Bolinas Community Public Utility District

WHARF ROAD LIFT STATION STUDY

November 9, 2023

Submitted by NUTE Engineering

WHARF ROAD LIFT STATION STUDY

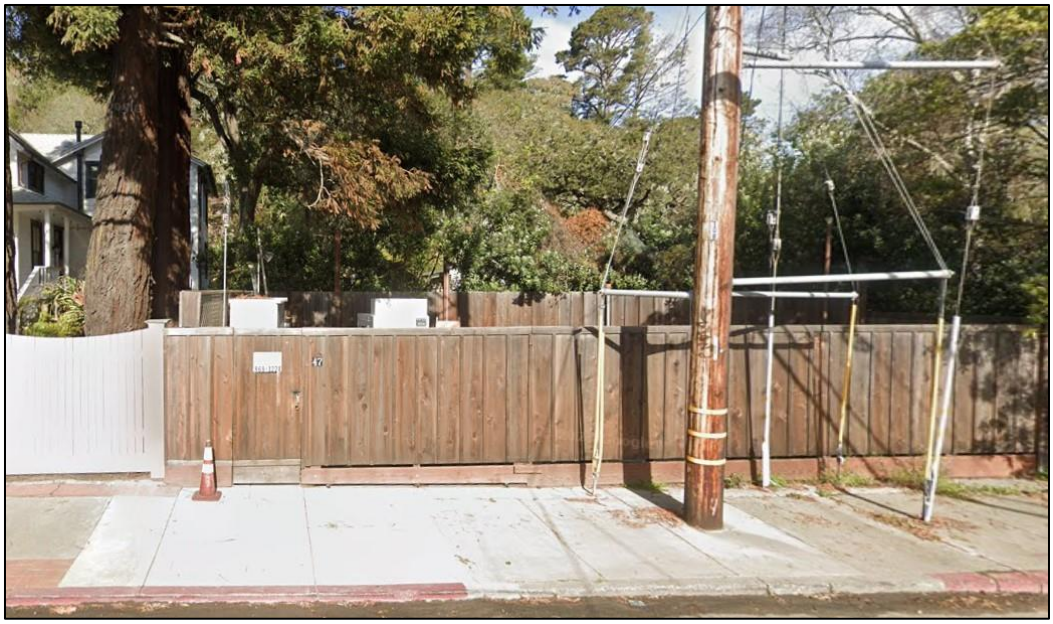
Assessment of Vogelsang Pump Failures
Assessment of Issues for Coating Wet Well to Protect the Concrete
Assessment of Existing Electrical Power Switch Gear and Motor Control Center

As authorized by the Bolinas Community Public Utility District (BCPUD), we have conducted a Study for the Wharf Road Lift Station. An important element of the study is the existing condition assessment of the lift station's electrical metering panel and motor control center, and standby power system. This assessment was conducted, with an electrical engineering review, on January 20, 2023, and the findings have been incorporated in this study. The other key element of this study is to assess the recent failures of the Vogelsang positive displacement rotary lobe pumps, including the pump supplier claim regarding "rags" in the sewage flow stream. Included in the investigation is the consideration of locating a rag removal process by installing a Vogelsang "XRipper" macerator ahead of the pumps in the flow stream.

In addition, the study will address the aging condition of the lift station wet well and methods for preserving this valuable infrastructure, such as adding a resistant coating.

Finally, we will review options for modification of the existing wet well/dry well pump station into a submersible pump station.

We appreciate the opportunity to work with the District on this important pump station. Nute Engineering has teamed with lead electrical engineering consultant, John Calton, to prepare this investigation of the District's sole and primary sewage lift station.



Wharf Road Lift Station Frontage

1.0 Background

The BCPUD provides sewage collection for the community of Bolinas, California and a small commercial area, and operates a duplex, 30 horsepower lift station located on Wharf Road in downtown Bolinas. This lift station pumps the raw sewage to the BCPUD wastewater treatment plant, which is approximately 200 feet higher and at a distance of approximately two-thirds of a mile from the Wharf Road Lift Station location.

