

Lift Station L16 Feasibility Report



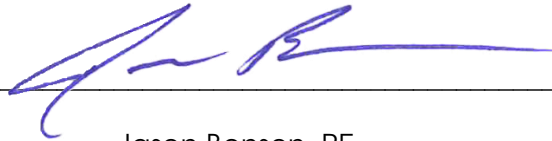
Shakopee, Minnesota

October 2020

AE2S Project #: P05475-2018-002

October 30, 2020

I hereby certify that this report was prepared by me or under my direct supervision and that I am a duly Licensed Professional Engineer under the laws of the State of Minnesota.



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I. Introduction

A. General

The City of Shakopee intends to rehabilitate its largest lift station and provide additional redundancy and emergency backup for one of their most critical assets. Recent pump failures have led to the necessity of developing a plan for necessary improvements. Lift Station 16 was originally constructed by the Metropolitan Council in the 1970's and reconstructed in the late 1990's. Ownership of the lift station, associated force main, and downstream trunk gravity sewer was turned over to the City of Shakopee in 2009. The lift station was originally designed for a peak capacity of 3,900 gallons per minute (gpm).

The Minnesota Pollution Control Agency (MPCA) utilizes Ten States Standards as a guideline for the process design of lift stations. The lift stations are also required to meet the National Fire Protection Association (NFPA) Code 820, which governs the electrical classification and ventilation requirements for these types of structures.

B. Summary of Recommendations

Anticipated capital improvements over the next ten years have been identified based upon the condition assessment of the existing lift station and forcemain, useful life, future design flow projections, and discussions with City staff regarding desired redundancy and emergency management considerations. The general scope of improvements for the lift station to be considered over the next ten years is listed below as well as a recommended implementation plan in Table 1 below.

- Process Equipment and Piping:
 - New submersible pumps, discharge elbows and guide rails.
 - New submersible grinder (completed).
 - New valves and flow meter.
 - Recoat existing exposed piping.
- Electrical/Instrumentation and Controls:
 - New switchgear, motor control centers, and variable frequency drives.
 - Demolition of existing electrical, controls, and generator system.
 - New controls and SCADA upgrade.
 - New telemetry system (fiber connection).
 - Improved security.
- Mechanical:
 - New ventilation equipment for building.
 - New sump pump for dry well/valve vault area.
- Structural/Architectural:
 - Coat/repair cracks in wet well slab.
 - General interior coatings (cosmetic).

- Utilize remaining life of larger rehab items like roof, etc.
- Forcemain:
 - New 12-inch PVC forcemain constructed parallel to existing 16-inch forcemain.
 - Replace existing valves along existing forcemain route.
 - Schedule inspection of existing forcemain.
- Emergency Bypass Pumping:
 - New portable diesel pump bypass system (purchased under separate CIP item: L-16 Bypass Pump - Sewer 20-016).
 - Buried bypass pumping piping and quick connections.
- Old Lift Station:
 - Demolish above grade building.
 - Fill dry well areas and cap with concrete slab.
 - Modifications to existing wet well for overflow storage.

Table 1 – Lift Station Improvements Implementation Plan

Item	Phasing Plan			
	Phase I (2020)	Phase II (2021)	Phase III (2025)	Phase IV (2030+)
Mobilization, Bonds, Insurance	\$0	\$113,000	\$85,000	\$84,000
Demolition	\$0	\$104,000	\$30,000	\$28,000
Site Work/Bypass Pumping	\$100,000	\$129,000	\$0	\$42,000
Levee Rehabilitation	\$0	\$129,000	\$0	\$0
Process Piping	\$40,000	\$259,000	\$0	\$0
Pumps	\$50,000	\$207,000	\$0	\$0
Structural	\$0	\$78,000	\$0	\$212,000
Architectural	\$0	\$145,000	\$0	\$212,000
Mechanical	\$0	\$0	\$238,000	\$0
Electrical	\$0	\$41,000	\$534,000	\$14,000
Instrumentation & Controls	\$0	\$41,000	\$48,000	\$21,000
Generator	\$0	\$0	\$0	\$310,000
Subtotal	\$190,000	\$1,246,000	\$935,000	\$923,000
ELA (15%)	\$0	\$187,000	\$140,000	\$138,000
Construction Contingencies (15%)	\$0	\$187,000	\$140,000	\$138,000
Total Opinion of Probable Cost	\$190,000	\$1,620,000	\$1,215,000	\$1,199,000
Total Opinion of Probable Cost (Phase I-IV)				\$4,224,000

II. Design Flow Analysis

A. Current Average Flows

Existing daily flow data from 2018 and 2019 were reviewed. There is no hourly flow data available from the Omni-Site system at the lift station. The following Table 2 shows the monthly average daily flows for 2019.

Table 2 – Existing Average Daily Flow (2019)

2019 Flow Condition	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Average
Avg Day (MGD)	0.73	0.76	1.05	1.10	0.86	0.88	0.89	0.86	0.82	0.88
Peak Day (MGD)	1.13	1.43	2.62	1.67	1.18	1.38	1.39	1.36	1.24	1.49
Avg Day (GPM)	509	527	730	765	600	609	620	595	573	614
Peak Day (GPM)	783	996	1,822	1,161	821	957	967	942	862	1,035

*2018 Average Day (GPM) - **531**

B. Peak Hourly Wet Weather Flow

The typical design flows for lift stations include the average annual flow (AAF) and the peak hour wet weather flow (PHWF). In the absence of meter data, the peak hour wet weather flow (PHWF) is calculated by applying a peaking factor to the annual average flow. The Metropolitan Council Environmental Services (MCES) has established peaking factor (PF) tables for various average annual flow conditions. MCES has a design PF table for new construction and an Inflow/Infiltration (I/I) PF table for existing systems based upon Metro area flow data. Due to existing I/I in the collection system, the higher and more conservative I/I PF table from MCES will be used for estimating lift station peak design flows. The following Figure 1 summarizes the MCES I/I Peaking Factors for various average annual flow rates.

Figure 1 – MCES Peaking Factor Chart

Table A-2: Wastewater Flow Variation Factors for Determining Infiltration/Inflow Mitigation Goals

Average Flow (MGD)	Peak Hourly Flow Factor	Average Flow (MGD)	Peak Hourly Flow Factor
<0.10	4.5	2.51-3.00	3.2
0.11- 0.20	4.4	3.01-3.50	3.1
0.21-0.30	4.3	3.51-4.00	3.0
0.31-0.40	4.2	4.01-4.50	2.9
0.41-0.50	4.1	4.51-5.00	2.8
0.51-0.60	4.0	5.01-6.00	2.7
0.61-0.70	3.9	6.01-8.00	2.6
0.71-0.80	3.8	8.01-10.00	2.5
0.81-1.00	3.7	10.01-12.00	2.4
1.01-1.20	3.6	12.01-16.00	2.3
1.21-1.50	3.5	16.01-20.00	2.2
1.51-2.00	3.4	20.01-30.00	2.1
2.01-2.50	3.3	>30.00	2.0

The following Table 3 indicates the existing peak hourly wet weather (PHWW) flow based upon the above MCES peaking factor determination.

Table 3 – Existing Peak Hourly Wet Weather Flow

Average Annual Flow (GPM)	Peak Hour Factor	Peak Hourly Wet Weather Flow (GPM)	Notes
614	3.7	2,272	MCES I&I Peak Hour Factor

C. Future Design Flows

As part of the Sanitary Sewer Master Plan modeling efforts completed in 2019, two growth alternatives were reviewed for the lift station service area. The growth alternatives were established based upon future land use, new development area, and potential redevelopment areas within the lift station service area. Alternative No. 1 accounted for new growth in a Mixed Employment Center land use area along County Road 69, on the west end of the Northwest Shakopee sewer district. In Alternative No. 2, this area is routed to the West Louisville Jackson sewer district, which is served by the MCES Shakopee – Chaska Interceptor.

1. Alternative No. 1

Alternative No. 1 represented approximately a 60% increase in average daily flow due to potential service area growth and redevelopment. The following Table 4 indicates the potential average annual and peak hourly wet weather design flows associated with growth Alternative No. 1.

Table 4 – Growth Alternative No. 1 Future Design Flow

Average Annual Flow (GPM)	Peak Hour Factor	Peak Hourly Wet Weather Flow (GPM)	Notes
976	3.5	3,416	MCES I&I Peak Hour Factor

2. Alternative No. 2

Alternative No. 2 represented approximately a 27% increase in average daily flow due to potential service area growth and redevelopment. The following Table 5 indicates the potential average annual and peak hourly wet weather design flows associated with growth Alternative No. 2.

Table 5 – Growth Alternative No. 2 Future Design Flow

Average Annual Flow (GPM)	Peak Hour Factor	Peak Hourly Wet Weather Flow (GPM)	Notes
781	3.6	2,812	MCES I&I Peak Hour Factor

3. Recommended Alternative

The projected peak design flow from both alternatives is less than the original peak design capacity of 3,900 gpm. The master planning efforts recommended Alternative No. 2 as the preferred future growth alternative for the service area. The lift station will need to meet a minimum future peak hour wet weather design flow of 2,812 gpm with an average annual daily flow of 781 gpm.

III. Hydraulic Calculations

A. General

Along with the projected design flow, the total dynamic head (TDH) is used to select and size the lift station pumps. The total dynamic head (TDH) is the static head plus the friction losses in the piping at a corresponding flow rate. The static head for the lift station can be calculated by taking the high point in the forcemain and subtracting the operating levels in the wet well. The friction losses in the discharge piping and the forcemain will vary depending upon the roughness coefficient (C-factor) of the piping and the number of pumps operating at the lift station. Typically for pump design purposes you look at a range of C-factors from new pipe conditions (C= 140) to old pipe conditions (C=100) along with the low and high wet well levels to determine the pumping envelope. From a redundancy perspective, the lift station must be able to meet the proposed design condition with the largest unit out of service. With a total of three (3) pumps, the lift station will need to meet the proposed design condition with two (2) pumps operating in parallel.

B. Existing Pumps

1. Single Pump Operation

Figure 2 in the Appendix B shows the pumping capacity of a single existing pump based upon the system curves established from the TDH calculations. The red diamond in the figure signifies the actual measured flow of a single pump in operation (~2,200 gpm).

2. Two Pump Operation

Figure 3 in Appendix B shows the actual lift station pumping capacity with two (2) existing pumps in operation based upon the system curves established from the TDH calculations. Actual pumping capacity (3,200 gpm) is less than the original design capacity of 3,900 gpm.

C. New Pumps

1. General

Given the condition of the existing pumps and the recent pump failures, the City recently proceeded with obtaining quotes from multiple manufacturers to purchase and install a new pump ahead of a larger rehabilitation project. Quotes were received for two pump sizes: one meeting the size of the existing pumps and one that would be sized to meet the projected design flow from growth Alternative No. 2. Following review of the manufacturer quotes, Sulzer/ABS was selected as the pump manufacturer. Two pump selections were reviewed from Sulzer/ABS.

2. Sulzer/ABS XFP 205J

The Sulzer/ABS XFP 205J was selected to closely match the existing pumps and includes a 115 horsepower (hp) motor which is the same as the existing pumps. Based upon the calculated total dynamic head conditions, the operating range with two (2) pumps in operation is approximately 2,800 to 3,700 gpm. The average design flow is approximately 3,300 gpm. The average efficiency of a single pump in operation is approximately 65%. The quoted price for the pump was \$48,800. Figure 4 in Appendix B shows the pumping capacity of the Sulzer/ABS XFP 205J.

3. Sulzer/ABS XFP 200M

The Sulzer/ABS XFP 200M was selected to better match the projected design flow from growth Alternative No. 2 (~2,800 gpm) and includes a 70 hp motor. Based upon the calculated total dynamic head conditions, the operating range with two (2) pumps in operation is approximately 2,300 to 3,000 gpm. The average design flow is approximately 2,700 gpm. The average efficiency of a single pump in operation is approximately 66%. The quoted price for the pump was \$50,600. Figure 5 in Appendix B shows the pumping capacity of the Sulzer/ABS XFP 200M.

4. Sulzer/ABS Pump Model Selection

The following summarizes the differences between the two pumps:

- Both pumps have a similar operating efficiency and thus the operating power differential will be negligible.
- The larger pump is actually less expensive from a capital cost perspective but does have additional requirements for pump protection monitoring.
- Operating either pump on variable frequency drives (VFD) will allow the pumps to better meet the incoming flow thereby reducing the number of pump starts and resulting in some energy savings.
- The smaller pump would offer some capital savings, due to the fact that it would require a smaller and less costly variable frequency drive (VFD) than the larger pump.

- The larger pump comes very close to meeting the projected design flow from growth Alternative No. 2 with a single pump in operation, providing some additional redundancy in the event a pump is out of service.
- The larger pump comes with the manufacturer's "Contrablock" impeller which provides better protection from clogging and provides a larger turndown capability, allowing it to meet a similar low flow condition as the smaller pump.

Based upon the above, it was recommended that the larger XFP 205J model be selected for all three pumps given the added redundancy for a similar price and a comparable operating cost. The first pump has been purchased and installed with an adaptor plate to fit on the existing guide rail system. New guide rails and discharge elbows would be provided when the other two pumps are replaced.

IV. Forcemain

A. Existing Forcemain

1. General

The existing 16-inch forcemain (FM) was installed as part of two projects in 1993 and 1995. The existing FM has the capacity to meet the future projected peak design flow. The FM is a little oversized for average flows, resulting in a minimum velocity of less than the recommended 2 feet per second (ft/s).

