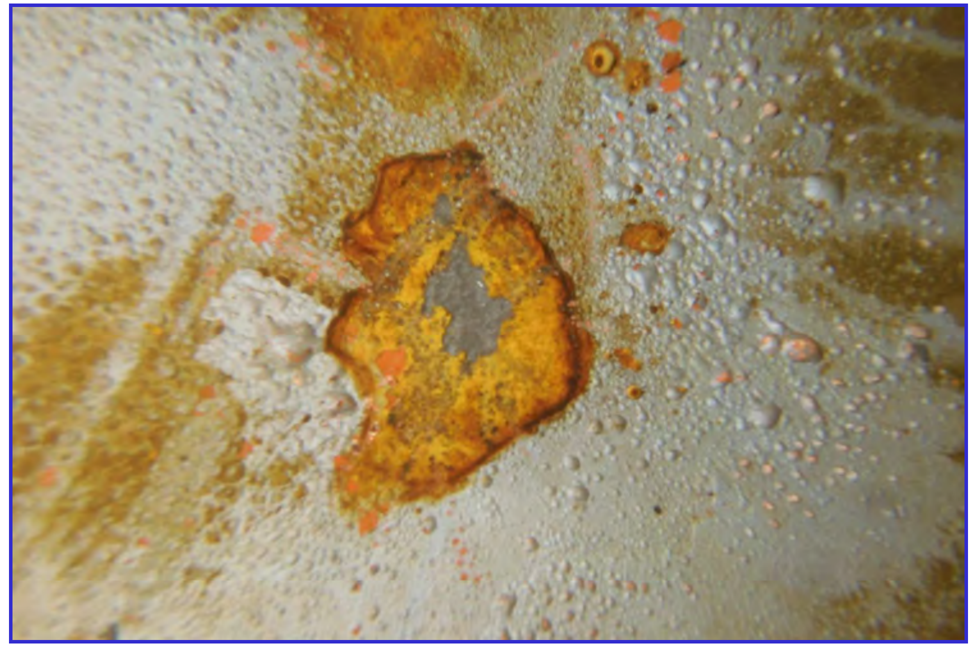
INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -245



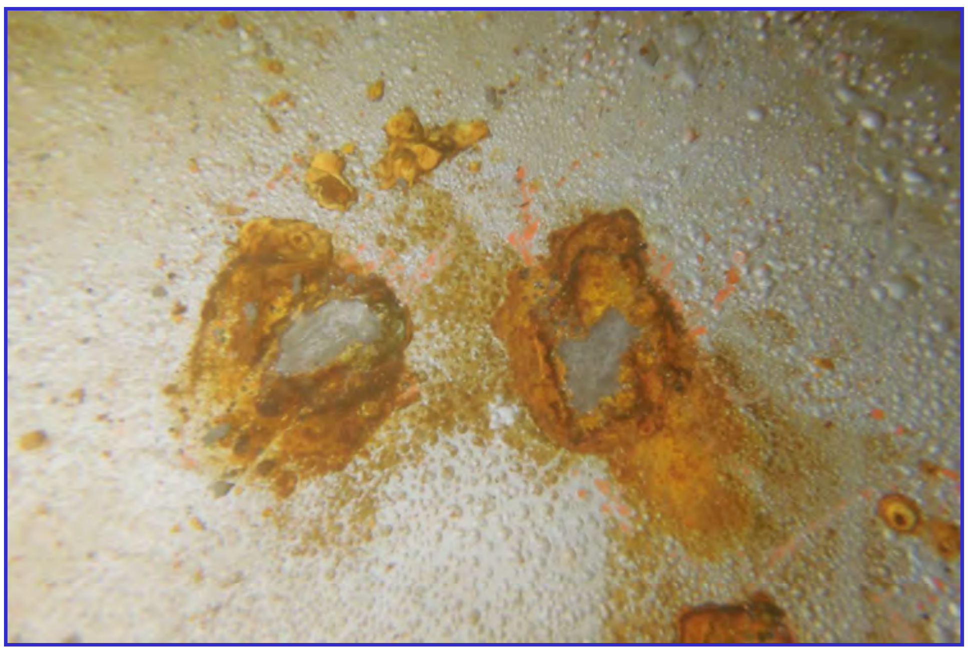
INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -246

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -247

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -248



INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -249



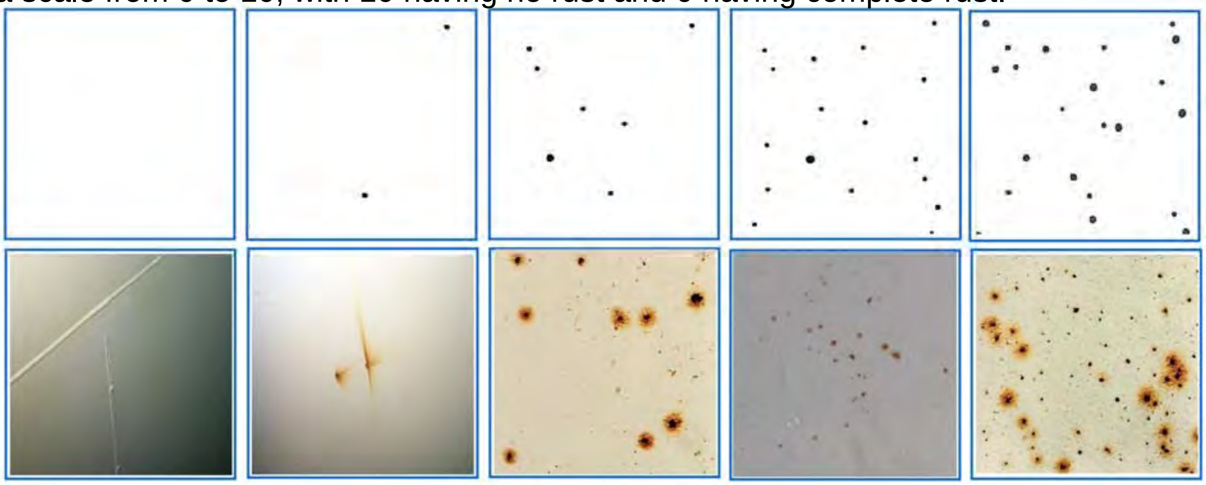
INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -250

INTERIOR - CPUD - San Anderas Reservoir - Maintenance Inspection -251

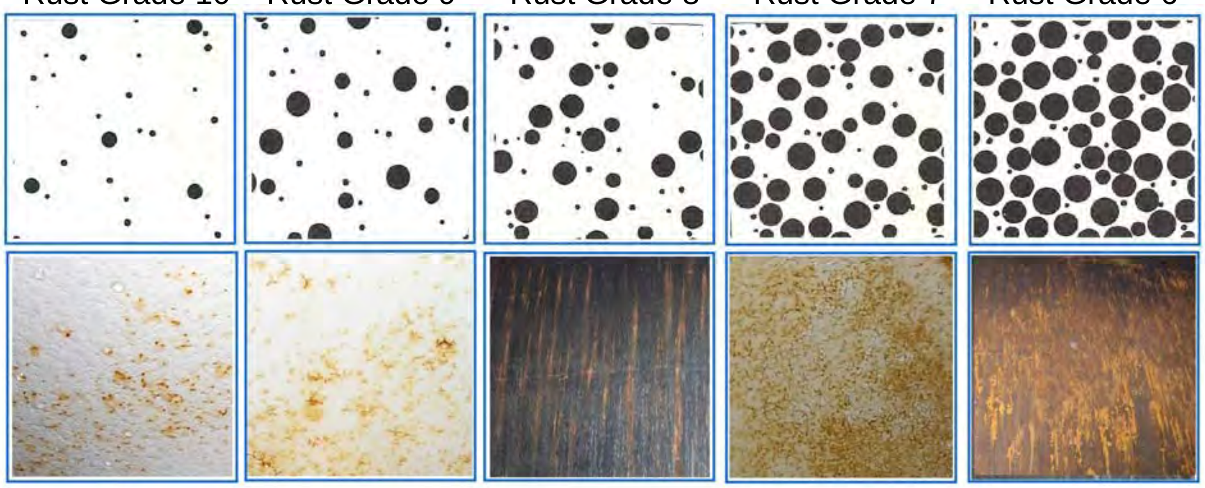
Chart 1 - Condition Rating The table below gives a basic description of the four different categories that CSI Services, Inc. uses to provide a general depiction of the condition of each defined area of a structure. The categories are Poor, Fair, Good, or Excellent. The development of these categories is based on historical knowledge and experience of various paint and lining systems over given periods of time in certain service environments. Basically, the rating is determined based on what should be expected of the paint or lining system at that point in its life cycle. As a result, different determinations are made for maintenance inspection versus warranty inspections. A detailed description of each rating with relative consideration addressed follows:

Rating	General Description of Conditions	
	Maintenance Inspection	**Warranty Inspection**
Poor	This condition is usually prioritized for rework in the short-term. Typically, these surfaces have considerably more coating defects and/or corrosion than what is expected for the age of the system.	This condition identifies an area with wholesale coating defects or corrosion concerns that will typically require significant removal and replacement of the coatings in the area.
Fair	Typically, these surfaces have a level of coating defects and/or corrosion that is slightly worse than what should be expected for the age of the system. This condition is placed on a short-term monitoring schedule.	This condition identifies an area with partial coating defects or corrosion concerns that will require significant rework.
Good	This condition is rated for areas without any considerable coating defects or corrosion. These surfaces are in a condition that is typical for the age of the coating system.	This condition identifies areas with coating defects or corrosion that is typically seen in one-year warranty inspections. Typically, only minor spot repairs are required.
Excellent	This condition is for areas without any considerable coating defects or corrosion. Typically, these surfaces are in a condition that is better than expected for the age of the system.	This condition identified areas that typically are in perfect condition and require no repair work.