Based on historical plans (1973) this station was designed around progressive cavity pumps, which have been replaced several times in the intervening years. Progressive cavity pumps were a traditional choice for high head sewage pumping because they can readily produce the high head required and can also pump solids. For this installation there is an eight-foot diameter concrete wet well which was initially constructed with an elevated comminutor/ grinder level. Sewage flow would enter the grinder and drop down to the level which drains directly into the pump inlet pipes. Both grinder/macerators are no longer installed, and the uncoated structure just functions as a wet well.

The original progressive cavity pumps were located in a dry well which is approximately 19 foot deep below grade and is a designated confined space with no intermediate levels. In order to maintain the two pumps and various valves mounted on the dry well floor, District crew climb down fixed steel ladders.

In 2015, West Yost Associates provided a Lift Station Pump Evaluation to the District which evaluated replacement pump alternatives to the original progressive cavity style pump. At the time, the District was experiencing the “loss of both pumps in the lift station” and these were the progressive cavity style pumps. Because of this pump failure, the West Yost Associates replacement pump alternative evaluation did not consider replacement with new progressive cavity pumps but looked at:

- Rotary Lobe Positive Displacement Pumps (Vogelsang Pumps)
- Non-Clog Centrifugal Pumps (Flygt Pumps)
- Centrifugal Chopper Pumps (Vaughn Horizontal Pumps)

The Vogelsang pumps were selected and installed in 2016. Maintenance records indicate that they operated without repair until 2020.

In 2020, the crew discovered that the Vogelsang progressive cavity pumps had severely damaged rotary lobe surfaces, which radically reduces the pumping capability. At the time, the pump distributor and repair company verified that either the pumps could be completely overhauled with a new rotary lobe assembly, or the entire pump be replaced. These pumps had less than 5 years of service. The District proceeded with the repair of one of the pumps, but elected not to repair the other as it was more severely damaged. The District ultimately purchased a new pump to replace it.

1.1 Existing Wharf Road Lift Station Condition Assessment Lift Station Condition Wet Well Structure Assessment. According to the 1973 Kirker, Chapman and Associates (KCA) plan set for the Wastewater Treatment and Disposal System, the existing concrete wet well was constructed at the same time as the dry well but was made of eight-foot diameter precast reinforced concrete pipe (RCP) material. The lower wet well is a pipe section which is stacked on top of a thick (greater than 24") reinforced, cast in place, concrete slab and originally intended to perform as the wastewater storage portion of the wet well (approximately 1000 gallon). This wet well always provides flooded intakes for the sewage pumps, but because there is no sand or rock pocket below the pump, intakes do not protect the pumps from sand or rock. The upper wet well is delineated by another cast in place, 10-inch-thick concrete deck, stacked on top of the first RCP pipe section, and was intended to support two sewage grinder/macerators. These grinder/macerators appear to have been removed at some point in the past but not replaced. This concrete deck is also the level which influent wastewater enters from the collection system manhole located in Wharf Road, outside the lift station entry gate.

District maintenance crews have observed beach sand within the collection system that enters the pumping system. The sand can act as an abrasive on the rubber rotary lobe. The existing lower wet well does not trap the sand by settling and instead, directs the sand directly to the rotary pump's inlet pipe through the bottom concrete channel.

The hydrogen sulfides formed in decomposing wastewater has an aggressiveness which over time attacks the interior surface of the concrete wet well. This is observable in the upper wet well chamber and grinder deck, by loss of the smooth cement paste surface of the concrete (see photo on the next page).

Short Term Fix

- Create a gravity sand removal pilot test within the collection system manhole located in front of the lift station in Wharf Road by constructing redwood stop logs slid into stainless steel channels bolted onto the manhole walls (see attached Sketch 1). If sand settles out and is trapped, consider constructing a wet well sand trap.

Long Term Fix

- Sawcut and enlarge grinder deck openings above lower wet well.
- Modify wet well by turning lower portion into sand/rock pocket to prevent sand from entering pumps.