2. Material/Condition

The majority of the forcemain is polyvinyl chloride (PVC), with some segments of epoxy lined ductile iron pipe (DIP). The general accepted piping design life is 50 years, however, many forcemains provide a service life in excess of 100 years. The exact condition of the existing FM is unknown, however, given the materials and age, it is anticipated to have additional life remaining. Given the material type, corrosion, which is the most common method of failure, will not have an impact on failure. Most PVC failures are a result of improper installation, which tends to surface much sooner. There have not been any breaks in the FM nor any visible problems. There are several valves at air release and cleanout manholes along the FM route that provide the ability to isolate and inspect segments of the FM.

3. Redundant Parallel Forcemain

Given the critical nature and large service area of the lift station, construction of a redundant parallel FM should be a consideration. The existing FM follows the right of way along Highway 101, which will be a constructability concern. To alleviate construction impacts along Highway 101 and possible archaeological areas, it is likely that a large portion of the new parallel FM would need to be installed by the directional drilling method. An important consideration when sizing the parallel FM is to be able to

maintain minimum velocity >2 ft/s at average flows. The following Table 6 shows the velocities at various flow rates in 10-inch, 12-inch, and 16-inch PVC DR18 forcemains.

Table 6 – Forcemain Velocities (ft/s)

Flow (gpm)	10" PVC DR18	12" PVC DR18	16" PVC DR18
500	2.13	1.51	0.87
600	2.56	1.81	1.04
750	3.20	2.26	1.30
1,000	4.26	3.01	1.73
1,500	6.39	4.52	2.60
2,000	8.52	6.02	3.47
2,500	10.66	7.53	4.33
3,000	12.79	9.03	5.20
3,500	14.92	10.54	6.07

The projected average annual daily design flow is approximately 780 gpm, which results in a velocity of 2.3 ft/s in a 12-inch diameter forcemain. Sizing the parallel forcemain as a 12-inch would provide better velocities at average flows and would typically be used during the non-wet weather months. The existing 16-inch PVC forcemain would be utilized during the wet weather periods each year. The following figure indicates a projected lift station capacity of approximately 1,800 gpm with two pumps in operation and a 12-inch PVC DR18 forcemain. This will provide full redundancy for a majority of the time, with the exception of the most extreme wet weather events. Figure 6 in Appendix B shows the pumping capacity with a 12-inch diameter forcemain.

Alternatively, a 10-inch PVC DR18 forcemain was reviewed and the following Figure 7 indicates a projected lift station capacity of approximately 1,100 gpm with two pumps in operation. The 10-inch provides improved velocities at low and average flows, however, it does limit the redundancy a bit more than the 12-inch FM due to the peak flow reduction. Figure 7 in Appendix B shows the pumping capacity with a 10-inch forcemain.

The redundant forcemain sizing could be reviewed in the future when actual historical peak hourly flow data is available from the impending SCADA upgrades. Currently there is no actual peak hourly flow data available to determine how often this flow might be exceeded.

4. Recommendations

The following are recommendations related to the forcemain;

- Construct redundant parallel 12-inch forcemain (review sizing in future).
- Perform inspection of existing 16-inch forcemain within 5-10 years.

- Replace existing valves along forcemain route.

V. Emergency Bypass Pumping

A. General

Due to the critical nature and large service area of the lift station and the fact that the wet well can't be taken out of service for repair, an emergency bypass pumping system is recommended. This will allow the wet well to be taken down periodically for cleaning and maintenance as well as provide redundancy in the event of an emergency.

B. Bypassing Concepts

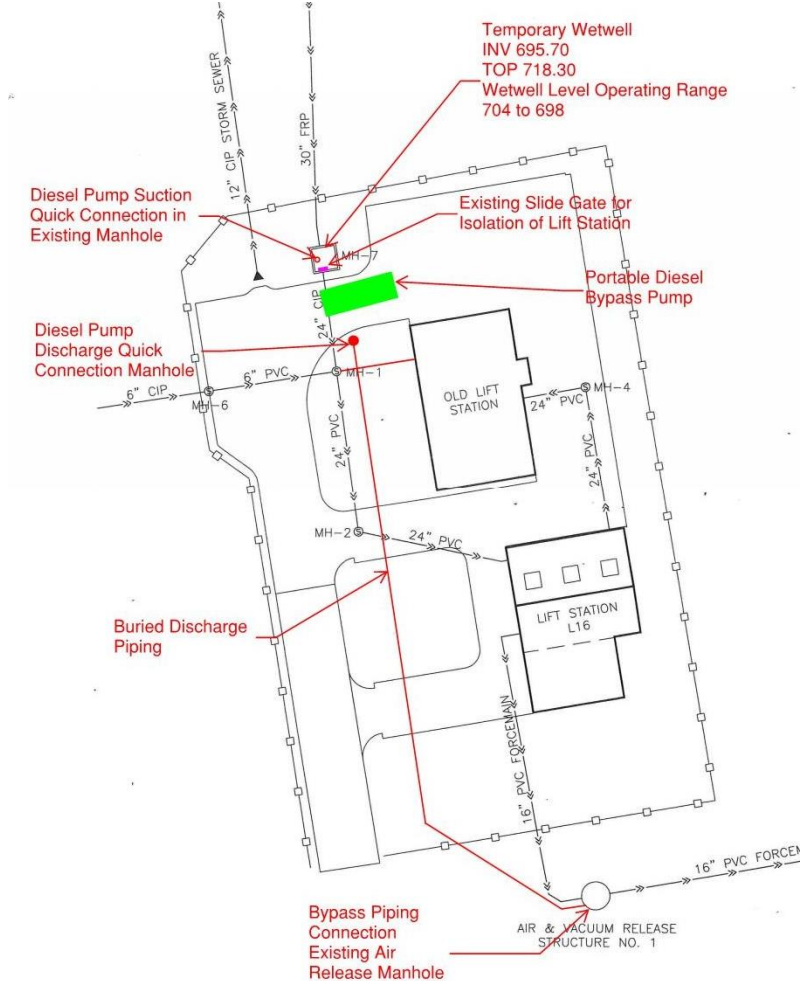
A couple of bypassing alternative concepts were reviewed; including a portable diesel pumping system and installation of submersible pumps within the old lift station wet well. While both options provide a means to bypass the existing wet well, the submersible pump concept is more costly and provides a slightly lesser degree of redundancy. While the lift station does have emergency standby power, the portable diesel pump concept provides additional redundancy in the event power is lost and the generator fails to start. It is recommended that the City proceed with the portable diesel pump concept, as it provides the highest degree of redundancy, is lower cost, and has the ability to provide redundancy for other lift stations in the sanitary sewer or storm sewer systems.

C. Recommended Improvements

The following is a general description of the improvements necessary to implement a permanent portable diesel bypass pump system at the lift station. Figure 8 below shows the general improvements concept.

- Trailer mounted portable diesel pump.
- Utilize existing Manhole No. 7 for the inlet. Existing slide gate provides isolation of existing lift station and creates a wet well for the bypass pump.
- Utilize existing air release manhole for bypass pump discharge piping connection.
- Provide permanent buried piping between Manhole No. 7 and the existing air release manhole to limit the amount of discharge hose required for the portable diesel pump, allowing for faster setup in an emergency. Quick connect fittings would be provided on the piping for easy connection of the portable pump.

Figure 8 – Emergency Bypass Pumping Concept



D. Portable Diesel Pump Requirements

The following is a general description of the minimum requirements for the proposed portable diesel pump.

- | | |
|---|--------------------|
| • Design Flow: | 2,200 gpm |
| • Design Head: | 100 ft |
| • Minimum Suction Head at Design Condition: | 20 ft |
| • Maximum Suction Lift: | 28 ft |
| • Solids Handling (min): | 3" |
| • Impeller Type: | Open |
| • Suction Connection (min): | 10" (8" pump) |
| • Discharge Connection (min): | 8" |
| • Maximum RPM: | 2,400 |
| • Emission Standard: | Tier 4i/Stage IIIB |
| • Enclosure Sound Level: | <70 dB(A) at 33 ft |

- Fuel Tank Capacity (min): 24 hours
- Pump Casing: Cast Iron
- Replaceable Wear Plates
- Continuous Self Priming System
- Runs dry unattended
- 12-volt, electric start with auto-start capable control panel
 - Auto start/stop system
 - Two float switches
 - Switch Manual-0-Auto
 - Ramp-Up/Down function
 - RPM control with push buttons
 - Warning lights

VI. Existing Lift Station Condition Assessment

A. Process Equipment

1. Existing Condition

- Existing Fairbanks Morse submersible pumps were installed in 1997 and are not as prevalent as other manufacturers in the submersible application, due to lack of representation in the area and poor performance with respect to clogging.
- Pumps had clogging issues prior to the addition of a grinder.
- Pumps have been rehabbed and there have been several failures including one currently. One of the existing Fairbanks Morse pumps has been replaced with the recommended Sulzer/ABS XFP 205J pump from above.
- The existing grinder was just recently replaced after approximately seven (7) years of service.

2. Replacement Recommendations

- Install new non-clog submersible pumps.
- Install new discharge elbows and guide rail system.
- Re-evaluate the necessity for a grinder in the future following installation of all three new pumps.

B. Process Piping

1. Piping

The interior piping is ceramic lined ductile iron pipe (DIP) and generally is in good condition. The ceramic lining is an upgrade for corrosion control from standard and would be expected to last in excess of 50 years in this application. The only recommendation would be to coat the exterior of the exposed piping at this time.

2. Valves and Appurtenances

The valves are generally in good operating condition but they are nearing the end of their useful life and it is recommended that all valves and appurtenances be replaced.

C. Process Metering

1. Meter

The existing flow meter is a “clamp on” style ultrasonic flow meter. The existing meter is nearing the end of its useful life and it is recommended that a new magnetic flow meter be installed.

D. Electrical

1. Existing Condition

- Generally, the electrical equipment in good condition, but it is beginning to age and spare parts are more difficult to find.
- 1997 – Main switchgear, motor control center (MCC), and emergency generator.
- 2012 – Variable frequency drives (VFD) for pumps were updated.

2. Replacement Recommendations

- Conduct thermal imaging of gear to determine if there are poor wiring connections or other “hot spots” indicating degradation due to age.
- Within five years, replace the main switchgear and MCC.
- Within ten years, replace the VFDs.
- Within twenty years replace the emergency generator. Due to new emission standards it is likely that the new generator will require a larger footprint than is available, which will require it to be located in its own enclosure outside the building.

E. Instrumentation and Controls

1. Existing Condition

- Installed in 1997 and is generally at the end of useful life.
- The programmable logic controller (PLC) is not from a common supplier.
- The Omni-Site supervisory system provides limited information and performs remote monitoring only.

2. Replacement Recommendations

- Construct a new subpanel in the control panel with all new components. The existing cabinet is in good condition.
- Provide more common components for the PLC and operator interface terminal (OIT).

- Implement new supervisory control and data acquisition system (SCADA) for improved monitoring and control.
- Provide telemetry solution (fiber if feasible).
- These recommended improvements should be constructed as part of a separate larger system wide SCADA improvements project so that panel construction for multiple sites can be completed by one supplier.

F. Mechanical

1. Building Code Ventilation Requirements

Enclosed building facilities must be designed and operated with proper air handling and ventilation facilities. The American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) developed standards which require specific air supply and exhaust volumes for occupied buildings. The State of Minnesota has adopted the 2015 International Mechanical Code (IMC) with amendments referencing to ASHRAE 62.1-2004 for ventilation rates in enclosed building spaces.

2. NFPA 820 Requirements

The National Fire Protection Association (NFPA) is concerned with ventilation of wastewater structures from a fire and explosion prevention standpoint. Specifically, the facility should comply with 2016 Edition of the NFPA Standard 820 “Standard for Fire Protection in Wastewater Treatment and Collection Facilities” which requires specific ventilation rates, airspace segregation and electrical equipment classifications for various areas of a wastewater treatment plant. NFPA guidelines state specifically in Section 1.3.2.2 “This standard shall not apply to toxicity and biological hazards. CAUTION: It is recognized that, from a personnel safety standpoint, toxicity and biological hazards can be present in life-threatening concentrations while no threat of fire or explosion exists.”

The most stringent ventilation requirements are often imposed by NFPA guidelines. Although legally unenforceable by themselves, some state and local governments incorporate the NFPA standards and codes into their own law either verbatim, or with only minor modification. Many local municipalities and organizations require compliance to the NFPA 820 standards as a minimum. Even when not written into law, the Association’s standards and codes are typically accepted as a professional standard and are recognized by many courts as such. Most local Fire Departments require compliance with all NFPA standards as a pre-requisite for acceptance as compliant with local fire codes.

The purpose of NFPA 820 is to prevent fire and explosion from flammable materials that may be present in the wastewater. It is recognized by fire protection professionals that the greatest risk of explosion and fire comes from materials that are accidentally spilled

or discharged to the sewer system and not from methane generated in the sewer from natural processes. If explosive atmospheres could exist, NFPA 70 requires explosion proof electrical equipment if certain ventilation requirements are not met. Ventilation requirements are in terms of “air changes per hour” (ac/h) for any given enclosure or room. With a few exceptions, the basic requirements of NFPA 820 are referenced.

3. Dry Well Spaces

The existing dry well/valve vault is an underground space connected to the wet well.

a) Code Ventilation Requirements

The following is a review of the standard as it relates to mechanical ventilation and the electrical rating of the below grade Dry Well spaces based on the ventilation rates:

NFPA 820, Table 4.2.2, Row 17:

This area has an NEC rating as a Class 1/Division 2 (C1/D2) space if not ventilated or ventilated at less than 6 air changes per hour (AC/H) continuously. The rating is reduced to “Unclassified” if ventilated continuously at 6 AC/H.

There are provisions (subp. 9.3.3) that allow for a recirculation of up to 75 percent of the air when the space is unoccupied and if combustible gas detectors are below the LFL threshold if the continuous ventilation scheme is used to allow the room to be rated as “Unclassified”

b) Proposed Ventilation Rates

The dry well space should be ventilated on an intermittent basis with 6 AC/H when the space is occupied. The NEC rating will be Class 1/Division 2. All electrical lights, outlets, motors and electrical equipment will need to be constructed to meet this rating.