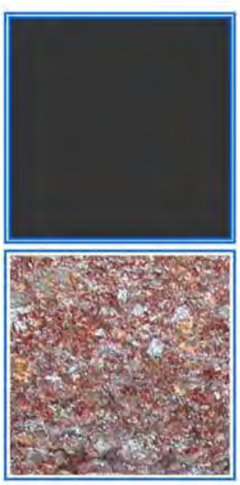
Chart 2 -Rust Grade The black and white figures below depict the standards referenced in ASTM D610 “Standard Test Method for Evaluating Degree of Rusting on Painted Surfaces.” Below each standard is a photographic depiction of each level of corrosion, as used by CSI Services, Inc. The standards depict the percentage of rust on a scale from 0 to 10, with 10 having no rust and 0 having complete rust.



Rust Grade 10 Rust Grade 9 Rust Grade 8 Rust Grade 7 Rust Grade 6



Rust Grade 5 Rust Grade 4 Rust Grade 3 Rust Grade 2 Rust Grade 1



Rust Grade 0

Rust Grade	Description
10	No rusting or less than 0.01% of surface rusted
9	Minute rusting, less than 0.03% of surface rusted
8	Few isolated rust spots, less than 0.1% of surface rusted
7	Less than 0.3% of surface rusted
6	Excessive rust spots, but less than1% of surface rusted
5	Rusting to the extent of 3% of surface rusted
4	Rusting to the extent of 10% of surface rusted
3	Approximately one-sixth of the surface rusted
2	Approximately one-third of the surface rusted
1	Approximately one-half of the surface rusted
0	Approximately 100% of the surface rusted

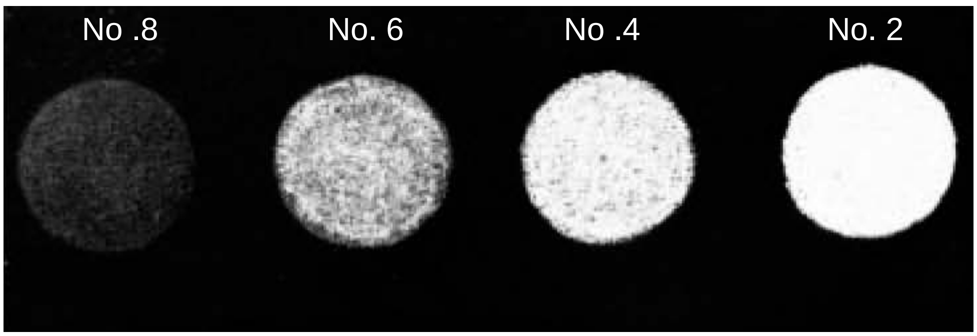
Chart 3 - Corrosion Grade The figure below depicts the photographic standards referenced by CSI Services, Inc. in the determination of the characteristics and stages of corrosion progression. This standard is used to better quantify the level of corrosion once it has progressed to Rust Grades 3, 2, 1, or 0 (see Chart 2). When applicable, CSI classifies an area as one or more of the five different Corrosion Grades. Corrosion Grades 1 through 5 are described below:

Grade	Description	Photo Examples
1	Light Rust - This condition involves relatively light colored rust that does not have any significant metal loss.	 
2	Dark Rust -This condition involves relatively dark colored, thicker rust that is progressing towards the next phase, significant metal loss.	 
3	Pitting - This condition involves isolated or widespread deep spot corrosion (pitting).	  
4	Scale - Also known as lamellar or exfoliation corrosion. The edges of the affected area are leaf like and resemble the separated pages of a wetted book.	 
5	Structural Loss - This condition involves metal loss or failure where components will require structural consideration	 

The photos depicted are examples and were not taken on this project.

Chart 4 - Chalking The figure below depicts the photographic standards referenced in ASTM D4214 “Standard Test Method for Evaluating the Degree of Chalking of Exterior Paint Films,” Method D659, Method C. Generally speaking, chalking is the degradation of a paint’s binder leaving behind loose pigments as the binder reacts with the environment, primarily ultraviolet light and oxygen. Evaluating chalking is a means to measure the performance of a coating system and its life cycle projection. It is also important to quantify for consideration of future overcoating options. This test uses these pictorial standards to quantify the amount of chalking present on paint films. The depictions below represent the mount of colored chalk removed onto a cloth during the test. The scale ranges from 2 to 8 with the rating 2 having the most chalk.

Light Colored Paints



Dark Colored Paints

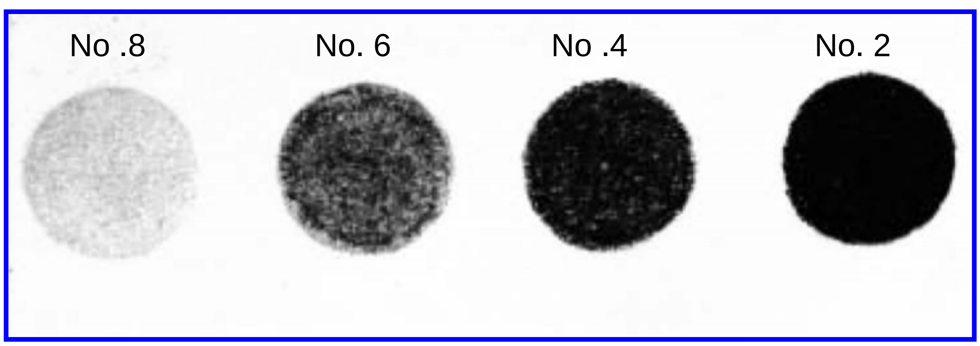
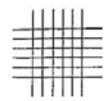
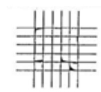
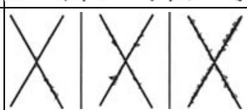
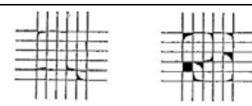
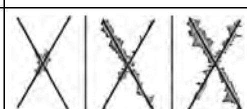
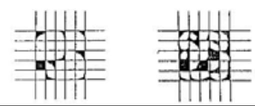
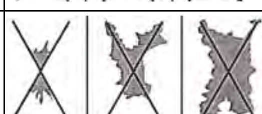
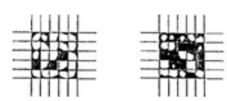
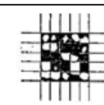
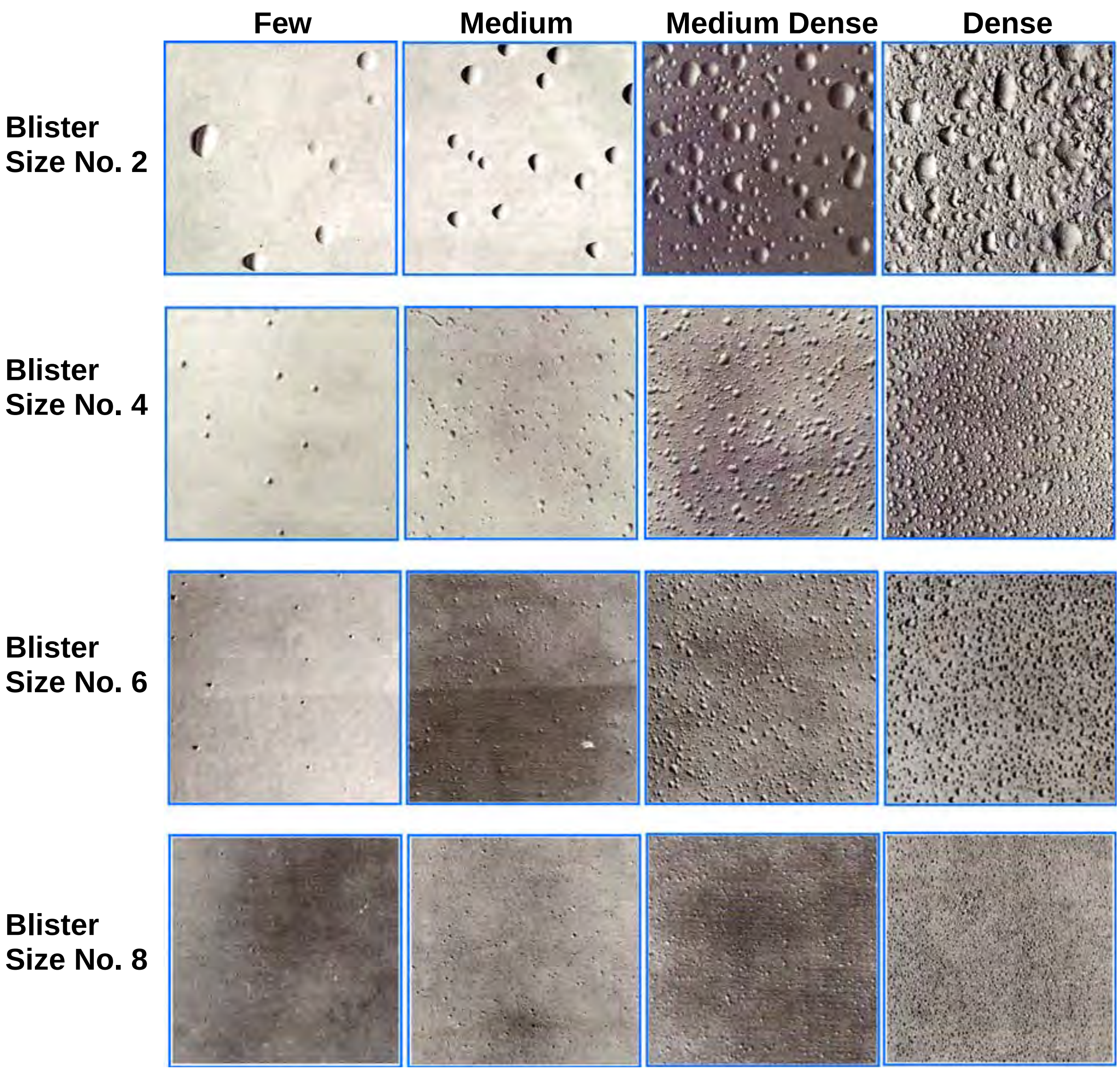