- Sandblast and coat wet well with a modern, protective, sewage resistant coating.
- Rehabilitate the existing Wharf Road gravity sewer by pipebursting to prevent sand from entering the pumping system.

Existing Concrete Wet Well

1.2 Lift Station Dry Well/Pump Room Condition Structure Assessment

Based on the 1973 KCA plan set for the Wastewater Treatment and Disposal System, the dry well concrete structure walls and ceiling are cast in place, 18 inch thick, 3000 psi concrete with two mats of steel reinforcement bar (mostly No. 8). The below grade concrete structure is not currently painted or coated, which is not necessary for its current use. The unpainted surface allows for an easy surface inspection of the concrete walls and ceiling. From this inspection it is clear that the concrete is in good shape with no serious cracking or water intrusion (see photo on the next page). Based on these observations and plan review, it appears the structure should provide many more years of service.

Personal access to the dry well relies on an able-bodied person to navigate a steel ladder system. District personnel manage this by following their confined space rules with every entering person being managed with a harness and lowering tripod. Many modern pump stations are designed as submersible pump stations which nearly eliminates the confined space entry necessary for maintenance workers. This is because the pumps can be pulled out of the

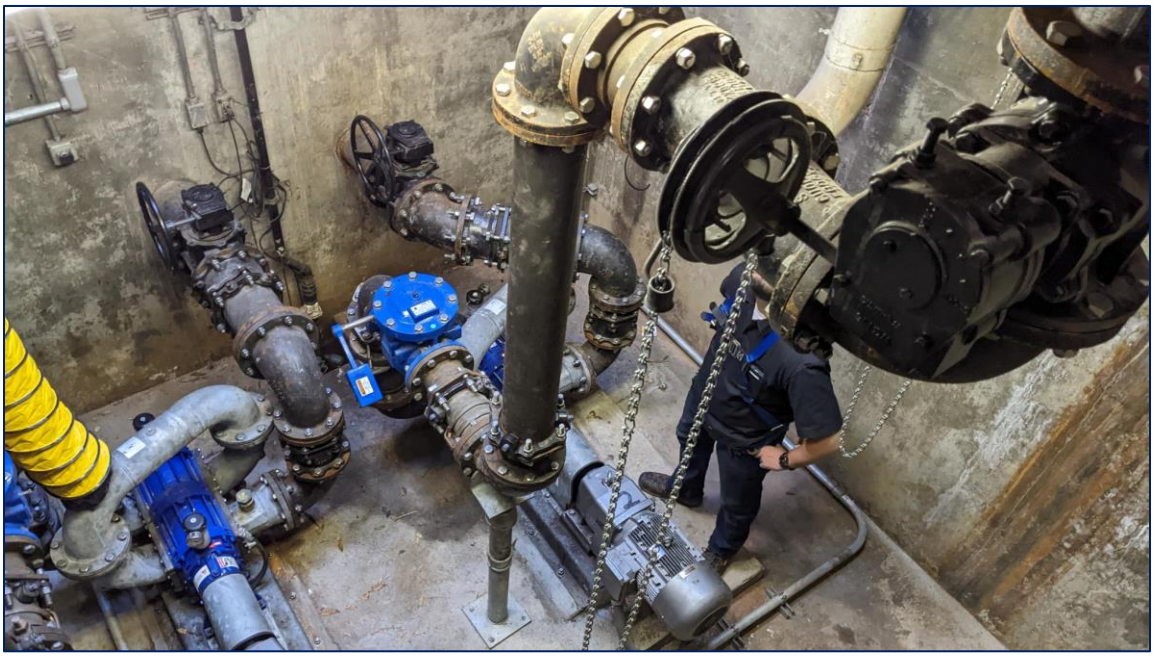
sewage wet well and maintained in the open air on the concrete deck or sent to a repair center.

Short Term Fix

- No short term structure fix recommended.

  Long Term Fix

- Convert dry well/pump room to submersible pump station wet well (see discussion below).