4. Wet Well Spaces

There are no building code ventilation requirements defined for these spaces as they are rather unique. The recognized standard for the design of Wastewater Treatment and Collection Facilities is the 2016 Edition of National Fire Protection Association (NFPA) 820.

a) Code Ventilation Requirements

The following is a review of the standard as it relates to mechanical ventilation and the electrical rating of the Wet Well spaces based on the ventilation rates:

NFPA 820, Table 4.2.2, Row 16:

This area has an NEC rating as a Class 1/Division 1 (C1/D1) space if not ventilated or ventilated at less than 12 air changes per hour (AC/H)

continuously. The rating is reduced to Class 1/Division 2 (C1/D2) space if ventilated continuously at 12 AC/H.

b) Proposed Ventilation Rates

Because this space is not frequently occupied, it is recommended to only provide ventilation when the space is occupied. With this intermittent ventilation scheme, the space will have an electrical rating of NEC Class 1/Division 1 (C1/D1).

5. **Recommended HVAC Improvements**

Given the age/condition of the existing equipment it is recommended that the ventilation equipment be replaced to meet the requirements above for the dry well space. Existing ductwork can be reused where practical and in good condition. There is limited access to the wet well and it is recommended that this area be treated as a “confined space” and only be ventilated when occupying for maintenance utilizing portable ventilation and proper gas monitoring equipment.

6. **Recommended Plumbing Improvements**

All exposed plumbing will be replaced, including the dry well sump pump systems.

G. **Structural/Architectural**

1. **Existing Condition**

The following is a summary of the visual inspection and assessment of the building and structural components.

- Above grade building is generally in good condition.
- There are cracks in the wet well top slab at the hatch corners which is not unusual.
- Wet well coatings appear to be in sound condition and there are no visible signs of corrosion. The high-performance epoxy system specified by Metropolitan Council has typically held up well and is suitable for the corrosive environment of wet wells.
- Mostly minor cosmetic items.

2. **Replacement Recommendations**

- Coat/repair cracks in the wet well top slab.
- General interior coatings (cosmetic).
- Utilize remaining life of larger rehab items like roof, etc.

H. Old Lift Station

1. Existing Condition

The following is a summary of the visual inspection and assessment of the old lift station building and structural components.

- Above grade building is falling apart.
- Concrete of the substructure is visually sound.
- Access into the wet and dry well areas has deteriorated over time.
- The wet well fills with water at high river levels.

2. Old Wet Well Storage Evaluation

The wet well in the old lift station was evaluated for use as emergency storage. To utilize the old wet well for emergency storage it should be coated/sealed to limit intrusion of ground/river water at high river levels. In addition, the condition of the top slab should be further reviewed and the openings should be closed off with hatches installed for access and installation of a portable submersible pump that will be necessary to pump out the old wet well following an emergency event. Based upon the estimated dimensions of the old wet well the rough volume for emergency storage is approximately 60,000 gallons. This equates to approximately 25 minutes at the 2019 peak hourly flow and 1.5 hours at the 2019 average daily flow.

The existing wet well has approximately 58,000 gallons of storage to the elevation of the overflow to the old wet well and the interceptor has a similar amount of storage (55 to 60,000 gallons) up to the same overflow elevation. This would result in approximately 50 minutes of storage at the existing peak hourly flow and 3 hours at average annual flow before the flow would overflow into the old wet well.

While the old wet well provides approximately 50% percent more emergency storage, the available existing emergency storage should allow adequate time to get the new portable diesel pump into operation if the decision is made in the future to not utilize the old wet well for additional emergency storage.

3. Replacement Recommendations

- Demolish above grade building.
- Fill dry well area and cap with concrete slab or cut off top of structure to approximately four feet below grade and restore to grade.
- Plan for utilizing old wet well for additional emergency storage.

I. Levee

1. Existing Condition

The existing levee has a significant amount of large vegetation growing on it and has a couple of low spots that are in need of repair. The levee appears to be located within Mdewakanton Sioux property limits and the exact level of flood protection is unknown.

In addition to the levee condition and property ownership, there is an existing storm drain discharging to the river that does not have backflow prevention.

2. Replacement Recommendations

- Confirm levee protection level, land ownership, and any necessary easement/access requirements.
- Remove overgrowth vegetation on levee.
- Reshape levee and repair low spots and consider raising to the 100-year flood elevation if necessary.
- Establish new vegetation on levee.
- Add backflow prevention to existing storm drain and consider replacement of the storm piping through the levee.

VII. Opinion of Probable Cost/Phasing Plan

A. General

Given the degree of investment required over the next ten years, the recommended improvements have been broken into multiple phases, based partly upon need and fitting within a reasonable capital improvements plan to spread out the costs and reduce the potential impacts to existing user rates. The costs for future phases have been inflated to the year of construction utilizing an annual inflation rate for construction of 3.5%. The first phase of the project includes the items and or amount budgeted in the CIP for 2020, which generally included dollars for pump replacement and grinder replacement. The emergency bypass pump purchase was budgeted as a separate capital improvements item but it is shown as part of the first phase costs along with the pump and grinder replacement, given its relationship to the overall lift station improvements. Following the initial budgeted improvements for 2020 (Phase I) which have already been completed, the proposed lift station improvements have been divided into three additional phases to be constructed over the next ten plus years (Phase II – 2021, Phase III – 2025, Phase IV – 2030+). In addition to the lift station improvements, installation of the redundant parallel 12-inch PVC forcemain is projected for 2027 at a cost of approximately \$2.3 million.

B. Opinion of Probable Cost – Lift Station Rehabilitation Total Project

The following Table 7 summarizes the total project cost if the rehabilitation improvements were to be completed as a single project. These costs include the improvements already completed in 2020. The recommended control and SCADA improvements are not included in these costs because they have been included in a separate feasibility report for system wide SCADA improvements.

Table 7 – Opinion of Probable Cost – Lift Station Rehabilitation Total Project

Item	Opinion of Probable Cost	Notes
Mobilization, Bonds, Insurance	\$222,000	
Demolition	\$120,000	Demolish existing above grade building and fill in dry wells
Site Work/Bypass Pumping	\$250,000	New diesel pump and permanent bypass piping
Levee Rehabilitation	\$125,000	Levee repair and storm sewer
Process Piping	\$290,000	New valves and flow meter including existing FM valves
Pumps	\$250,000	Three new pumps, discharge elbows, and guide rails
Structural	\$200,000	Miscellaneous structural improvements
Architectural	\$275,000	Miscellaneous architectural improvements
Mechanical	\$200,000	HVAC upgrade (Equipment Replacement)
Electrical	\$460,000	Electrical service, MCC, and VFD upgrade
Instrumentation & Controls	\$80,000	New instrumentation and pump control connections
Generator	\$220,000	New generator
Subtotal	\$2,692,000	
ELA (15%)	\$404,000	
Construction Contingencies (15%)	\$404,000	
Total Opinion of Probable Cost	\$3,500,000	

From Table 7, rehabilitation of the facility as a single project is estimated to cost \$3.5 million. If a complete replacement (i.e., demolishing the existing facility and constructing a new one in its place) were considered instead, additional variables such as existing soil conditions, space availability, floodplain elevations, maintaining service during a 12– 15-month construction period, etc., would also need to be taken into account and could result in a total cost ranging from \$5.0 million - \$6.0 million. If a full replacement of the existing lift station is desired, further analysis to determine a more refined replacement cost is recommended.

C. Lift Station Rehabilitation Phasing Summary

The following Table 8 summarize the total project cost if the rehabilitation project were to be completed in multiple phases including the improvements already completed in 2020. The total project cost associated with phasing the improvements in multiple projects is higher than if the improvements were completed in a single project due to the additional complexity of administering multiple projects with multiple contracts over an extended period of time. The recommended control panel upgrade and SCADA improvements are not included in these costs because they have been included in a separate feasibility report for the system wide SCADA improvements. Levee rehabilitation is included in the Phase II project but is expected to be completed as separate project. The purchase of the bypass pump was included in the Phase I cost even though it was a separate capital improvements item, since it is part of the overall system improvements to the lift station.

Table 8 – Lift Station Rehabilitation Phasing Summary

Item	Phasing Plan			
	Phase I (2020)	Phase II (2021)	Phase III (2025)	Phase IV (2030+)
Mobilization, Bonds, Insurance	\$0	\$113,000	\$85,000	\$84,000
Demolition	\$0	\$104,000	\$30,000	\$28,000
Site Work/Bypass Pumping	\$100,000	\$129,000	\$0	\$42,000
Levee Rehabilitation	\$0	\$129,000	\$0	\$0
Process Piping	\$40,000	\$259,000	\$0	\$0
Pumps	\$50,000	\$207,000	\$0	\$0
Structural	\$0	\$78,000	\$0	\$212,000
Architectural	\$0	\$145,000	\$0	\$212,000
Mechanical	\$0	\$0	\$238,000	\$0
Electrical	\$0	\$41,000	\$534,000	\$14,000
Instrumentation & Controls	\$0	\$41,000	\$48,000	\$21,000
Generator	\$0	\$0	\$0	\$310,000
Subtotal	\$190,000	\$1,246,000	\$935,000	\$923,000
ELA (15%)	\$0	\$187,000	\$140,000	\$138,000
Construction Contingencies (15%)	\$0	\$187,000	\$140,000	\$138,000
Total Opinion of Probable Cost	\$190,000	\$1,620,000	\$1,215,000	\$1,199,000
Total Opinion of Probable Cost (Phase I-IV)				\$4,224,000

Phase III electrical work includes full replacement of the main switchgear, automatic transfer switch, motor control centers, variable frequency drives, and other ancillary electrical equipment. Phase III mechanical work includes replacement of the makeup air units, exhaust fans, motorized louvers, HVAC controls, and some ductwork.

Phase IV architectural work includes replacement of the building roof, flashing, and doors, as well as placement of new coatings on all exposed surfaces and wet well.

D. Opinion of Probable Cost – Redundant Forcemain (2027)

The following Table 9 summarize the total project cost for a 12-inch redundant forcemain to be completed by 2027.

Table 9 – Opinion of Probable Cost – Redundant Forcemain (2027)

Description	Opinion of Probable Cost	Notes
Mobilization, Bonds, Insurance	\$147,000	
Bituminous Restoration	\$64,000	
Connections to Existing System	\$13,000	
12" PVC DR18 FM (8,500 lf)	\$1,081,000	Directionally drilled
Erosion Control	\$64,000	
Traffic Control	\$32,000	
Air Release/Cleanout Manholes	\$382,000	
Subtotal	\$1,783,000	
ELA (15%)	\$267,000	
Construction Contingencies (15%)	\$267,000	
Total Opinion of Probable Cost	\$2,317,000	

APPENDIX A – OPINION OF PROBABLE COST TABLES

Shakopee - Lift Station No. 16 Rehabilitation Project
Opinion of Probable Project Cost Summary

Item	Phasing Plan			
	Phase I (2020)	Phase II (2021)	Phase III (2025)	Phase IV (2030+)
Mobilization, Bonds, Insurance	\$0	\$113,000	\$85,000	\$84,000
Demolition	\$0	\$104,000	\$30,000	\$28,000
Site Work/Bypass Pumping	\$100,000	\$129,000	\$0	\$42,000
Levee Rehabilitation	\$0	\$129,000	\$0	\$0
Process Piping	\$40,000	\$259,000	\$0	\$0
Pumps	\$50,000	\$207,000	\$0	\$0
Structural	\$0	\$78,000	\$0	\$212,000
Architectural	\$0	\$145,000	\$0	\$212,000
Mechanical	\$0	\$0	\$238,000	\$0
Electrical	\$0	\$41,000	\$534,000	\$14,000
Instrumentation & Controls	\$0	\$41,000	\$48,000	\$21,000
Generator	\$0	\$0	\$0	\$310,000
Subtotal	\$190,000	\$1,246,000	\$935,000	\$923,000
ELA (15%)	\$0	\$187,000	\$140,000	\$138,000
Construction Contingencies (15%)	\$0	\$187,000	\$140,000	\$138,000
Total Opinion of Probable Cost	\$190,000	\$1,620,000	\$1,215,000	\$1,199,000
Total Opinion of Probable Cost (Phase I-IV)				\$4,224,000

Shakopee - Lift Station No. 16 Rehabilitation Project
Opinion of Probable Project Cost (Full Project)

Item	Opinion of Probable Cost	Notes
Mobilization, Bonds, Insurance	\$222,000	
Demolition	\$120,000	Demolish existing above grade building and fill in dry wells
Site Work/Bypass Pumping	\$250,000	New diesel pump and permanent bypass piping
Levee Rehabilitation	\$125,000	Levee repair and storm sewer
Process Piping	\$290,000	New valves and flow meter including existing FM valves
Pumps	\$250,000	Three new pumps, discharge elbows, and guide rails
Structural	\$200,000	Miscellaneous structural improvements
Architectural	\$275,000	Miscellaneous architectural improvements
Mechanical	\$200,000	HVAC upgrade (Equipment Replacement)
Electrical	\$460,000	Electrical service, MCC, and VFD upgrade
Instrumentation & Controls	\$80,000	New instrumentation and pump control connections
Generator	\$220,000	New generator
Subtotal	\$2,692,000	
ELA (15%)	\$404,000	
Construction Contingencies (15%)	\$404,000	
Total Opinion of Probable Cost	\$3,500,000	

Shakopee - Lift Station No. 16 Rehabilitation Project
Opinion of Probable Project Cost (Phase I - 2020)