Chart 5 - Adhesion Rating The figures below depict the photographic standards and criteria referenced in ASTM D3359 “Standard Test Method for Evaluating Adhesion by Tape Test” and ASTM D6677 “Standard Test Method for Evaluating Adhesion by Knife.” Both Standards are used to assess the condition of a paint system for life-cycle projections. It is also used to evaluate an existing paint system’s ability to withstand the added stress that any overcoating strategies can create. Depending upon the thickness of the paint system, ASTM D3359 has two different test methods. The rating criteria for both standards follow:

ASTM D3359					
Method A			Method B		
Rating	**Observation**	**Surface of X-cut from which flaking/peeling has occurred**	**Rating**	**Percent Area Removed**	**Surface of cross-cut area from which flaking has occurred for six parallel cuts and adhesion range by percent**
5A	No peeling or removal	None	5B	0% none	
4A	Trace peeling or removal along incisions or their intersection		4B	Less than 5%	
3A	Jagged Removal along incisions up to 1/16” on either side		3B	5 – 15%	
2A	Jagged removal along most of incisions up to 1/8” on either side		2B	15 – 35%	
1A	Removal from most of the area of the X under the tape		1B	35-65%	
0A	Removal beyond the area of the X		0B	Greater than 65%	

ASTM D6677	
Rating	Description
10	Fragments no larger than $\frac{1}{32}$” x $\frac{1}{32}$” can be removed with difficulty
8	Chips up to $\frac{1}{8}$” x $\frac{1}{8}$” can be removed with difficulty
6	Chips up to $\frac{1}{4}$” x $\frac{1}{4}$” can be removed with slight difficulty
4	Chips larger than $\frac{1}{4}$” x $\frac{1}{4}$” can be removed with slight pressure
2	Once coating removal is initiated by knife, it can be peeled at least $\frac{1}{4}$”
0	Coating can be peeled easily to length greater than $\frac{1}{4}$”

Chart 6 – Blistering Rating The figure below depicts the photographic standards referenced in ASTM D714 “Standard Test Method for Evaluating Degree of Blistering of Paints”. This test uses these pictorial standards to quantify both the size and density of blisters that may develop in linings. Although the standard uses a blister size scale of 0 to 10 this chart uses the most common sizes of blisters found in the field. The standard does not use a reference for the size of each of the blisters depicted. CSI used this scale as a means for further quantification by qualifying the largest blister depicted as being 1 inch in width (Blister Size No. 2) and the smallest blister being 1/32 of an inch in width (Blister Size No. 8).