Existing Dry Well With Sewage Pumps

1.3 Lift Station Dry Well/Pump Room Mechanical

The pump room mechanical piping consists of the piping for the two Vogelsang Positive Displacement Rotary Lobe pumps. Based on the 1973 KCA plan set and the 2015 West Yost report, the original progressive cavity pumps were horizontal rotor pumps which relied on a simple suction and discharge manifold ductile iron piping connection. The Vogelsang pumps, in order to fit into the existing station suction and discharge configuration, have a more complicated piping configuration. The downside of this is more difficult pump removal and maintenance. However, it appears that many of these ductile iron pipes, fittings, plug valves and check valves were replaced or installed when the Vogelsang pumps were installed and are well maintained by District staff and therefore have many years of service remaining.

A major impetus of this study is to evaluate the recent past operational damage to the rotary lobe of the Vogelsang Pumps. Based on staff observation and discussions with the repair shop, the rubber coated rotary lobes of the pumps were severely damaged by 2020. The regional distributor of the Vogelsang pump, and the repair mechanic, believe the damage was due to fibrous rags in the sewage (commonly the cleaning cloth marketed as “Swiffer”). However, the Vogelsang Engineering staff have not officially commented on the cause of the damage. All sewage utilities are faced with the complications of transporting this debris in the sewage, which commonly causes clogs in valves and pumps, and is laborious to remove. But, in most sewage pumping installations the rags may clog the pumps but do not seriously damage the pumps. The pump can be “deragged” and is placed back into operation.

Damaged Vogelsang Rotary Lobes Compared to New Rotary Lobes

Another source of damage to the rubber coated Vogelsang rotary lobes, could be the presence of beach sand in the wastewater. District maintenance crew members have detected sand in the collection system which serves Wharf Road and have removed it by vacuuming periodically. Sand would have a regular abrasive affect on the rotating parts and piping. The photo above, taken during a recent pump repair by Vogelsang, compares the damaged rotary lobe on the lefthand side to a brand-new rotary lobe on the righthand side and appears to validate that the damage is from something abrasive.

The ductile iron discharge piping manifold is generally the same as originally designed with both pump discharges having a swing check valve and plug valve. The District maintenance crew were concerned about slamming of the manifold

check valves and a redundant check valve was installed in a below grade vault on the buried ductile iron sewage force main in the street in front of the pump station (see photo below). Due to the high head pumping, this check valve must take the brunt of the pressure water hammer when the pumps shut down; somewhat relieving the check valves in the pump room. Because of this, the check valve in the street vault failed in 2022 and was subsequently replaced with a more appropriate model.

Short Term Fix

- Install a sand and grit trap in the influent manhole located in the street in front of the lift station and upstream of the wet well.

Long Term Fix

- Elect to install a permanent sand and grit trap in the wet well, or
- Elect to rehabilitate the entire pump station to submersible Flygt pumps. Modern Flygt pumps would not require rag removal in all but extreme conditions (see attached Sketch 2).

Lift Station Force Main in Wharf Road

1.4 Lift Station Discharge Force Main

The force main is approximately 3,500 feet long and significantly rises in elevation as it pumps to the treatment ponds with a water surface level of 193 ft +/-. The 1973 plan set called out the construction of this force main using 6-inch ductile iron pipe. However, crew's visual observation while working on this buried pipeline indicates that it is an asbestos cement pipe. This pipeline is expected to be nearly 50 years old. Older asbestos cement pipe used for force

mains can have a weakening of the pipe walls from long term exposure to hydrogen sulfide.

Short Term Fix

- Verify pipe material by reviewing records or carefully potholing the existing pipe.

Long Term Fix

- Plan for the eventual installation of new PVC or HDPE parallel force main. The parallel construction would simplify any construction related to sewage bypassing.

2.0 Existing Wharf Road Lift Station Electrical Equipment Condition Assessment

Overall Assessment**:** Overall, the electrical equipment is in sufficient condition and functional. Most of the equipment has surface rust on the exterior, but the interior electrical connections are clean and corrosion free. The electrical equipment has adequate working clearances, as defined by the National Electrical Code (NEC). The major electrical equipment is nearing the end of its useful life, installed in 1990. It is recommended that the District begin planning for electrical equipment replacement. The most noted electrical issue at the station is poor power quality (low voltage), and lack of reliable power from PG&E, the electrical service provider. The site visit was conducted on January 17, 2023, with District staff: Stew Oakander, Blake Miller, and Evan Kahn.