Item	Opinion of Probable Cost	Notes
Mobilization, Bonds, Insurance		
Demolition		
Site Work/Bypass Pumping	\$100,000	Purchase new diesel pump (under separate CIP item)
Levee Rehabilitation		
Process Piping	\$40,000	Purchase and installation of new grinder (completed)
Pumps	\$50,000	Purchase and installation of first new pump (completed)
Structural		
Architectural		
Mechanical		
Electrical		
Instrumentation & Controls		
Generator		
Subtotal	\$190,000	
ELA (15%)		
Construction Contingencies (15%)		
Total Opinion of Probable Cost	\$190,000	

Shakopee - Lift Station No. 16 Rehabilitation Project
Opinion of Probable Project Cost (Phase II - 2021)

Item	Opinion of Probable Cost	Notes
Mobilization, Bonds, Insurance	\$113,000	
Demolition	\$104,000	Demolish existing above grade building and fill in wet/dry wells
Site Work/Bypass Pumping	\$129,000	Permanent buried bypass piping
Levee Rehabilitation	\$129,000	Levee repair (to be completed as a separate project)
Process Piping	\$259,000	New valves and flow meter including existing FM valves
Pumps	\$207,000	2 New pumps, discharge elbows, and guide rails
Structural	\$78,000	Slab repair and old wet well improvements
Architectural	\$145,000	Miscellaneous coatings and old wet well repair
Mechanical	\$0	
Electrical	\$41,000	Electrical connections
Instrumentation & Controls	\$41,000	New instruments and pump control additions
Generator	\$0	
Subtotal	\$1,246,000	
ELA (15%)	\$187,000	
Construction Contingencies (15%)	\$187,000	
Total Opinion of Probable Cost	\$1,620,000	

Shakopee - Lift Station No. 16 Rehabilitation Project
Opinion of Probable Project Cost (Phase III - 2025)

Description	Opinion of Probable Cost	Notes
Mobilization, Bonds, Insurance	\$85,000	
Demolition	\$30,000	Demo existing electrical and mechanical
Site Work/Bypass Pumping	\$0	
Levee Rehabilitation	\$0	
Process Piping	\$0	
Pumps	\$0	
Structural	\$0	
Architectural	\$0	
Mechanical	\$238,000	HVAC upgrade (Equipment Replacement)
Electrical	\$534,000	Electrical service, MCC, and VFD upgrade
Instrumentation & Controls	\$48,000	Miscellaneous controls
Generator	\$0	New generator
Subtotal	\$935,000	
ELA (15%)	\$140,000	
Construction Contingencies (15%)	\$140,000	
Total Opinion of Probable Cost	\$1,215,000	

Shakopee - Lift Station No. 16 Rehabilitation Project
Opinion of Probable Project Cost (Phase IV - 2030+)

Description	Opinion of Probable Cost	Notes
Mobilization, Bonds, Insurance	\$84,000	
Demolition	\$28,000	Demo roof and miscellaneous arch
Site Work/Bypass Pumping	\$42,000	Generator pad and driveway improvements
Levee Rehabilitation	\$0	
Process Piping	\$0	
Pumps	\$0	
Structural	\$212,000	Miscellaneous structural improvements
Architectural	\$212,000	Miscellaneous architectural improvements
Mechanical	\$0	
Electrical	\$14,000	Miscellaneous electrical
Instrumentation & Controls	\$21,000	Miscellaneous controls
Generator	\$310,000	
Subtotal	\$923,000	
ELA (15%)	\$138,000	
Construction Contingencies (15%)	\$138,000	
Total Opinion of Probable Cost	\$1,199,000	

**Shakopee - Lift Station No. 16 Redundant Parallel Forcemain Project
Opinion of Probable Project Cost (2027)**

Description	Opinion of Probable Cost	Notes
Mobilization, Bonds, Insurance	\$147,000	
Bituminous Restoration	\$64,000	
Connections to Existing System	\$13,000	
12" PVC DR18 FM (8,500 lf)	\$1,081,000	Directionally drilled
Erosion Control	\$64,000	
Traffic Control	\$32,000	
Air Release/Cleanout Manholes	\$382,000	
Subtotal	\$1,783,000	
ELA (15%)	\$267,000	
Construction Contingencies (15%)	\$267,000	
Total Opinion of Probable Cost	\$2,317,000	

APPENDIX B – HYDRAULIC CALCULATION FIGURES

Figure 2 - Lift Station 16 (Existing Pumps) - Single Pump (no adjustment)

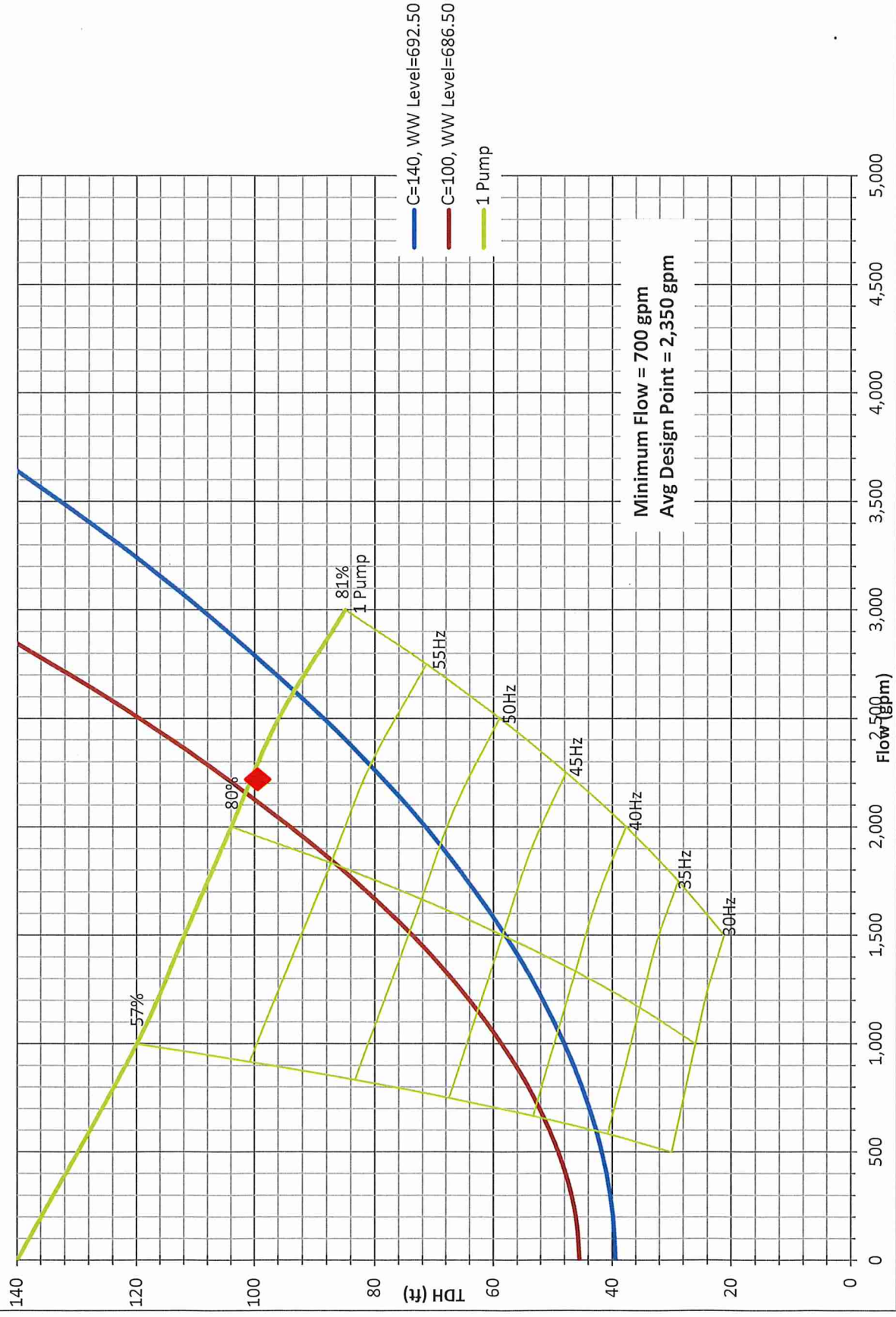


Figure 3 - Lift Station 16 (Existing Pumps) - Multiple Pumps (adjusted for individual losses)

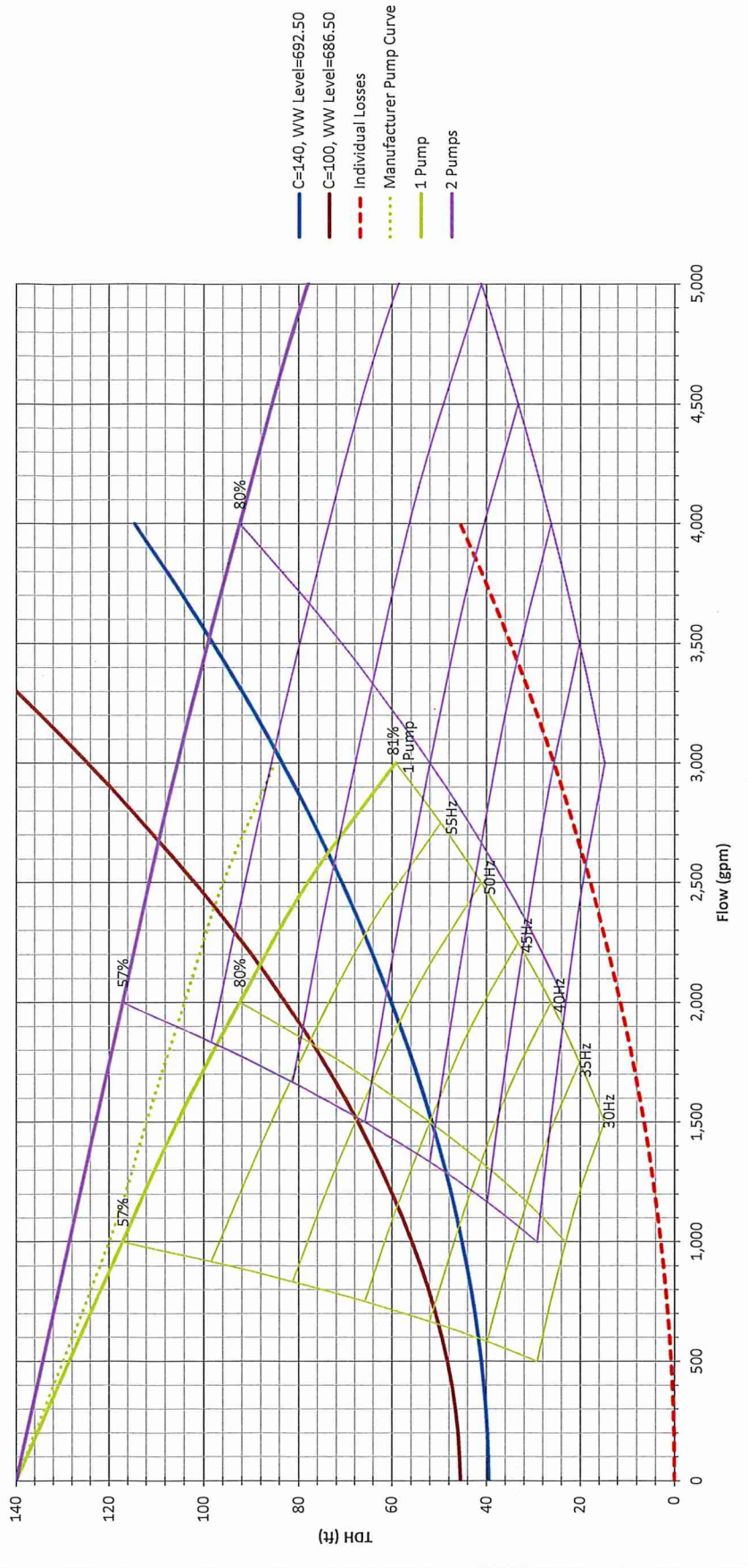


Figure 4 - Lift Station 16 (Sulzer/ABS XFP 205J) - Multiple Pumps (adjusted for individual losses)