Appendix D

Available Fire Flow Results

ID	Static Demand (gpm)	Static Pressure (psi)	Static Head (ft)	Fire-Flow Demand (gpm)	Residual Pressure (psi)	Hydrant Available Flow (gpm)	Hydrant Pressure at Available Flow (psi)
10H-10	0	158.21	1,365.72	1,500.00	136.71	4,337.18	20
10H-130	0	52.07	940.26	1,000.00	49.5	3,914.07	20
10H-40	0	92.45	1,433.55	1,000.00	78.99	2,572.83	20
10H-80	0	87.91	1,120.51	1,500.00	73.47	3,484.86	20
10H-90	0	85.11	1,120.52	1,500.00	79.36	5,476.79	20
10WH-155	0	191.65	1,311.34	1,000.00	180.14	4,010.08	20
11H-10	0	82.91	1,843.04	1,000.00	78.06	4,246.55	20
12H-100	0	122.7	1,842.60	1,000.00	100.41	2,352.05	20
12H-120	0	78.98	1,842.60	1,000.00	62.53	2,063.03	20
12H-130	0	70.93	1,842.61	1,000.00	56.27	2,032.31	20
12H-140	0	131.48	1,842.63	1,000.00	96.78	1,905.27	20
12H-60	0	48	1,630.50	1,000.00	42.27	2,413.01	20
12H-80	0	115.67	1,842.63	1,500.00	75.82	2,439.03	20
13H-70	0	72.38	1,630.35	1,500.00	55.55	2,840.55	20
14H-40	0	130.17	1,630.29	1,000.00	104.57	2,252.94	20
14H-50	0	145.84	1,630.28	1,000.00	104.98	1,863.08	20
15H-10	0	103.77	1,633.17	1,500.00	79.91	3,029.83	20
15H-130	0	87.68	1,633.09	1,000.00	66.09	1,904.95	20
15H-160	0	65.49	1,633.08	1,000.00	27.6	1,107.69	20
15H-50	0	115.4	1,633.14	1,500.00	85.82	2,886.19	20
16H-10	0	104.58	1,851.70	1,000.00	78.4	1,937.27	20
16H-110	0	69.28	1,862.78	1,000.00	65.63	7,067.62	20
16H-150	0	79.98	1,862.77	1,000.00	56.39	1,702.73	20
16H-50	0	156.7	1,851.71	1,500.00	145.66	6,547.07	20
17H-10	0	130.42	1,311.35	1,000.00	121.34	3,643.52	20
17H-30	0	86.16	1,311.35	1,000.00	75.31	2,712.07	20
17H-60	0	88.03	1,433.53	1,500.00	3.07	1,325.96	20
17H-90	0	173.17	1,433.61	1,000.00	160.53	4,043.82	20
18H-110	0	100.44	2,988.31	1,500.00	78.14	3,020.94	20
18H-120	0	82.62	2,988.31	1,000.00	74.46	3,060.13	20
18H-130	0	47.83	2,988.32	1,000.00	43.5	2,792.86	20
18H-140	0	61.27	2,988.32	1,500.00	38.23	2,061.39	20
18H-60	0	11.73	2,740.53	1,000.00	10.11	0.35	11.73
1H-10	0	43.68	1,004.91	1,500.00	38.88	3,594.43	20
1H-50	0	115.2	1,226.44	1,500.00	91.02	3,717.17	20
2H-20	0	82.22	1,246.69	1,900.00	15.02	1,819.26	20
2H-40	0	53.52	1,246.70	1,900.00	-5.7	1,374.15	20
3H-40	0	56.46	1,246.71	1,000.00	38.57	1,510.92	20
4H-100	0	75.71	1,162.02	1,500.00	55.51	2,606.95	20
4H-60	0	71.13	1,162.01	1,500.00	53.53	2,683.27	20
5H-10	0	70.17	1,364.67	1,000.00	59.17	2,479.31	20
5H-100	0	89.67	1,363.64	1,500.00	46.07	1,957.96	20
5H-120	0	98.6	1,363.58	1,000.00	90.77	4,277.04	20
5H-200	0	57.37	1,217.35	1,000.00	45.62	1,883.92	20
5H-220	0	62.58	1,217.35	1,000.00	55.9	2,758.43	20
5H-40	0	66.49	1,364.73	1,000.00	59.77	3,370.66	20
6H-140	0	85.64	1,365.23	1,500.00	73.95	4,222.48	20
6H-160	0	58.98	1,365.22	1,000.00	39.59	1,493.71	20
6H-50	0	122.33	1,365.15	1,500.00	115.2	8,174.47	20
6H-60	0	123.96	1,365.44	1,500.00	112.73	5,548.00	20
7H-10	0	86.01	1,365.08	1,500.00	57.82	2,437.81	20
7H-130	0	102.26	1,226.79	1,000.00	88.02	3,678.66	20
7H-160	0	87.11	1,227.45	1,500.00	79.53	5,488.24	20
7H-180	0	82.12	1,227.75	1,500.00	66.22	2,870.97	20
7H-40	0	91.76	1,365.00	1,000.00	86.7	5,470.68	20
7H-70	0	58.55	1,433.54	1,000.00	42.95	1,664.80	20
8H-40	0	97.8	1,226.81	1,500.00	77.94	5,867.31	20
8H-60	0	150.39	1,365.75	1,500.00	143.97	6,005.59	20
9H-100	0	39.89	1,004.91	1,500.00	37.21	4,095.94	20
9H-20	0	95.76	1,226.86	1,500.00	82.09	5,217.85	20
9H-40	0	114	1,226.60	1,500.00	93.7	4,211.07	20
FH-NO_ID_3	0	129.13	1,842.91	1,000.00	110.19	2,644.72	20
FH-NO_ID_4	0	52.97	940.26	1,000.00	46.03	2,321.79	20
FH-NO_ID_6	0	59.56	1,246.69	1,000.00	39.45	1,477.89	20
J1000	0	74.42	1,633.08	1,000.00	25.16	1,057.00	20
J1002	0	122.85	1,633.14	1,000.00	105.56	2,714.85	20
J1004	0	87.46	1,433.52	1,000.00	38.68	1,197.72	20
J1006	0	73.03	1,311.35	1,000.00	58.14	2,010.80	20
J1008	0	139.11	1,311.33	1,000.00	87.93	1,584.27	20
J1010	0	55	940.26	1,000.00	54.97	7,930.15	20
J1012	0	66.71	1,433.54	1,000.00	41.96	1,423.69	20
J1014	0	70.41	1,120.51	1,500.00	60.22	3,582.72	20
J1016	0	170.61	1,365.72	1,500.00	150.55	4,754.26	20
J1018	0	102.48	1,226.82	1,500.00	84.02	6,586.66	20
J102	7.32	199.86	1,433.58	1,000.00	195.56	8,709.55	20
J1020	0	46.53	1,004.91	1,500.00	22.84	1,594.93	20
J1022	0	121.43	1,226.54	1,500.00	99.78	4,200.44	20
J1024	0	62.09	1,246.69	1,000.00	40.39	1,463.32	20
J1026	0	83.5	1,227.79	1,500.00	77.58	4,995.90	20
J1028	0	61.49	1,217.35	1,000.00	48.22	1,866.02	20
J1030	0	126.09	1,365.44	1,500.00	115.09	5,692.58	20
J1032	0	47.73	1,365.22	1,000.00	21.62	1,034.89	20
J1034	0	68.71	1,365.06	1,000.00	55.94	2,187.19	20
J1038	0	78.9	1,162.01	1,500.00	54.28	2,410.97	20
J104	4.18	79.12	1,311.35	1,000.00	66.99	2,398.63	20

ID	Static Demand (gpm)	Static Pressure (psi)	Static Head (ft)	Fire-Flow Demand (gpm)	Residual Pressure (psi)	Hydrant Available Flow (gpm)	Hydrant Pressure at Available Flow (psi)
J1040	0	68.9	1,364.66	1,500.00	53.08	2,948.59	20
J1042	0	67.78	1,364.66	1,000.00	46.93	1,613.38	20
J1044	0	99.42	2,988.31	1,000.00	90.14	3,243.17	20
J1046	0	82.62	2,988.31	1,000.00	74.5	3,069.39	20
J1048	0	61.27	2,988.32	1,000.00	50.73	2,110.33	20
J1050	0	47.83	2,988.32	1,000.00	43.94	2,973.46	20
J1052	0	11.38	2,740.53	1,000.00	10.47	0.02	11.38
J1054	0	23.91	2,735.66	1,000.00	19.88	977.27	20
J1056	0	69.14	1,862.78	1,000.00	66.14	10,433.63	20
J1060	0	79	1,862.77	1,000.00	55.64	1,696.57	20
J1062	0	155.55	1,851.71	1,000.00	150.47	7,409.77	20
J1066	0	104.58	1,851.70	1,000.00	78.47	1,940.08	20
J1068	0	127.89	1,842.91	1,000.00	111.72	2,881.84	20
J1070	0	82.91	1,843.04	1,000.00	78.26	4,361.90	20
J1072	0	45.81	1,630.50	1,000.00	41.01	2,555.49	20
J1074	0	72.38	1,630.35	1,500.00	55.64	2,849.93	20
J1076	0	116.84	1,842.63	1,500.00	79.02	2,529.51	20
J1078	0	131.48	1,842.63	1,000.00	96.95	1,910.77	20
J1080	0	145.84	1,630.28	1,500.00	62.11	1,877.44	20
J1082	0	130.17	1,630.29	1,000.00	104.58	2,253.41	20
J1088	0	123.41	1,842.60	1,000.00	102.66	2,461.94	20
J1090	0	79.14	1,842.60	1,000.00	63.63	2,140.60	20
J1092	0	65.49	1,633.08	1,000.00	27.61	1,107.88	20
J1094	0	88.7	1,633.09	1,000.00	67.53	1,942.82	20
J1096	0	115.39	1,633.14	1,500.00	86.56	2,928.89	20
J1098	0	103.77	1,633.17	1,500.00	80.38	3,064.52	20
J110	8.36	123.72	1,842.67	1,500.00	117.06	7,540.91	20
J1100	0	89.48	1,433.53	1,000.00	49.69	1,365.11	20
J1102	0	171.71	1,433.61	1,000.00	159.92	4,195.76	20
J1104	0	87.07	1,311.35	1,000.00	76.42	2,760.38	20
J1106	0	130.42	1,311.35	1,000.00	121.4	3,651.30	20
J1110	0	193.87	1,311.34	1,000.00	183.24	4,151.29	20
J1112	0	52.07	940.26	1,000.00	49.99	4,392.94	20
J1114	0	50.49	940.26	1,000.00	47.67	3,622.83	20
J1116	0	87.15	1,433.55	1,000.00	79.28	3,429.71	20
J1118	0	58.55	1,433.54	1,000.00	42.97	1,665.89	20
J112	4.18	112.33	1,842.64	1,000.00	106.25	4,890.48	20
J1120	0	88.61	1,120.51	1,500.00	76.4	3,843.93	20
J1122	0	120	1,120.53	1,000.00	120	7,325.74	20
J1124	0	255.63	1,433.55	1,000.00	248.5	7,327.61	20
J1126	0	85.95	1,120.52	1,500.00	80.98	5,622.27	20
J1128	0	160.78	1,365.72	1,500.00	143.28	4,990.98	20
J1130	0	151.66	1,365.75	1,000.00	145.91	6,585.73	20
J1132	0	97.8	1,226.81	1,500.00	78.24	5,959.33	20
J1134	0	100.48	1,226.79	1,000.00	87.08	3,956.84	20
J1136	0	39.35	1,004.91	1,500.00	38.21	4,310.71	20
J1138	0	43.49	1,004.91	1,500.00	39.64	4,025.16	20
J114	4.18	112.28	1,842.64	1,000.00	106.25	4,918.99	20
J1140	0	96.48	1,226.86	1,500.00	85.24	6,307.37	20
J1142	0	116.48	1,226.44	1,500.00	94.99	4,157.26	20
J1144	0	59.56	1,246.69	1,000.00	40.32	1,517.36	20
J1146	0	57.24	1,246.71	1,000.00	39.89	1,557.89	20
J1148	0	82.67	1,246.69	1,000.00	61.79	1,877.92	20
J1150	0	53.8	1,246.70	1,000.00	35.44	1,425.66	20
J1152	0	87.14	1,227.45	1,500.00	81.36	6,474.60	20
J1154	0	81.75	1,227.75	1,500.00	67.49	3,070.84	20
J1156	0	56.86	1,217.35	1,000.00	45.52	1,907.61	20
J1158	0	64.43	1,217.35	1,000.00	58.59	3,044.50	20
J116	7.32	63.22	1,633.09	1,000.00	38.18	1,368.58	20
J1160	0	123.07	1,365.44	1,500.00	117	8,973.75	20
J1162	0	123.6	1,365.15	1,500.00	117.38	9,588.89	20
J1164	0	58.81	1,365.22	1,000.00	40.5	1,542.27	20
J1166	0	86.7	1,365.23	1,500.00	78.81	5,745.58	20
J1168	0	85.06	1,365.08	1,000.00	73.35	2,725.97	20
J1170	0	91.76	1,365.00	1,000.00	86.76	5,536.32	20
J1172	0	74.15	1,162.02	1,500.00	54.75	2,624.45	20
J1174	0	71.13	1,162.01	1,500.00	53.62	2,690.13	20
J1176	0	89.34	1,363.64	1,500.00	50.9	2,101.87	20
J1178	0	98.47	1,363.58	1,000.00	91.84	4,977.66	20
J1180	0	68.75	1,364.67	1,000.00	58.42	2,546.08	20
J1184	0	66.49	1,364.73	1,000.00	60	3,469.46	20
J1194	0	114.01	1,226.60	1,000.00	104.61	4,748.04	20
J1196	0	591.81	1,365.81	1,500.00	562.51	7,742.20	20
J1198	0	591.81	1,365.81	1,500.00	549.41	6,257.89	20
J120	5.25	102.82	1,433.54	1,000.00	72.8	1,770.25	20
J1200	0	591.81	1,365.81	1,500.00	555.42	6,829.40	20
J1202	0	591.81	1,365.81	1,500.00	544.5	5,881.01	20
J1204	0	150.18	1,365.81	1,000.00	146.5	9,048.29	20
J1208	0	59.35	1,246.70	1,500.00	22.27	1,551.98	20
J1210	0	1,185.36	2,735.66	1,500.00	1,148.55	10,123.74	20
J1212	0	9.23	1,433.53	1,500.00	-85.56	0.01	9.23
J122	4.18	88.02	1,433.53	1,000.00	48.13	1,351.35	20
J124	5.25	82.9	1,433.53	1,000.00	48.34	1,403.50	20
J128	7.32	74.42	1,630.55	1,000.00	73.31	6,688.37	20
J130	3.14	60.8	1,433.55	1,000.00	52.73	2,556.25	20