The current National Fire Protection Association (NFPA) 820 Standard requires that wastewater pumping station dry wells have a minimum 6 air changes per hour; otherwise, the pump room is classified as a hazardous area (Class 1, Division 2). Class 1, Division 2 areas require certain electrical equipment to be rated explosion proof, and all conduits need to have seal off fittings installed; note that the electrical equipment is not explosion proof, and there are no seal off fittings on the conduits. Because of the air change requirement, the fan in the dry well pump room recently was modified to operate continuously. Also, the National Electrical Code (NEC) Articles 110.16 and 110.24, requires arc flash labels on the Metering Panel, the Motor Control Center (MCC), and the Panelboard. Arc flash labels contain information to what level personal protective equipment (PPE) is required to approach and work on said equipment. Currently there are no arc flash labels on the listed equipment.

3.0 PG&E Metering Panel with Main Disconnect

Electrical service from PG&E is via underground conduit and cable, 120/240VAC, 3 phase, 4 wire. The existing service is from open delta transformers on adjacent overhead pole. The Metering Panel is NEMA 3R painted steel, stanchion mounted, with surface rust but in working condition. The existing main breaker is 225 amp, 3 pole, and was replaced in July 2014. There is sufficient working clearance in front of the Metering Panel.

Short Term Fixes:

- Stanchion has deteriorated and needs to be replaced.
- Duct seal conduit to MCC.

Long Term Fixes:

- Provide arc flash label with calculations on panel, per NEC Article 110.24.
- Replace Metering Panel with main disconnect as existing panel is nearing end of useful life.

Existing Lift Station PG&E Meter

3.1 Motor Control Center (MCC) with Pump Control Panel. The MCC is freestanding on a concrete pad, non-walk-in type, NEMA 3R painted steel enclosure, and manufactured by CMC in 1990. The MCC contains an automatic transfer switch, two full voltage non-reversing pump starters, a 9KVA 3 phase transformer, 120/208 Panelboard with 50-amp main breaker, and an integral pump control panel. The pump control panel contains the wet well level bubbler system for level monitoring, hardwired control relays for starting and stopping pumps in auto mode based on wet well level, as well as interlocking pumps for duty/standby operation, and a pneumatic level gauge.

Short Term Fixes:

- Adjust electronic overload trips to "automatic" reset, typical for each pump.
- Set Pump 1 full load amps setting on overload relay to 75. Currently set at 70.
- Replace lightbulbs for Running and Ready pilot lights.
- Duct seal all conduits routed underground.
- Replace existing 100-amp motor circuit protector (MCP) type breakers with 150-amp MCP at both pump starters.
- Add 120 VAC strip heater in bottom of ATS section of MCC.
- Provide flexible moisture curing polyurethane sealant all around perimeter of MCC, at least the front and sides to minimum water tracking in MCC. Sealant to be similar to Vulkem #116.
- Provide as-built Single Line Diagram and Pump Control Schematics within MCC.
- Add Power Monitoring Fail relay on load side of ATS and wire contact to Autodialer. Relay to monitor low voltage, phase loss, and phase reversal. Relay to be similar to Time Mark #258B.

- Add “Hand-Off-Dry Well” hand switch for pump control at MCC cubicles, typical for each pump. “Dry well” position would allow for hand switch at pump in dry well to have control.

Long Term Fixes:

- Provide arc flash label on exterior door front, per NEC Article 110.16.
- Add surge protection device on load side of ATS. Surge device to be similar to Eaton SPD, rated for 240 VAC, 3 phase and 250kA.
- Replace bubbler and pneumatic controls with submersible level transducer and duplex pump controller. Controller to be similar to MPE #SC100.
- Replace MCC as existing is at end of useful life. Locate new MCC on slab on grade that is 4” above grade.
- Add programmable logic controller (PLC) with operator interface terminal (OIT) for pump control, wet well setpoint adjustment, alarming, trending, etc.