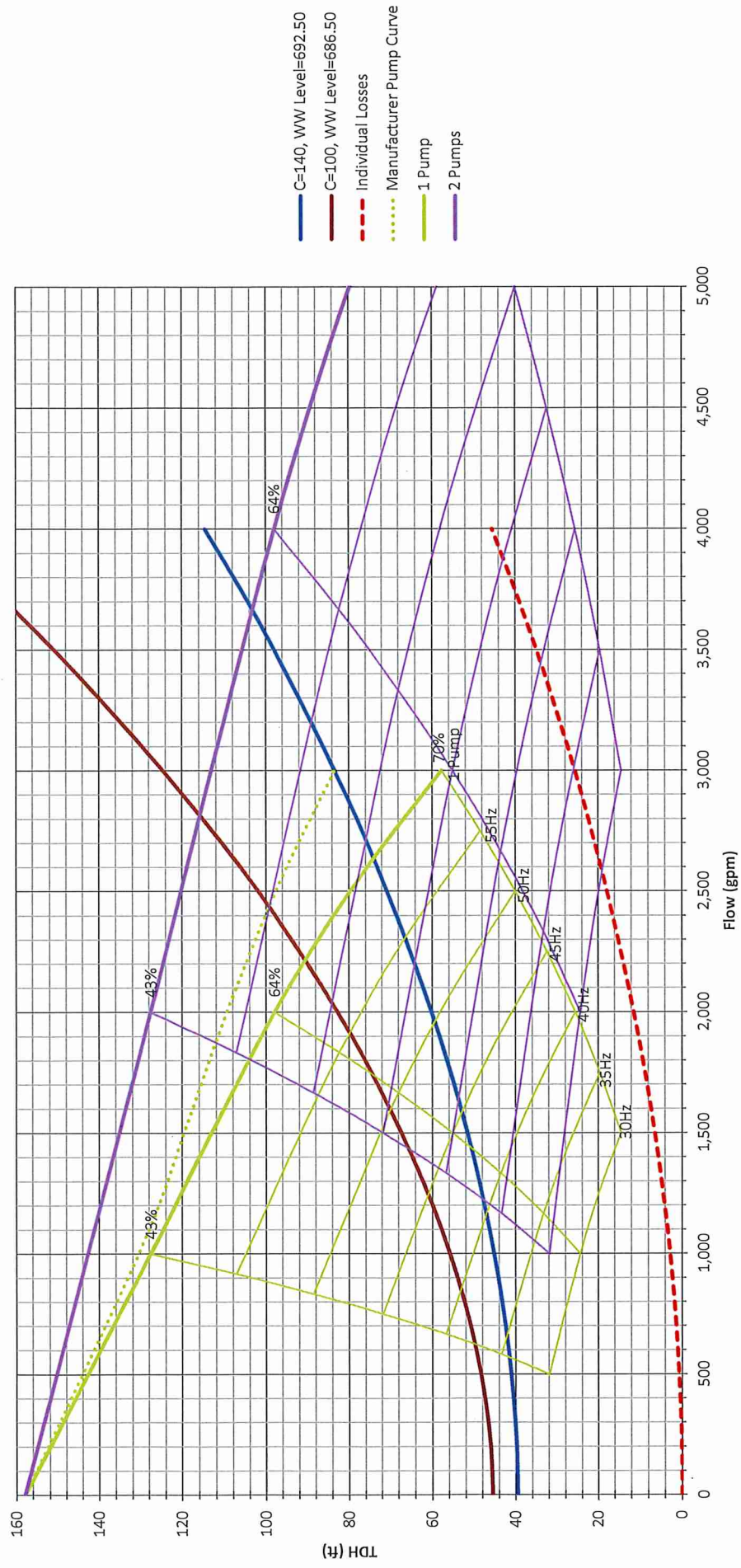


Figure 5 - Lift Station 16 (Sulzer/ABS XFP 200M) - Multiple Pumps (adjusted for individual losses)

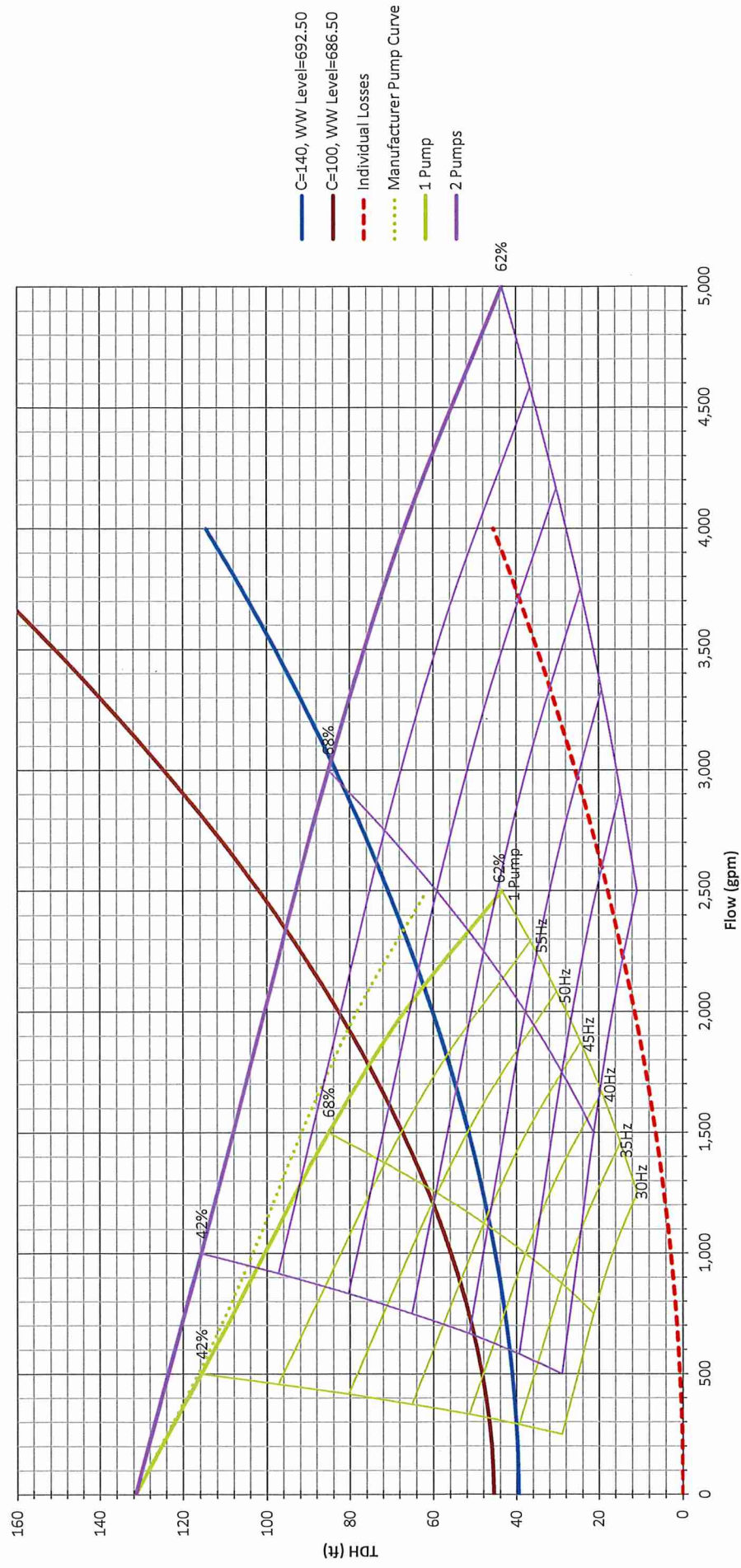


Figure 6 - Lift Station 16 (SULZER/ABS XFP-205J) - 12" FM

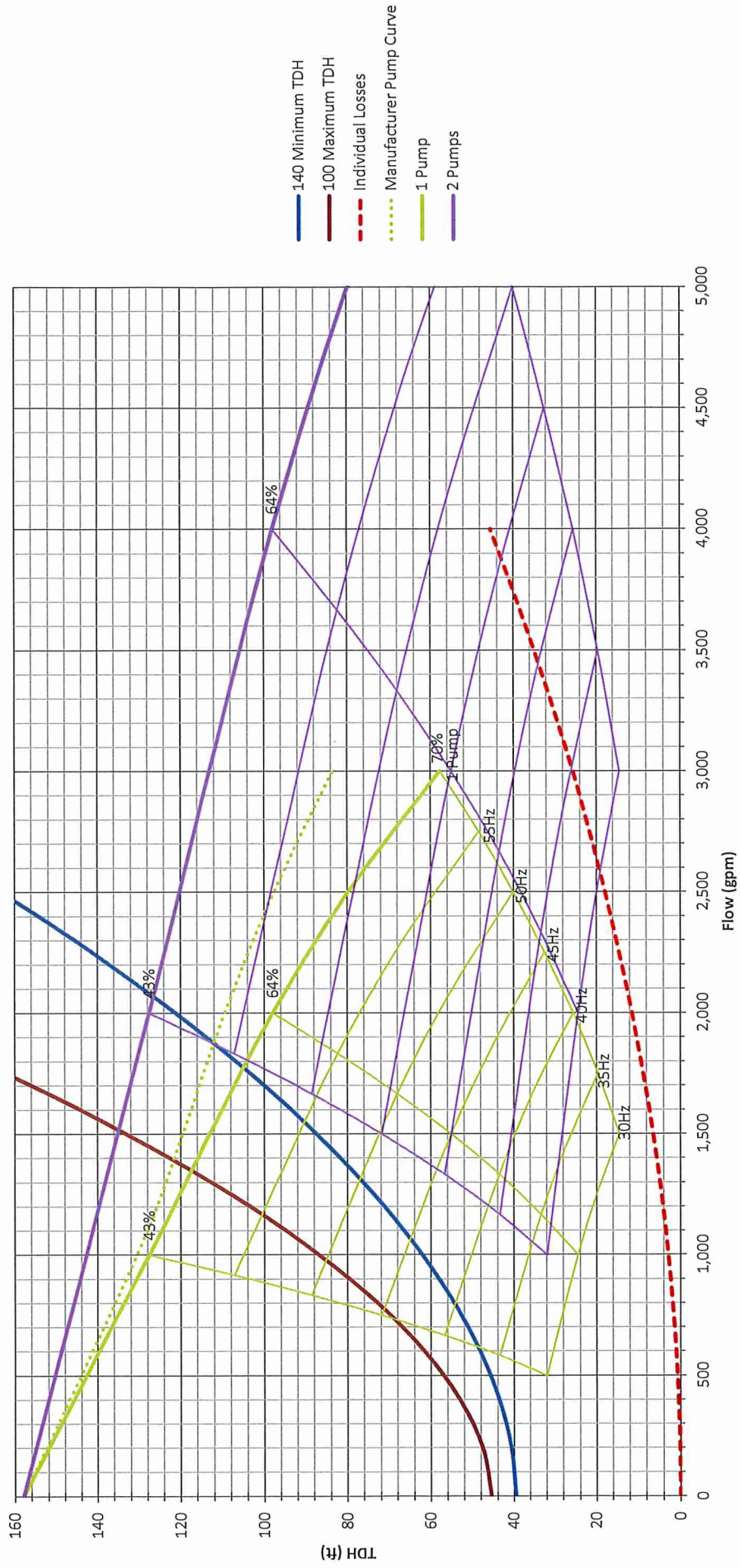
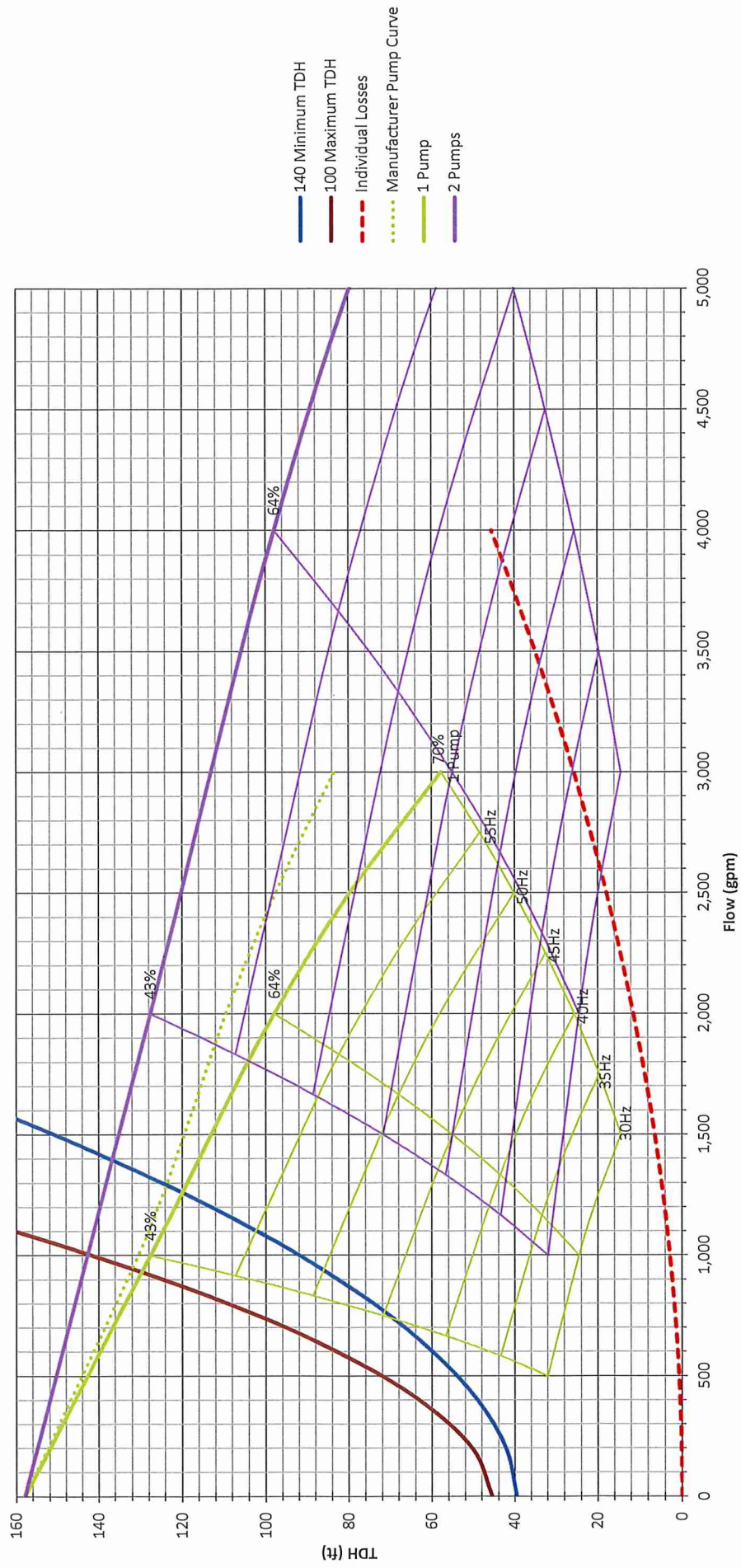
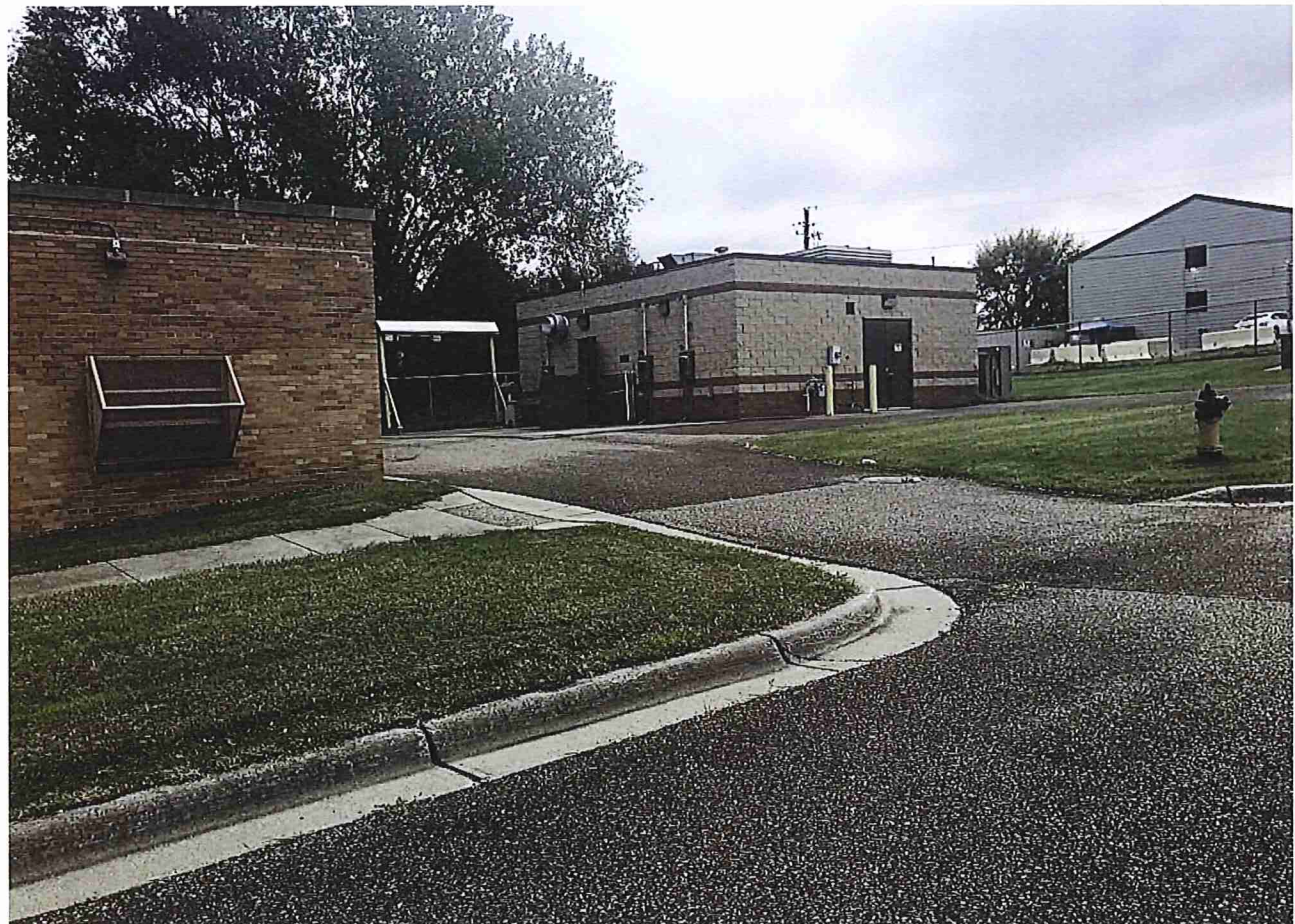