ID	Static Demand (gpm)	Static Pressure (psi)	Static Head (ft)	Fire-Flow Demand (gpm)	Residual Pressure (psi)	Hydrant Available Flow (gpm)	Hydrant Pressure at Available Flow (psi)
J132	6.29	82.86	1,120.51	1,500.00	76.62	5,308.81	20
J140	10.47	202.76	1,311.34	1,000.00	191.1	4,111.18	20
J142	4.18	86.42	1,120.51	1,500.00	78.65	4,851.18	20
J144	9.43	159.47	1,365.72	1,500.00	144.39	5,472.57	20
J146	4.18	114.57	1,365.83	1,500.00	110.39	11,543.25	20
J150	5.25	65.29	1,433.54	1,000.00	42.77	1,481.45	20
J152	5.25	121.76	1,365.60	1,500.00	117.16	11,398.90	20
J154	4.18	104.92	1,365.34	1,500.00	98.05	7,339.11	20
J158	7.32	100.09	1,365.24	1,500.00	93.28	7,277.57	20
J160	3.14	123.84	1,365.52	1,500.00	119.07	11,297.61	20
J164	4.18	123.22	1,365.44	1,500.00	117.12	8,941.38	20
J176	10.47	134.24	1,850.62	1,000.00	132.31	21,129.91	20
J196	3.14	53.57	940.26	1,000.00	52	5,256.50	20
J210	6.29	101.78	1,226.82	1,500.00	84.49	7,242.23	20
J214	8.36	146.79	1,365.77	1,000.00	140.73	6,109.78	20
J222	7.32	64.76	1,217.36	1,500.00	61.75	9,790.87	20
J224	4.18	126.68	1,363.11	1,500.00	112.21	5,300.99	20
J232	5.25	73.09	1,246.58	1,500.00	69.89	4,910.41	20
J234	14.65	79.24	1,227.74	1,500.00	50.88	2,271.99	20
J236	13.61	235.5	1,433.57	1,000.00	230.49	8,737.58	20
J238	8.36	247.32	1,433.56	1,000.00	242.02	8,674.41	20
J240	6.29	157.51	1,311.36	1,000.00	154.18	5,174.32	20
J242	5.25	254.3	1,433.55	1,000.00	247.21	7,337.12	20
J244	11.5	165.1	1,365.72	1,500.00	145.92	4,802.14	20
J246	13.61	151.39	1,365.72	1,500.00	135.07	5,034.91	20
J248	7.32	144.43	1,365.77	1,000.00	140	7,797.46	20
J250	20.93	115.13	1,365.81	1,500.00	110.26	10,027.01	20
J252	8.36	118.54	1,365.75	1,500.00	114.21	11,597.26	20
J254	5.25	124.67	1,365.44	1,500.00	119.53	10,820.40	20
J256	6.29	78.3	1,860.23	1,000.00	75.41	13,248.83	20
J258	7.32	281.91	1,433.56	1,000.00	276.16	8,901.62	20
J262	15.71	131.81	1,842.53	1,000.00	126.99	6,544.73	20
J266	7.32	80.31	2,988.31	1,000.00	72.39	3,054.90	20
J276	8.36	218.74	2,723.56	1,000.00	210.6	10,572.02	20
J278	4.18	70.41	1,862.78	1,000.00	65.84	5,407.02	20
J280	4.18	71.86	1,862.78	1,000.00	56.45	2,028.86	20
J282	4.18	76.26	1,862.77	1,000.00	67.01	3,021.03	20
J284	4.18	64.18	1,862.77	1,000.00	44.84	1,615.00	20
J286	5.25	79.23	1,862.77	1,000.00	64.3	2,245.33	20
J288	4.18	117.9	1,862.76	1,000.00	72.21	1,532.48	20
J290	6.29	147.5	1,860.21	1,000.00	95.89	1,659.71	20
J292	7.32	134.22	1,855.38	1,000.00	131.57	18,389.19	20
J294	6.29	105.39	1,855.38	1,000.00	72.62	1,719.34	20
J296	8.36	153.1	1,851.71	1,500.00	150.18	21,662.98	20
J298	6.29	106.07	1,851.71	1,000.00	88.89	2,520.10	20
J300	8.36	116.13	1,851.70	1,000.00	92.73	2,232.56	20
J302	5.25	150.43	1,846.06	1,000.00	149.57	30,638.23	20
J304	5.25	104.31	1,843.08	1,000.00	103.21	13,234.07	20
J306	4.18	64.37	1,842.97	1,000.00	22.47	1,036.17	20
J308	3.14	49.61	1,842.97	1,000.00	47.95	5,789.05	20
J310	4.18	88.88	1,630.51	1,000.00	42.26	1,242.50	20
J312	11.5	160.76	1,842.90	1,000.00	136.57	2,668.92	20
J314	11.5	98.68	1,842.88	1,000.00	33.54	1,121.27	20
J316	12.57	73.48	1,630.52	1,000.00	42.73	1,368.29	20
J318	10.47	50.18	1,630.55	1,000.00	43.15	2,250.02	20
J320	6.29	137.72	1,842.91	1,000.00	120.68	2,944.08	20
J322	7.32	142.11	1,842.89	1,000.00	114.96	2,308.94	20
J326	12.57	75.22	1,630.55	1,000.00	73.13	6,032.04	20
J336	3.14	146.8	3,046.74	1,000.00	145.37	11,517.62	20
J340	5.25	115.48	3,046.74	1,000.00	103.04	3,038.38	20
J342	3.14	98.46	3,046.74	1,000.00	65.18	1,596.31	20
J344	4.18	113.04	3,046.73	1,000.00	74.57	1,619.62	20
J346	5.25	154.62	3,046.73	1,000.00	98.33	1,610.78	20
J348	4.18	158.52	2,727.65	1,000.00	152.13	9,832.64	20
J350	12.57	23.25	2,735.66	1,000.00	18.45	766.12	20
J352	2.1	85.26	1,851.70	1,000.00	54.83	1,537.55	20
J354	3.14	105.28	1,842.97	1,000.00	95.43	3,361.50	20
J356	3.14	106.46	1,842.93	1,000.00	93.71	2,929.83	20
J358	7.32	132.16	1,842.89	1,500.00	81.49	2,334.63	20
J360	4.18	132.46	1,842.89	1,500.00	80.66	2,306.10	20
J364	3.14	126.63	1,842.89	1,500.00	67.2	2,073.87	20
J366	7.32	77.96	1,630.50	1,000.00	75.98	6,233.36	20
J368	8.36	75.47	1,630.45	1,500.00	69.8	5,518.08	20
J370	8.36	67	1,630.44	1,500.00	58.31	3,890.38	20
J372	10.47	40.44	1,630.52	1,000.00	37.14	2,789.63	20
J374	6.29	63.12	1,630.41	1,500.00	54.87	3,856.49	20
J376	7.32	65.03	1,630.42	1,500.00	57.86	4,297.21	20
J378	9.43	71.78	1,630.38	1,500.00	61.52	3,778.19	20
J380	3.14	89.4	1,630.38	1,000.00	80.82	3,240.42	20
J382	6.29	76.59	1,630.36	1,500.00	65.35	3,766.18	20
J384	12.57	81.49	1,630.35	1,500.00	69.76	3,858.02	20
J386	8.36	94.13	1,630.32	1,500.00	75.2	3,246.24	20
J388	4.18	80.23	1,630.32	1,500.00	50.24	2,217.62	20
J392	3.14	61.05	1,630.32	1,000.00	47.04	1,838.97	20
J394	9.43	63.84	1,630.35	1,000.00	53.84	2,316.77	20