Existing Lift Station Motor Control Center

3.2 Portable Generator

The portable generator is in great condition. The generator is Dyno MQ Power Whisperwatt #DCA-70SSIU4F, 70 kW, 3 phase, with 200-amp main breaker. Configured for 120/240 VAC an rated for 168 amps. Generator is wired to MCC automatic transfer switch and sized to operate one pump plus miscellaneous station loads.

Short Term Fix:

- None

Long Term Fix:

- Provide additional onsite fuel storage (may be possible to flush and reuse existing aboveground diesel tank already onsite).

Existing Lift Station Portable Generator

3.3 Autodialer Panel: The autodialer panel is wall mounted, NEMA 3R painted steel enclosure. Autodialer is hardwired to telephone utility and includes red light for alarm status. Only alarm is high level alarm. The enclosure had some standing water at bottom of panel.

Short Term Fixes:

- Drill 3/8" to 1/2" hole in bottom of enclosure to drain any water.
- Duct seal all conduits routed underground.
- Add the following alarms to existing autodialer: AC Power Monitoring Fail alarm.

Long Term Fixes:

- Replace autodialer with cellular (AT&T) option. Disconnect and cancel hardwired telephone service.
- Add the following alarms to new autodialer: Pump 1 Fault, Pump 2 Fault, Power Fail, ATS in Emergency, Generator General Alarm (General alarm can be any of: Not in Auto, Gen Fault, or Low Fuel), Dry Well Pump Room Flood.

3.4 Dry Well & Wet Well**:** The dry well pump room is below grade and has a limit switch activated exhaust fan and limit switch activated lights. The dry well pump room is clean and has sufficient working clearances. NFPA 820 classifies the dry well pump room as a hazardous area; Class 1 Division 2. Therefore, the electrical equipment (disconnect switches, light fixtures) needs to be explosion proof. The

alternative is to continuously ventilate the dry well room with minimum 6 air changes per hour, then it is “unclassified area”, and the existing electrical equipment is adequate. The District elected to do this and the fan now continuously ventilates the dry well.

The wet well was not assessed but per staff the bubbler level system is working fine.

Existing Lift Station Autodialer Panel

Short Term Fixes:

- Fix lights in dry well, limit switch may be faulty.
- Confirm fan is providing 6 air changes per hour, and leave running all the time. Otherwise, replace lights and disconnect switches with explosion proof type and add seal off fittings on electrical conduits leaving the dry well pump room.

Existing Dry Well Pump Disconnect (Not Explosion Proof)

Long Term Fixes:

- Add float switch for flood alarm in dry well pump room and tie into autodialer.
- Replace wet well bubbler system with submersible level transducer. Submersible level transducer to be similar to Blue Ribbon #BC001 Birdcage.
- Provide float switches (Off, Lead, High) in wet well for back up pump controls. Float switches to be similar to Flygt #ENM-10.

4.0 Wharf Road Lift Station Long Term Planning Recommendations

The Wharf Road lift station is functionally operating per the 1973 design, which is now 50 years old. Safety code changes and technological changes should be considered for long term planning. This report has identified these changes and has recommended both short term and long term actions for lift station modification. For the long term planning, budget level cost estimates are shown in the following tables:

Existing Concrete Wet well Modifications and Protective Coating Costs

Description	Unit	Unit Cost	Total Amount
Install Temporary Sewage Bypass System	LS	$12,000	$12,000
Temporary Bypass System Rental (1 month)	LS	$12,000	$12,000
Prepare Permanent Sand/Rock Trap Within Lower Level Wet well Floor	LS	$20,000	$20,000
Prepare Existing Wet well/Sawcut Comminutor Floor	LS	$28,000	$28,000
Brush Off Sand Blast Existing 8 ft Wet well	LS	$12,000	$12,000
Coat Wet well with Enduraflex Polyurethane	LS	$30,000	$30,000
		Subtotal	$114,000
		35% Contingency	$39,900
		TOTAL COSTS	**$153,900**

4.1 If rags are determined to contribute to the pump damage, a rag "macerator" such as the Vogelsang "XRipper" could be installed within a new manhole process vault located upstream of the existing wet well but within the paved Wharf Road in front of the station.