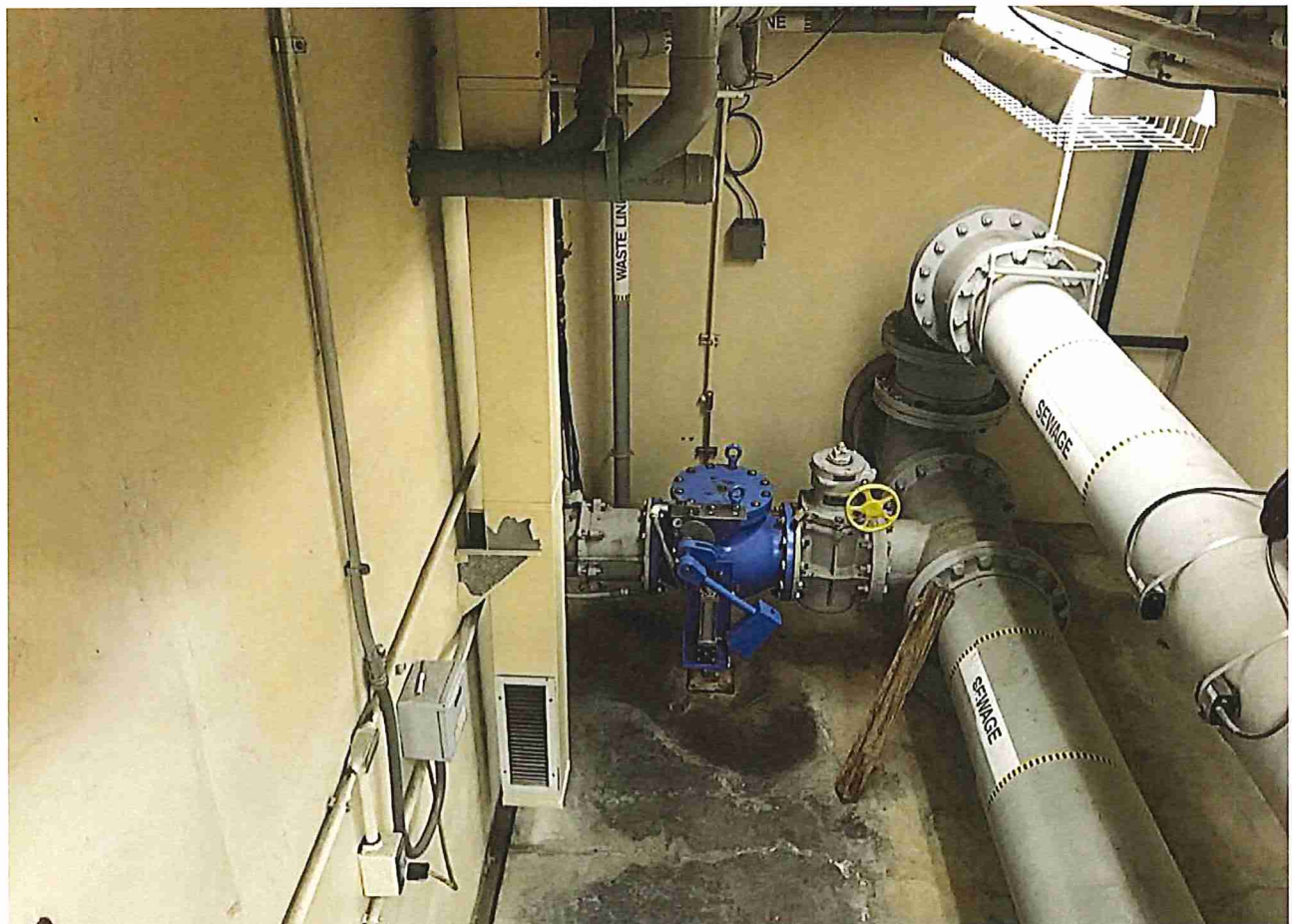
Figure 7 - Lift Station 16 (SULZER/ABS XFP-205J) - 10" FM