ID	Static Demand (gpm)	Static Pressure (psi)	Static Head (ft)	Fire-Flow Demand (gpm)	Residual Pressure (psi)	Hydrant Available Flow (gpm)	Hydrant Pressure at Available Flow (psi)
J396	6.29	76.43	1,630.37	1,500.00	64.75	3,664.77	20
J398	17.79	96.27	1,630.30	1,000.00	82.54	2,924.67	20
J402	14.65	149.66	1,630.27	1,000.00	100.31	1,719.67	20
J404	8.36	116.5	1,842.63	1,500.00	84.31	2,775.19	20
J408	6.29	143.97	1,842.62	1,500.00	39.32	1,652.21	20
J410	4.18	59.77	1,630.40	1,500.00	50.07	3,350.90	20
J412	9.43	58.37	1,630.39	1,500.00	47.86	3,141.39	20
J416	3.14	79.7	1,630.32	1,000.00	67.65	2,476.20	20
J418	14.65	69.41	1,842.61	1,000.00	57.78	2,311.03	20
J422	5.25	132.04	1,842.60	1,000.00	110.23	2,504.35	20
J424	17.79	113.7	1,633.14	1,500.00	86.8	3,035.74	20
J426	7.32	102.44	1,633.10	1,000.00	84.4	2,365.06	20
J428	13.61	99.02	1,633.11	1,000.00	82.99	2,478.43	20
J430	12.57	131.9	1,633.14	1,000.00	115.84	2,985.54	20
J432	9.43	76.98	1,633.07	1,000.00	19.24	1,002.10	20
J434	7.32	93.36	1,633.09	1,000.00	72.8	2,057.15	20
J440	17.79	92.83	1,842.60	1,000.00	75.07	2,238.95	20
J442	8.36	122.58	1,633.08	1,000.00	75.51	1,547.63	20
J444	4.18	125.04	1,630.30	1,500.00	80.06	2,514.69	20
J446	8.36	186.2	1,433.63	1,000.00	178.15	5,536.86	20
J448	4.18	162.7	1,433.62	1,000.00	71.19	1,278.32	20
J454	4.18	76.01	1,433.53	1,000.00	37.72	1,241.01	20
J456	5.25	86.29	1,433.52	1,000.00	24.67	1,046.64	20
J458	4.18	36.14	1,311.35	1,000.00	21.71	1,068.36	20
J460	5.25	127.53	1,311.35	1,000.00	121.56	4,107.90	20
J462	4.18	96.94	1,311.35	1,000.00	57.39	1,441.14	20
J464	4.18	154.13	1,311.35	1,000.00	149.98	4,895.08	20
J466	5.25	116.64	1,311.35	1,000.00	72.12	1,530.44	20
J468	5.25	85.02	1,433.53	1,000.00	48.58	1,387.12	20
J470	4.18	86.61	1,311.35	1,000.00	75.91	2,747.25	20
J472	4.18	64.23	1,311.35	1,000.00	48.26	1,755.92	20
J474	4.18	174.76	1,311.34	1,000.00	168.47	4,679.05	20
J476	6.29	100.94	1,311.33	1,000.00	86.07	2,552.19	20
J480	7.32	101.82	1,311.33	1,000.00	73.66	1,802.19	20
J482	0	217.34	1,433.58	1,000.00	212.8	8,842.96	20
J484	3.14	190.08	1,433.57	1,000.00	146.34	2,104.28	20
J488	4.18	139.25	1,311.33	1,000.00	78.11	1,442.93	20
J490	0	270.52	1,433.55	1,000.00	264.57	8,495.63	20
J494	7.32	110.77	1,366.62	1,500.00	107.84	13,870.61	20
J496	4.18	90.9	1,366.62	1,000.00	79.12	2,733.19	20
J502	8.36	93.07	1,120.51	1,500.00	62.67	2,425.28	20
J504	6.29	75.85	1,120.51	1,500.00	17.22	1,467.14	20
J506	8.36	83.13	1,120.50	1,500.00	20.94	1,520.59	20
J512	7.32	121.81	1,365.71	1,000.00	81.43	1,678.77	20
J514	6.29	139.21	1,365.72	1,500.00	92.11	2,523.72	20
J516	14.65	110.53	1,226.82	1,500.00	94.08	7,423.16	20
J518	9.43	133.32	1,365.73	1,500.00	77	2,221.10	20
J520	11.5	153.38	1,365.74	1,500.00	141.8	6,340.01	20
J522	7.32	151.77	1,365.73	1,500.00	137.29	5,436.61	20
J524	15.71	105.91	1,226.80	1,500.00	86.44	6,189.44	20
J526	12.57	97.66	1,226.77	1,000.00	78.49	2,537.08	20
J528	7.32	93.28	1,226.77	1,000.00	72.74	2,267.51	20
J530	7.32	97.74	1,226.77	1,000.00	71.67	1,920.27	20
J532	5.25	101.98	1,226.77	1,000.00	81.67	2,486.21	20
J534	12.57	109.69	1,226.81	1,500.00	90.75	6,432.61	20
J536	10.47	94.37	1,226.89	1,500.00	84.2	6,654.98	20
J538	9.43	112.93	1,226.84	1,500.00	98.62	7,335.24	20
J540	7.32	56.72	1,365.22	1,000.00	29.32	1,188.47	20
J542	8.36	62.1	1,365.22	1,000.00	47.11	1,830.99	20
J544	9.43	86.82	1,365.23	1,500.00	78.96	5,780.50	20
J550	10.47	91.11	1,365.23	1,000.00	71.19	2,071.93	20
J552	7.32	88.14	1,365.20	1,000.00	55.43	1,517.78	20
J554	8.36	90.56	1,365.20	1,000.00	71.48	2,119.79	20
J556	7.32	101.57	1,365.22	1,500.00	94.89	7,509.90	20
J558	0	101.26	1,365.21	1,000.00	97.38	7,594.82	20
J560	10.47	101.61	1,365.16	1,000.00	97.47	7,126.64	20
J562	10.47	85.77	1,365.08	1,000.00	74.17	2,770.38	20
J564	10.47	67.36	1,365.04	1,000.00	56.04	2,337.68	20
J566	11.5	92.65	1,365.03	1,000.00	87.86	5,797.38	20
J568	12.57	102.04	1,365.10	1,000.00	97.62	6,707.66	20
J570	9.43	88.53	1,364.99	1,000.00	83.45	5,329.68	20
J572	4.18	91.56	1,364.83	1,000.00	85.6	4,775.68	20
J574	6.29	66.49	1,364.73	1,000.00	59.99	3,471.39	20
J576	6.29	29.72	1,364.73	1,000.00	12.58	718.56	20
J578	6.29	68.59	1,364.68	1,500.00	56.14	3,465.79	20
J580	5.25	81.46	1,364.66	1,000.00	40.07	1,253.05	20
J582	6.29	68.01	1,364.67	1,500.00	49.39	2,640.96	20
J584	9.43	83.06	1,364.67	1,000.00	71.9	2,814.72	20
J586	12.57	62.15	1,364.66	1,000.00	35.39	1,309.53	20
J588	7.32	76.24	1,364.10	1,500.00	59.43	3,098.31	20
J590	0	104.37	1,363.64	1,500.00	91.26	4,746.40	20
J592	4.18	87.71	1,363.64	1,500.00	40.93	1,854.36	20
J594	9.43	102.71	1,365.09	1,000.00	60.79	1,470.39	20
J596	5.25	76.92	1,364.10	1,500.00	50.46	2,344.04	20
J598	4.18	111.58	1,365.30	1,500.00	105.65	8,938.18	20