Install XRipper Rag Control System

Description	Unit	Unit Cost	Total Amount
Install Temporary Sewage Bypass System in Upstream MH	LS	$12,000	$12,000
Temporary Bypass System Rental (1 month)	LS	$12,000	$12,000
Construct New Dual Channel MH/Vault	LS	$15,000	$15,000
Coat Macerator Vault with Enduraflex Polyurethane or Mainstay Coating	VF	$ 3,200	$ 3,200
Vogelsang "XRipper" Macerator	LS	$37,000	$37,000
Install Macerator and Controls	LS	$ 6,000	$ 6,000
		Subtotal	$85,200
		35% Contingency	$29,820
		TOTAL COSTS	**$115,020**

4.2 As indicated previously in this study submersible pumping systems can eliminate or drastically minimize confined space entry by maintenance crew. This modification would be a major pump station rehabilitation and includes budget

level cost for replacement of the motor Control Center and new meter main pedestal.

Modification of Pump Dry Well Into Submersible Pump Wet well and Motor Control Center Replacement*

Description	Unit	Unit Cost	Total Amount
Install Temporary Sewage Bypass System in Wet well	LS	$12,000	$12,000
Temporary Bypass System Rental/Operation (4 months)	LS	$48,000	$48,000
Pump Station Demolition Work	LS	$30,000	$30,000
Pump Station Dry Well Concrete Work	LS	$60,000	$60,000
Two (2) New 35hp Submersible Pumps and Mechanical Piping	LS	$55,000	$110,000
New Motor Control Center	LS	$260,000	$260,000
New Meter Main Pedestal	LS	$13,000	$13,000
Electrical Conduit and Conductors	LS	$30,000	$30,000
**does not include existing wet well modifications*		*Subtotal*	$563,000
		35% Contingency	$197,050
		TOTAL COSTS	**$760,050**

5.0 Recommendations

Nute Engineering recommends that all identified short term measures be addressed.

Part of the initial incentive for this condition assessment of Wharf Road lift station was to determine the cause of the Vogelsang pump failure and to address the cause(s) to prevent future failures. With this in mind, Nute Engineering contacted both the Vogelsang pump repair business and the manufacturer's representative but did not receive any written explanation of the damage to the Rotary lobe. Nute Engineering recommends District staff construct the recommended temporary gravity sand removal pilot test with a goal to trap sand within the collection system manhole.

Based on the results of this test, District staff should consider a larger sand trap constructed within the lift station wet well (see concrete wet well modifications and protection coating). Nute Engineering did not find significant evidence to promote the installation and addition of a rag macerator Vogelsang XRipper or other similar rag cutting system upstream of existing wet well.

The District could also consider pipebursting the existing collection system pipeline located on Wharf Road to eliminate the possible movement of sand into the lift station.