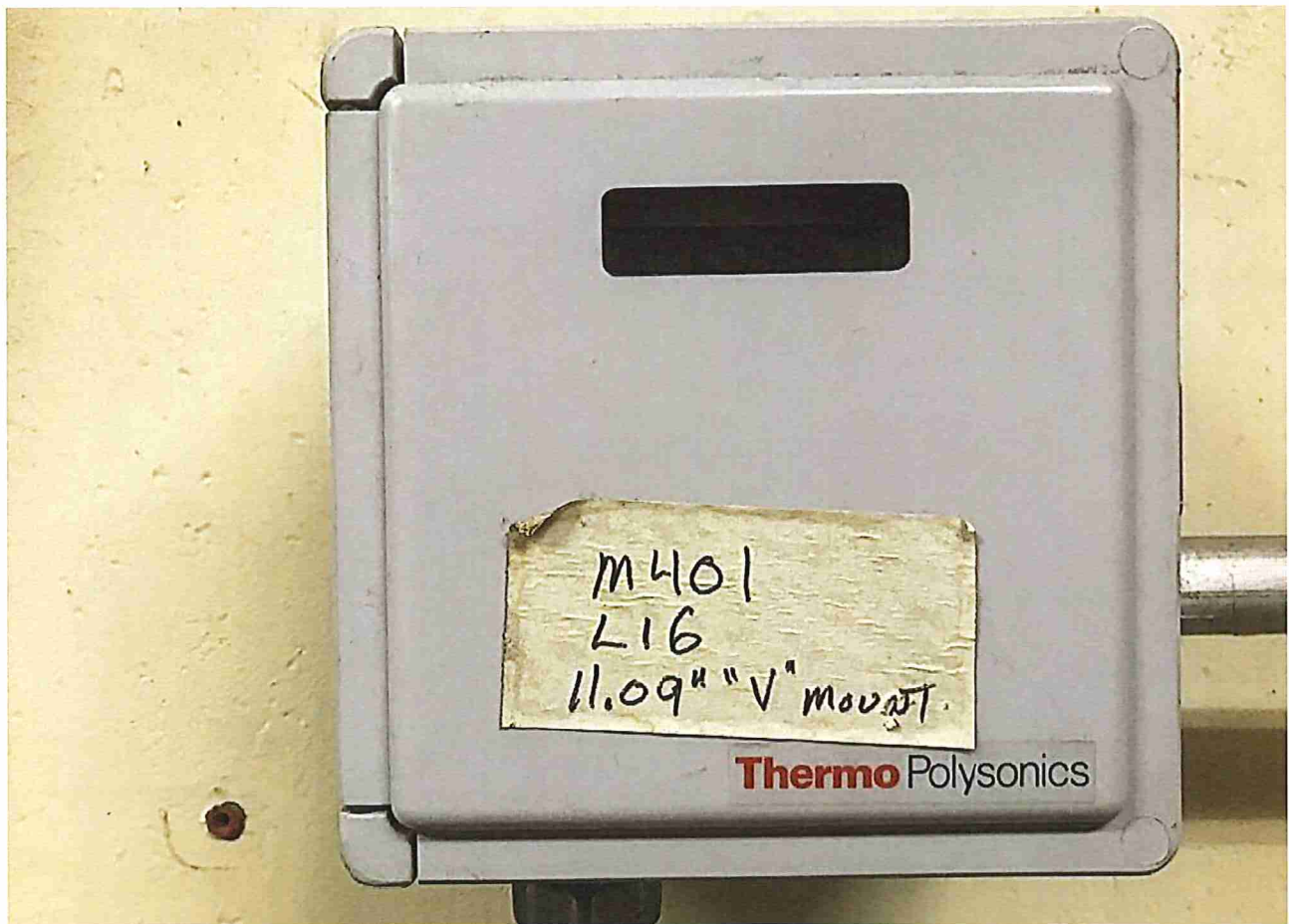


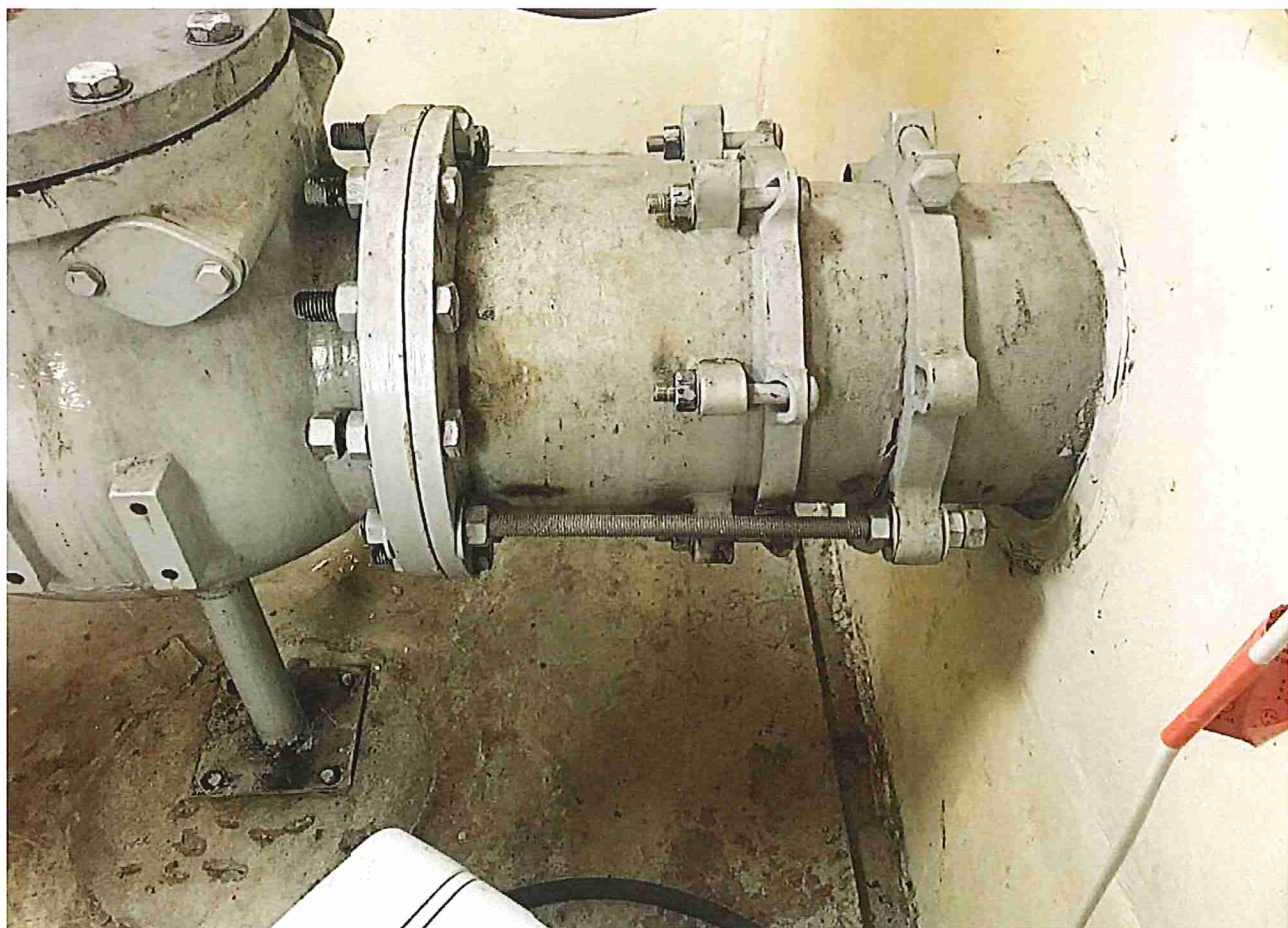
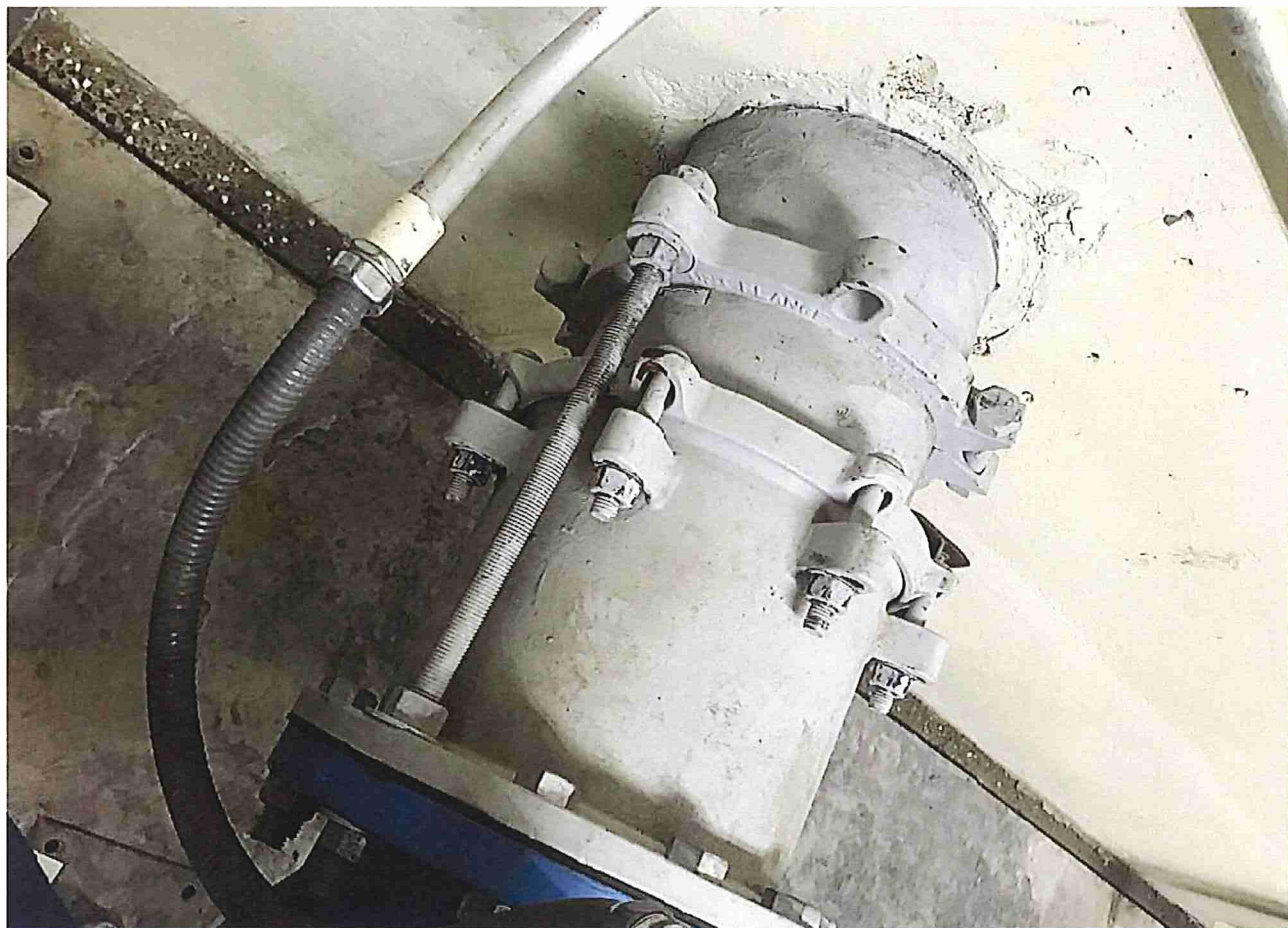
APPENDIX C – EXISTING PHOTOS