ID	Static Demand (gpm)	Static Pressure (psi)	Static Head (ft)	Fire-Flow Demand (gpm)	Residual Pressure (psi)	Hydrant Available Flow (gpm)	Hydrant Pressure at Available Flow (psi)
J600	4.18	105.04	1,365.28	1,500.00	98.85	8,253.98	20
J602	0	126.25	1,364.68	1,500.00	113.43	5,298.83	20
J604	3.14	119.33	1,364.68	1,000.00	98	2,389.87	20
J606	8.36	132.57	1,364.27	1,500.00	118.98	5,322.99	20
J608	13.61	98.74	1,363.55	1,000.00	92.41	5,281.95	20
J610	7.32	116.36	1,363.55	1,000.00	81.1	1,770.98	20
J612	13.61	99.46	1,363.58	1,000.00	92.81	5,011.91	20
J616	0	116.64	1,365.79	1,500.00	112.4	11,584.99	20
J62	5.25	14.54	2,740.48	1,000.00	13.61	5.24	14.54
J620	11.5	111.13	1,226.64	1,500.00	94.98	5,100.18	20
J622	4.18	115.88	1,226.64	1,500.00	99.43	5,157.30	20
J624	4.18	111.87	1,226.64	1,500.00	94.78	4,847.07	20
J626	8.36	121.33	1,226.64	1,500.00	104.5	5,214.83	20
J628	9.43	126.51	1,226.64	1,500.00	107.52	4,804.29	20
J630	6.29	118.63	1,226.64	1,000.00	109.36	4,928.33	20
J632	3.14	118.56	1,226.64	1,000.00	109.09	4,816.63	20
J634	3.14	109.56	1,226.64	1,000.00	99.73	4,378.95	20
J636	3.14	113.12	1,226.64	1,000.00	103.63	4,645.37	20
J638	4.18	113.22	1,226.64	1,000.00	103.58	4,578.57	20
J64	8.36	47.9	2,988.34	1,000.00	47.08	6,995.90	20
J640	4.18	98.25	1,226.64	1,000.00	88.08	3,894.27	20
J642	7.32	117.26	1,226.49	1,500.00	96.45	4,276.64	20
J644	7.32	120.58	1,226.44	1,500.00	99.08	4,271.76	20
J646	5.25	35.35	1,004.92	1,500.00	34.66	4,294.15	20
J648	16.75	40.27	1,004.92	1,500.00	39.23	4,363.56	20
J650	8.36	38.69	1,004.91	1,500.00	37.4	4,281.35	20
J652	4.18	42.05	1,004.91	1,500.00	40.82	4,360.45	20
J654	9.43	46.55	1,004.91	1,500.00	45.03	4,419.12	20
J656	9.43	42.1	1,004.91	1,500.00	40.54	4,317.59	20
J658	9.43	43.91	1,004.91	1,500.00	40.31	4,075.06	20
J66	18.86	49.99	2,988.32	1,000.00	46.29	3,204.26	20
J660	5.25	39.51	1,004.91	1,500.00	34.94	3,332.73	20
J662	3.14	35.71	1,004.91	1,500.00	29.8	2,567.77	20
J664	4.18	38.17	1,004.91	1,500.00	33.14	3,037.49	20
J666	6.29	34.63	1,004.91	1,500.00	28.95	2,528.35	20
J668	0	129.43	1,226.44	1,500.00	106.72	4,275.37	20
J670	5.25	123.64	1,226.44	1,500.00	100.22	4,033.18	20
J672	6.29	114.37	1,226.44	1,500.00	92.88	4,107.18	20
J674	7.32	120.84	1,226.44	1,500.00	98.37	4,113.23	20
J676	8.36	102.92	1,226.44	1,500.00	81.45	3,789.33	20
J678	10.47	102.69	1,226.49	1,500.00	81.75	3,847.17	20
J68	7.32	72.07	2,991.33	1,000.00	67.44	3,400.32	20
J680	8.36	83.83	1,226.48	1,000.00	59.08	1,733.60	20
J682	11.5	100.21	1,226.70	1,000.00	91.63	4,688.17	20
J684	7.32	91.52	1,226.80	1,500.00	78.6	5,449.36	20
J686	4.18	94.54	1,226.86	1,500.00	83.61	6,372.00	20
J688	6.29	90.17	1,226.84	1,500.00	73.56	4,117.93	20
J690	8.36	58.62	1,226.80	1,500.00	41.78	2,554.07	20
J692	6.29	70.65	1,226.80	1,000.00	61.25	3,031.56	20
J694	8.36	68.2	1,226.80	1,000.00	49.68	1,742.38	20
J696	10.47	97.93	1,226.43	1,000.00	82.82	2,763.56	20
J698	9.43	83.75	1,226.43	1,000.00	60.43	1,802.17	20
J70	9.43	103.58	2,988.31	1,500.00	83.43	3,271.95	20
J700	14.65	66.63	1,217.35	1,000.00	59.73	2,867.27	20
J702	6.29	57.37	1,217.35	1,000.00	45.89	1,915.20	20
J704	4.18	74.1	1,217.35	1,000.00	52.18	1,640.89	20
J710	8.36	87.36	1,227.42	1,500.00	81.4	6,485.90	20
J712	8.36	97.6	1,227.42	1,500.00	90.79	6,417.51	20
J714	3.14	106.15	1,227.42	1,500.00	98.89	6,462.40	20
J716	5.25	83.56	1,227.76	1,500.00	80.04	6,407.79	20
J718	12.57	83.28	1,227.76	1,500.00	79.37	6,134.94	20
J72	6.29	130.94	2,988.31	1,000.00	106.5	2,283.82	20
J720	4.18	96.16	1,227.76	1,500.00	91.17	6,064.04	20
J722	8.36	77.74	1,227.85	1,500.00	74.78	6,114.41	20
J724	0	74.28	1,227.85	1,500.00	58.26	2,734.29	20
J726	0	24.29	1,228.07	1,500.00	22.67	2,554.38	20
J728	0	25.3	1,228.32	1,500.00	25.19	2,682.09	20
J732	0	50.63	1,247.03	1,500.00	37.85	2,364.03	20
J734	4.18	55.33	1,247.02	1,000.00	48.71	2,432.13	20
J736	0	59.05	1,246.75	1,000.00	42.98	1,673.00	20
J738	8.36	57.15	1,246.72	1,000.00	40	1,574.83	20
J74	5.25	100.72	2,739.58	1,000.00	99.42	19,695.01	20
J740	8.36	70.37	1,246.70	1,000.00	52.02	1,798.57	20
J742	7.32	63.12	1,246.71	1,000.00	45.17	1,667.69	20
J746	9.43	55.39	1,246.70	1,000.00	37.07	1,475.41	20
J748	10.47	62.45	1,246.69	1,000.00	43.65	1,612.47	20
J750	7.32	92.05	1,246.69	1,000.00	67.97	1,871.59	20
J752	9.43	63.86	1,246.69	1,000.00	43.56	1,568.33	20
J754	4.18	87.41	1,246.69	1,000.00	63.01	1,786.98	20
J756	10.47	53.15	1,246.70	1,000.00	34.99	1,429.42	20
J758	11.5	81.89	1,246.69	1,000.00	59.95	1,822.28	20
J76	13.61	76.79	2,735.66	1,500.00	72.03	9,215.77	20
J762	4.18	84.61	1,246.69	1,000.00	60.75	1,769.02	20
J764	0	107.49	1,360.42	1,000.00	94.9	4,102.10	20
J766	0	105.49	1,361.25	1,500.00	87.02	4,482.87	20