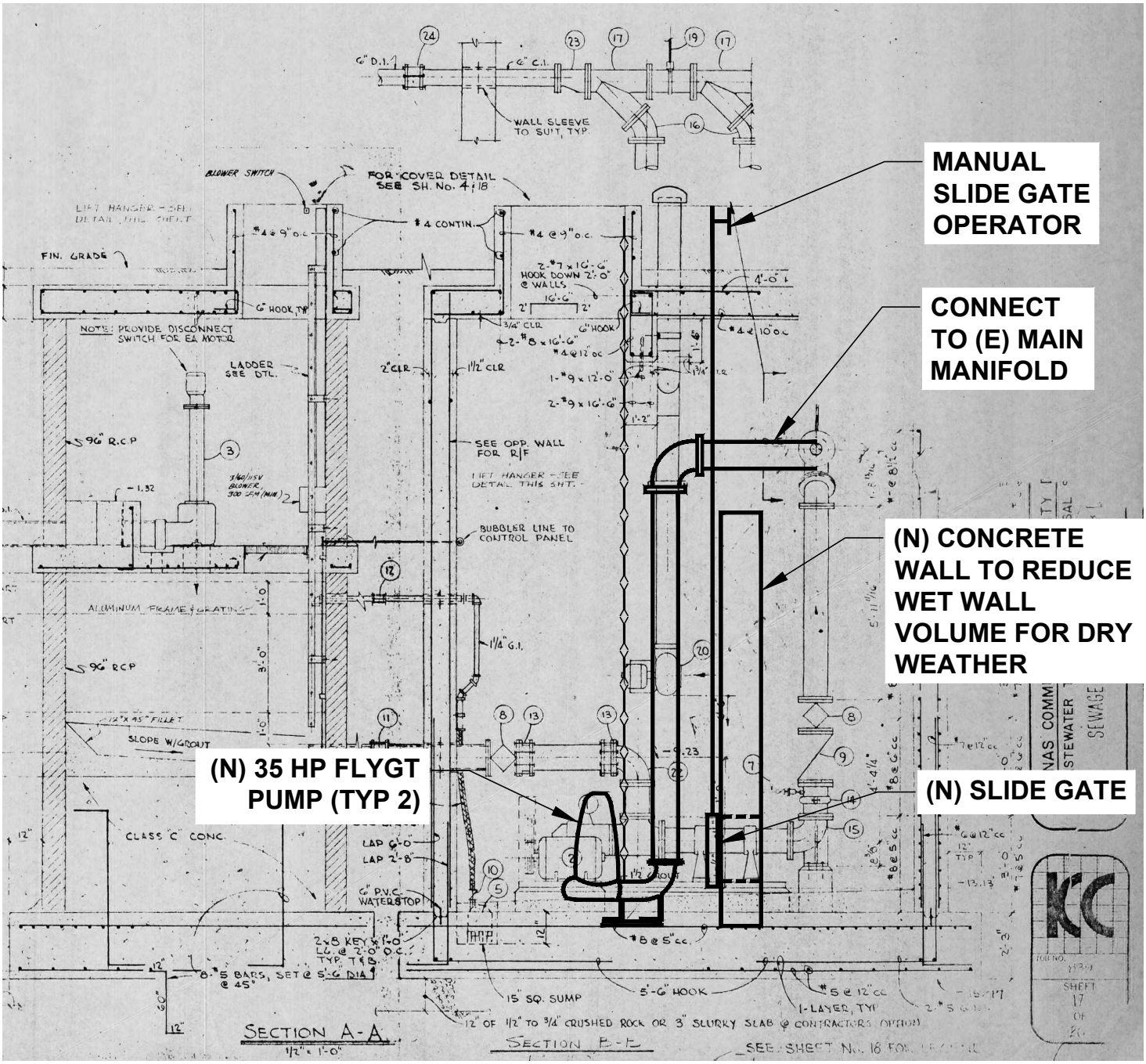
Finally, as indicated in the preceding pump station assessment, the pump electrical metering panel and main disconnect are nearing the end of their useful life and future replacement should be considered.

NUTE
907 MISSION AVENUE
SAN RAFAEL, CALIFORNIA
TEL 415-453-4480
WWW.NUTE.BIZ

TEMPORARY SAND AND ROCK REMOVAL PIT

WHARF ROAD LIFT STATION

DRAWN BY: BEO	JOB NUMBER: 9051	DATE: JUNE 2023
CHECKED BY: MTW	SKETCH 1	SCALE: N.T.S.



NUTE
907 MISSION AVENUE
SAN RAFAEL, CALIFORNIA
TEL 415-453-4480
WWW.NUTE.BIZ

MODIFICATION OF PUMP DRY WELL INTO SUBMERSIBLE PUMP WETWELL

WHARF ROAD LIFT STATION

DRAWN BY: BEO	JOB NUMBER: 9051	DATE: JUNE 2023
CHECKED BY: MTW	SKETCH 2	SCALE: N.T.S.

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