ID	Static Demand (gpm)	Static Pressure (psi)	Static Head (ft)	Fire-Flow Demand (gpm)	Residual Pressure (psi)	Hydrant Available Flow (gpm)	Hydrant Pressure at Available Flow (psi)
J768	0	101.5	1,361.93	1,500.00	85.96	4,830.97	20
J770	3.14	113.93	1,362.44	1,500.00	100.32	5,677.23	20
J772	6.29	119.63	1,362.73	1,500.00	107.13	6,206.01	20
J774	3.14	105.61	1,362.44	1,500.00	68.19	2,437.08	20
J776	0	96.86	1,361.92	1,500.00	77.8	3,668.11	20
J778	0	102.3	1,361.92	1,500.00	81.75	3,611.62	20
J784	6.29	130.41	1,361.91	1,500.00	76.49	2,274.56	20
J786	0	72.4	1,162.02	1,000.00	70.23	3,862.65	20
J788	6.29	77.8	1,162.02	1,500.00	65.04	3,346.71	20
J790	7.32	72.87	1,162.01	1,500.00	39.91	1,947.29	20
J792	4.18	78.21	1,162.02	1,500.00	55.48	2,506.37	20
J794	3.14	73.93	1,162.02	1,500.00	61.92	3,335.82	20
J796	3.14	74.8	1,162.02	1,500.00	55.46	2,648.71	20
J798	4.18	74.81	1,162.02	1,500.00	62.43	3,327.28	20
J80	10.47	233.77	2,721.60	1,000.00	224.78	10,392.87	20
J800	5.25	60.42	1,162.01	1,500.00	37.12	2,030.32	20
J802	4.18	78.93	1,162.01	1,500.00	56.28	2,528.68	20
J804	6.29	70.41	1,217.37	1,500.00	69.59	8,165.35	20
J806	7.32	61.37	1,247.22	1,000.00	53.35	2,375.98	20
J808	10.47	54.72	1,246.58	1,000.00	47.42	2,354.91	20
J810	6.29	80.15	1,246.58	1,500.00	70.5	3,959.88	20
J812	0	120.95	1,365.07	1,500.00	114.45	9,196.51	20
J814	4.18	131.34	1,364.45	1,500.00	123.26	8,557.86	20
J816	0	138.84	1,363.91	1,500.00	129.74	8,289.63	20
J818	5.25	138.15	1,363.79	1,500.00	128.85	8,167.28	20
J82	13.61	209.65	2,263.59	1,000.00	195.47	9,295.43	20
J820	8.36	122.06	1,363.54	1,000.00	116.35	7,296.53	20
J822	0	127.05	1,363.68	1,000.00	121.51	7,631.89	20
J824	5.25	122.04	1,363.12	1,000.00	115.58	6,757.96	20
J826	16.75	117.6	1,363.55	1,000.00	111.51	6,507.97	20
J828	10.47	127.07	1,363.54	1,000.00	107.36	2,671.30	20
J830	7.32	82.22	1,246.69	1,000.00	55.86	1,636.65	20
J832	4.18	114.97	1,365.77	1,500.00	64.73	2,139.45	20
J836	0	90.96	1,226.81	1,500.00	71.88	5,976.95	20
J84	7.32	68.98	1,862.78	1,000.00	66.18	12,234.16	20
J842	5.25	161.02	1,365.77	1,000.00	135.04	2,566.12	20
J844	0	140.58	1,365.77	1,000.00	127.28	3,485.65	20
J848	3.14	75.72	1,227.74	1,500.00	40.45	1,934.59	20
J850	5.25	89.42	1,226.70	1,000.00	78.71	3,391.17	20
J852	5.25	96.09	1,246.70	1,000.00	74.13	2,033.00	20
J856	3.14	87.32	1,246.58	1,500.00	72.74	3,448.93	20
J858	3.14	54.76	1,247.22	1,000.00	45.05	2,005.76	20
J86	3.14	80.59	1,862.76	1,000.00	22.5	1,026.77	20
J860	0	86.15	1,359.53	1,500.00	60.29	2,810.75	20
J866	3.14	49.87	940.26	1,000.00	47	3,557.29	20
J868	0	39.57	1,630.64	1,000.00	39.54	6,475.30	20
J870	0	187.03	2,256.05	1,000.00	169.56	6,035.54	20
J872	0	32.2	1,874.05	1,000.00	32.05	7,002.29	20
J874	0	22.17	1,367.59	1,000.00	22.56	15,433.32	20
J876	0	261.61	1,845.87	1,000.00	259	15,477.36	20
J878	0	85.08	1,433.98	1,000.00	84.82	12,930.77	20
J880	0	262.14	1,845.86	1,000.00	259.52	15,534.31	20
J882	0	85.52	1,433.98	1,000.00	85.4	13,368.06	20
J884	0	262.05	1,845.87	1,000.00	259.49	15,779.80	20
J886	0	84.69	1,433.98	1,000.00	84.49	13,140.17	20
J888	0	6.75	2,743.28	1,500.00	5.89	37.85	6.75
J890	0	116.46	3,000.47	1,500.00	95.22	3,204.68	20
J892	0	14.34	2,738.95	1,000.00	10.4	0.01	14.34
J894	0	147.77	3,046.90	1,000.00	147.68	41,849.98	20
J898	0	233.76	2,721.59	1,000.00	224.75	10,340.52	20
J900	0	49.84	2,296.34	1,000.00	49.8	9,338.24	20
J902	0	101.96	1,842.60	1,000.00	46.96	1,245.40	20
J904	0	49.84	2,296.33	1,000.00	49.8	9,370.42	20
J906	0	50.28	2,991.33	1,000.00	47.59	3,218.58	20
J908	0	152.75	3,046.74	1,000.00	126.82	2,427.83	20
J910	3.14	60.48	3,046.74	1,000.00	18.12	978.75	20
J914	0	34.16	1,247.22	1,500.00	33.52	2,663.32	20
J916	0	88.03	1,247.22	1,500.00	65.29	2,539.07	20
J92	7.32	82.26	1,860.22	1,000.00	60.89	1,857.99	20
J920	0	102.84	2,988.31	1,500.00	82.74	3,251.09	20
J922	0	92.97	2,988.32	1,000.00	77.31	2,314.30	20
J924	0	70.86	1,862.77	1,000.00	44.35	1,448.38	20
J926	0	95.48	1,851.70	1,000.00	67.45	1,746.55	20
J928	0	104.05	1,842.99	1,000.00	95.49	3,603.80	20
J930	0	63.34	1,630.35	1,000.00	53.53	2,317.80	20
J932	0	126.19	1,842.62	1,500.00	118.68	7,108.22	20
J934	0	148.97	1,630.27	1,000.00	103.22	1,773.29	20
J936	0	74.14	1,633.08	1,000.00	25.46	1,060.89	20
J938	0	123.18	1,633.14	1,000.00	107.97	2,934.34	20
J94	7.32	180.63	1,433.67	1,000.00	177.68	10,192.96	20
J940	0	87.63	1,433.52	1,000.00	39.84	1,213.29	20
J942	0	79.12	1,311.35	1,000.00	66.96	2,390.95	20
J944	0	139.11	1,311.33	1,000.00	88.02	1,585.91	20
J946	0	55	940.26	1,000.00	54.98	7,941.86	20
J948	0	70.51	1,120.51	1,500.00	61.81	3,914.48	20

ID	Static Demand (gpm)	Static Pressure (psi)	Static Head (ft)	Fire-Flow Demand (gpm)	Residual Pressure (psi)	Hydrant Available Flow (gpm)	Hydrant Pressure at Available Flow (psi)
J950	0	170.61	1,365.72	1,500.00	150.92	4,809.40	20
J952	0	83.77	1,227.79	1,500.00	80.45	6,414.62	20
J954	0	61.49	1,217.35	1,000.00	48.33	1,874.59	20
J956	0	125.29	1,365.44	1,500.00	120.05	10,628.94	20
J958	0	78.1	1,162.01	1,500.00	55.55	2,510.71	20
J96	5.25	87.63	1,433.52	1,000.00	39.74	1,217.23	20
J960	0	68.23	2,734.90	1,500.00	62.95	7,711.20	20
J962	0	65.29	1,433.54	1,000.00	42.99	1,484.54	20
J964	0	103.64	1,226.82	1,500.00	86.51	7,251.33	20
J966	0	118.88	1,226.54	1,500.00	99.16	4,494.22	20
J968	0	63.29	1,246.69	1,000.00	43.03	1,548.91	20
J970	0	46.87	1,365.22	1,000.00	23.24	1,076.64	20
J972	0	69.79	1,365.06	1,000.00	57.35	2,252.00	20
J974	0	68.44	1,364.66	1,500.00	55.67	3,392.34	20
J976	0	69.17	1,364.66	1,000.00	48.96	1,670.78	20
J98	7.32	189.67	1,433.65	1,000.00	184.55	7,359.54	20
J980	0	71.49	1,842.61	1,000.00	58.1	2,160.39	20
J982	0	125.98	1,842.62	1,500.00	116.76	6,165.48	20
J984	0	102.84	2,988.31	1,500.00	82.15	3,199.30	20
J986	0	92.97	2,988.32	1,000.00	76.97	2,286.97	20
J988	0	55.28	2,734.90	1,500.00	44.12	3,076.58	20
J990	0	69.22	1,862.77	1,000.00	42	1,400.14	20
J992	0	95.2	1,851.70	1,000.00	66.89	1,732.68	20
J994	0	104.05	1,842.99	1,000.00	95.28	3,552.25	20
J996	0	63.34	1,630.35	1,000.00	52.5	2,183.83	20
J998	0	150.12	1,630.27	1,000.00	103.59	1,765.18	20