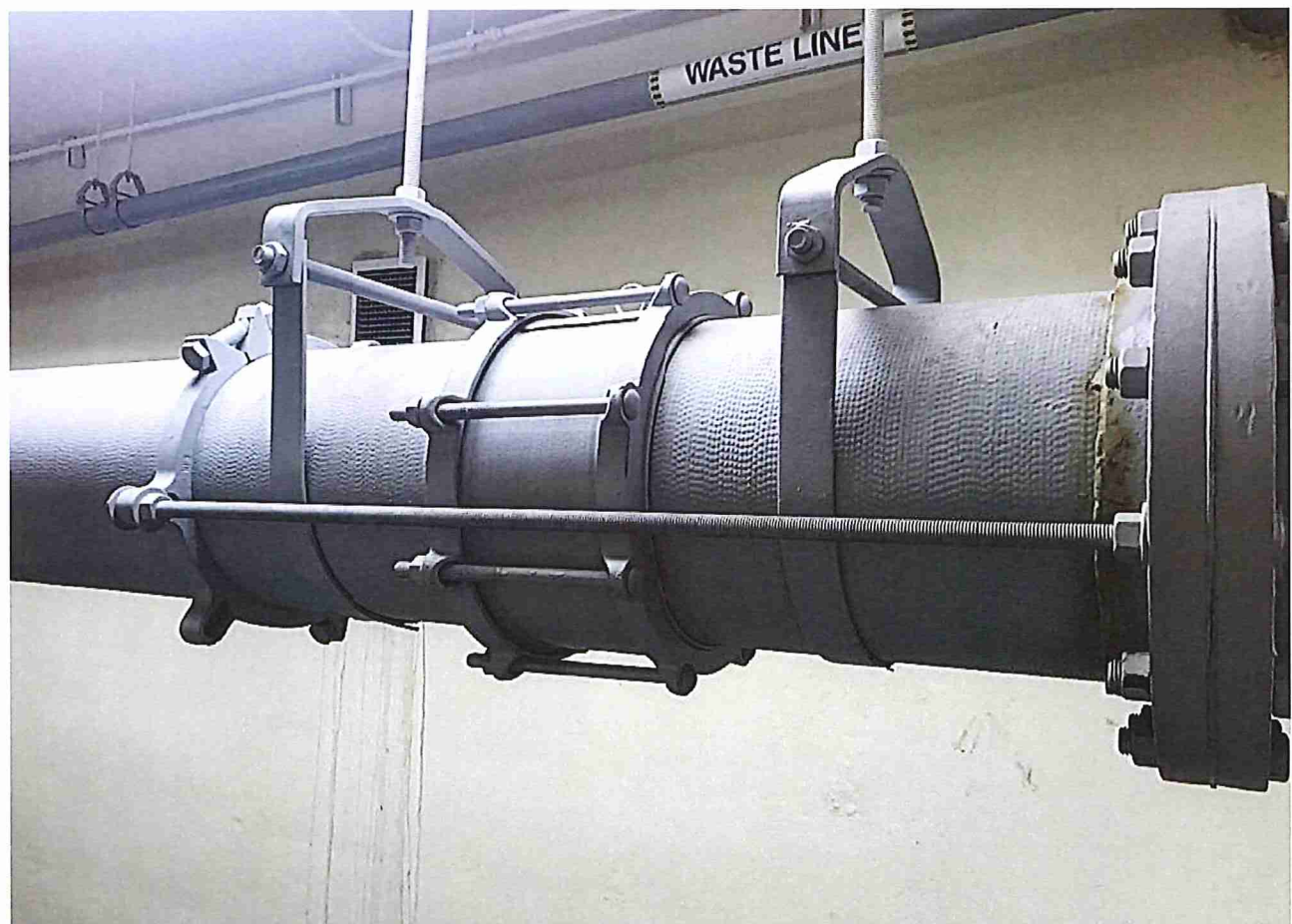


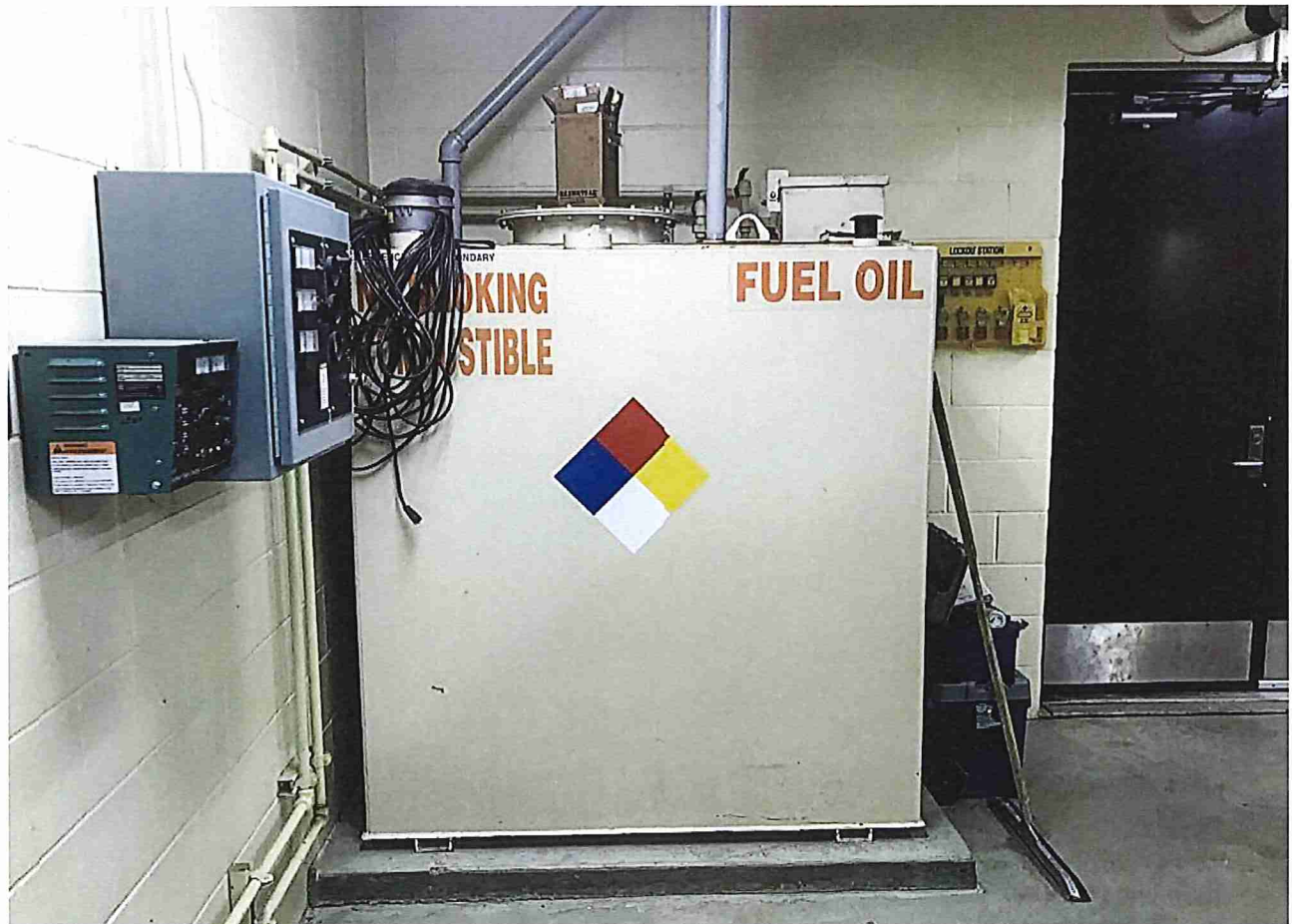


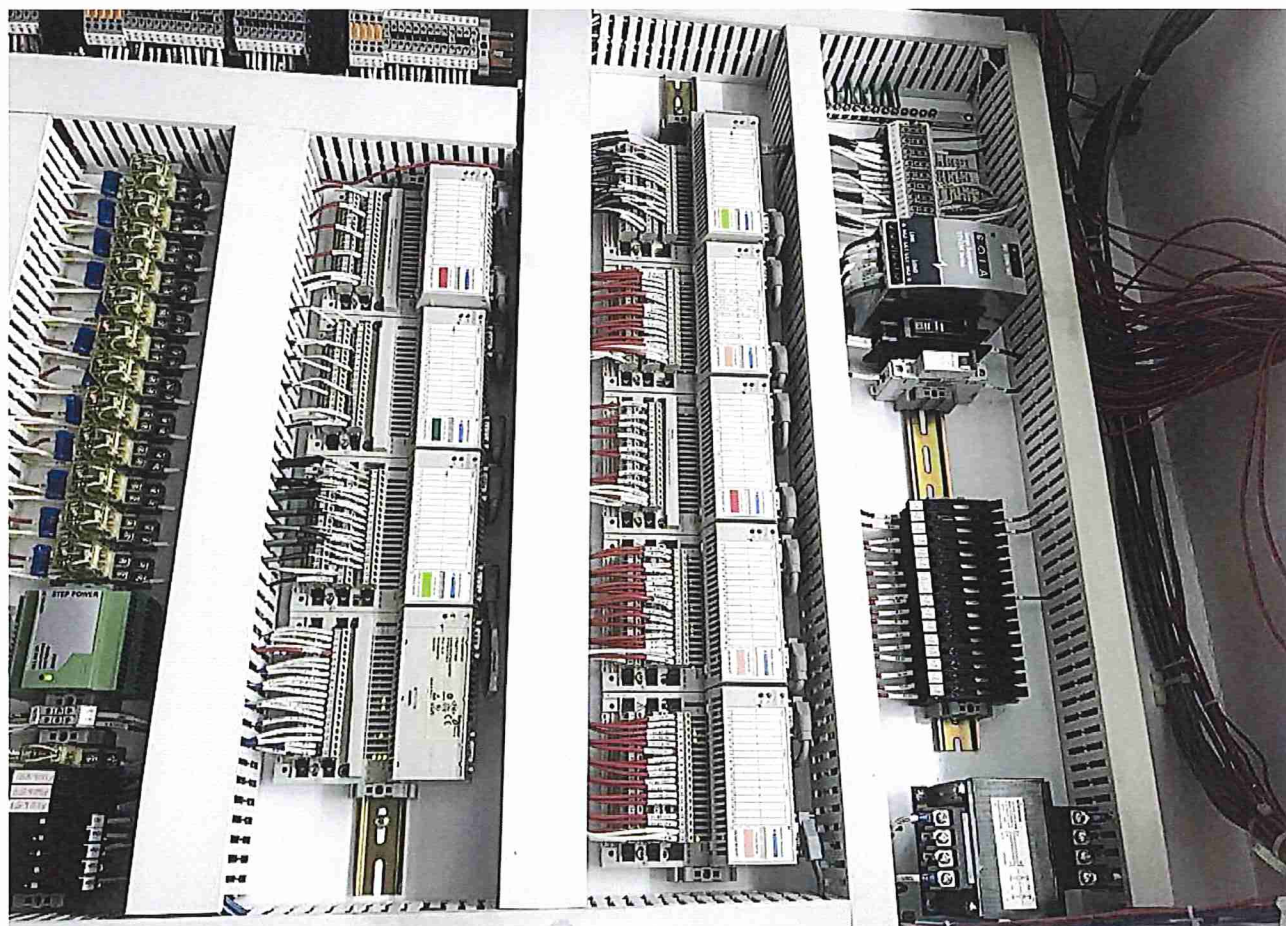
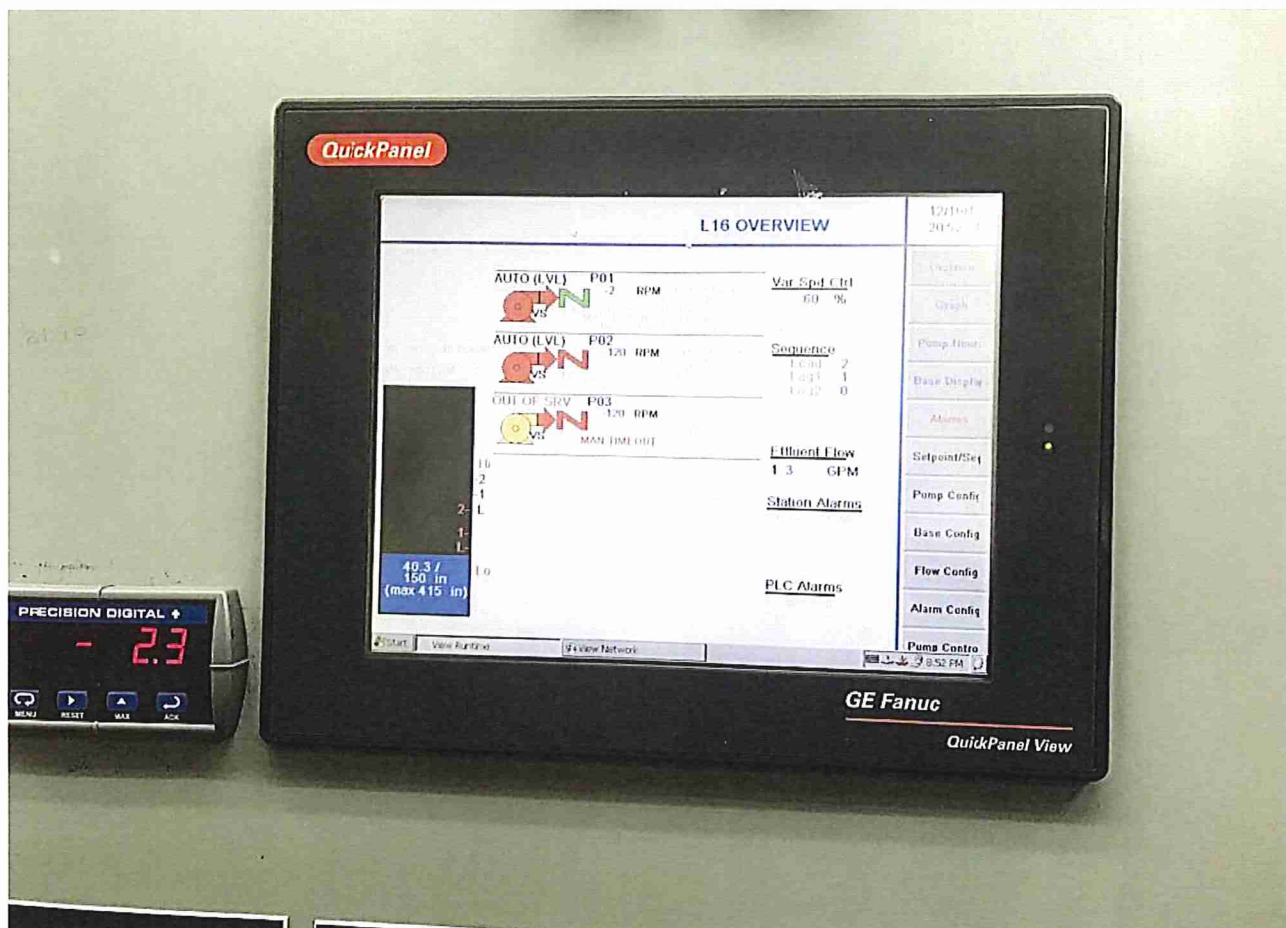


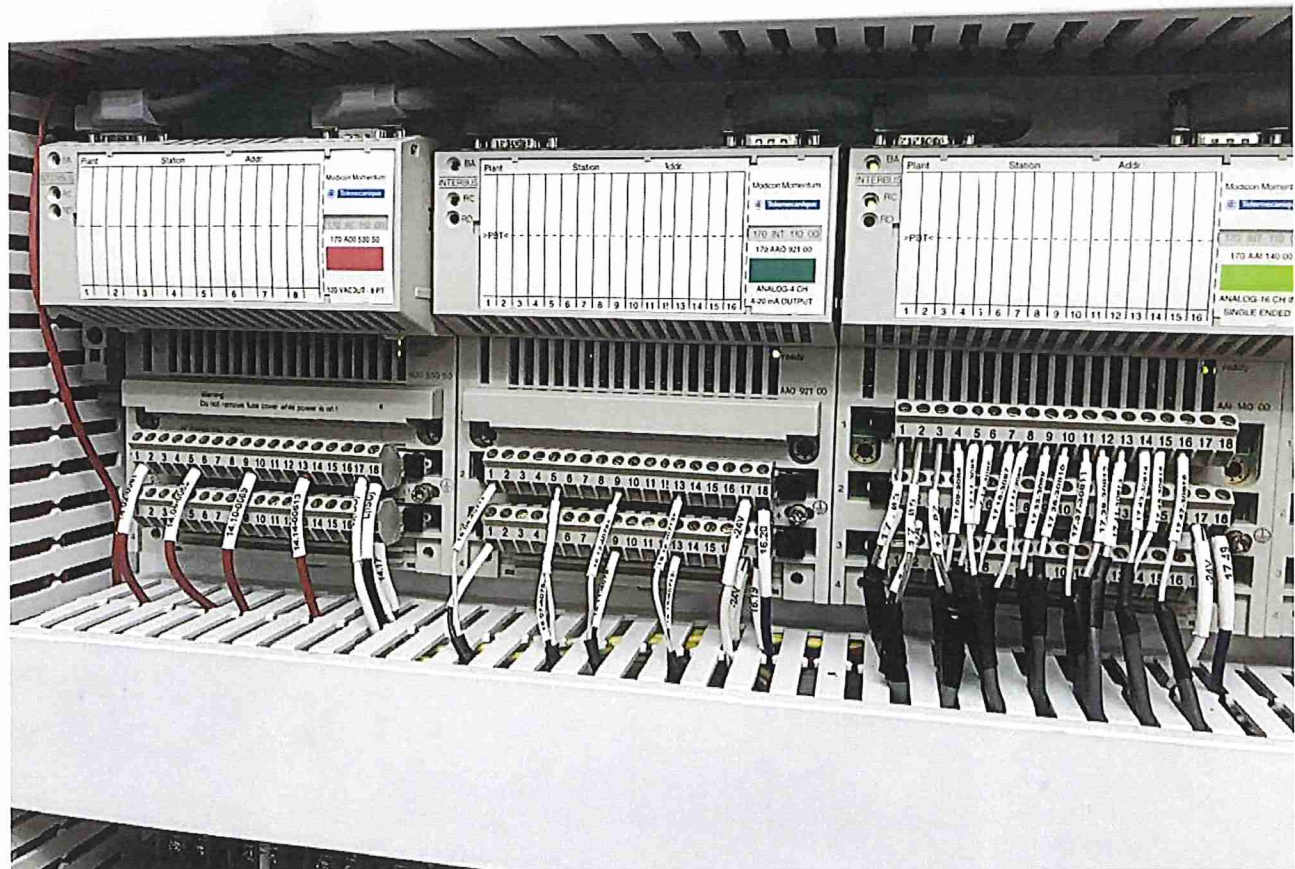
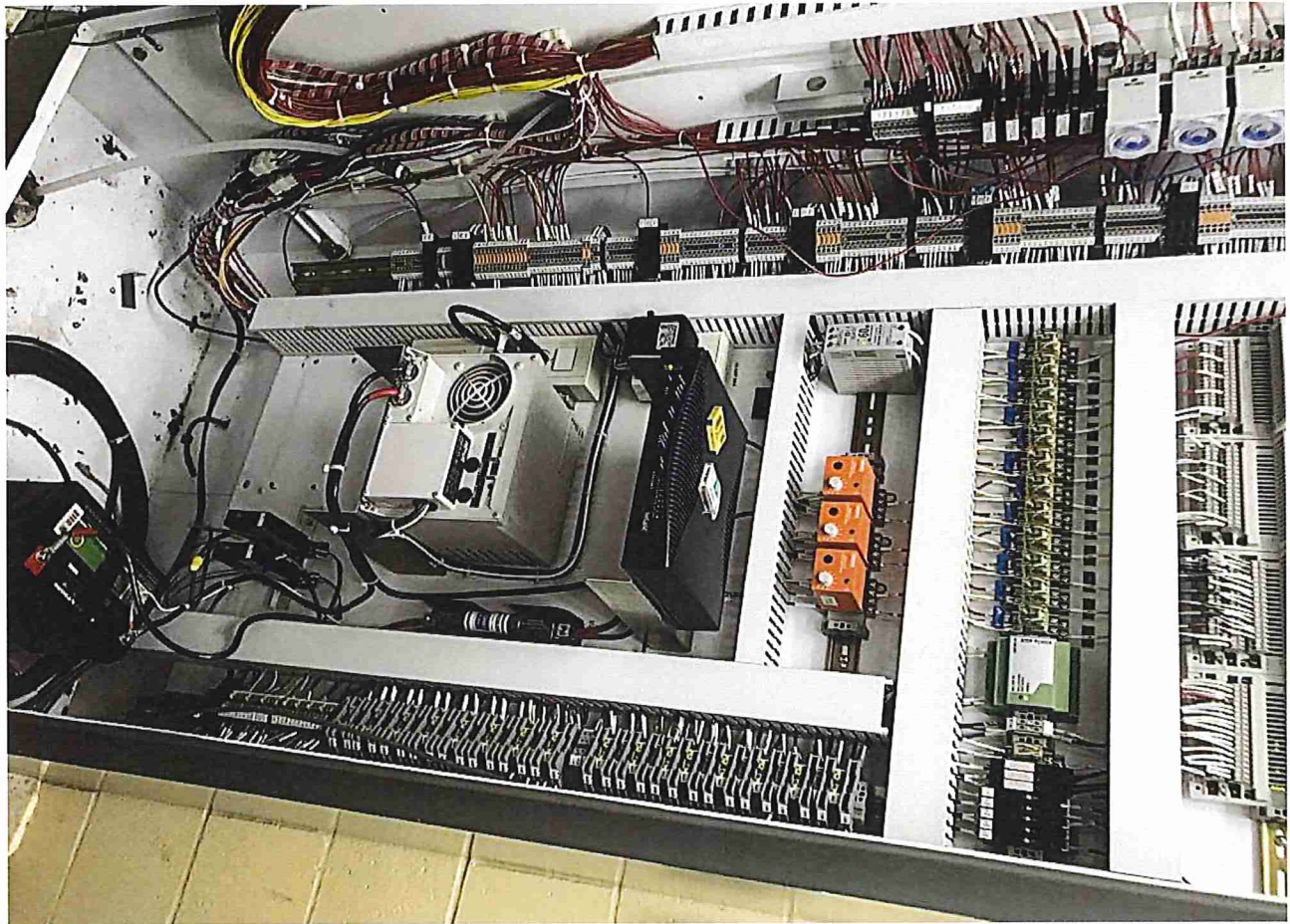


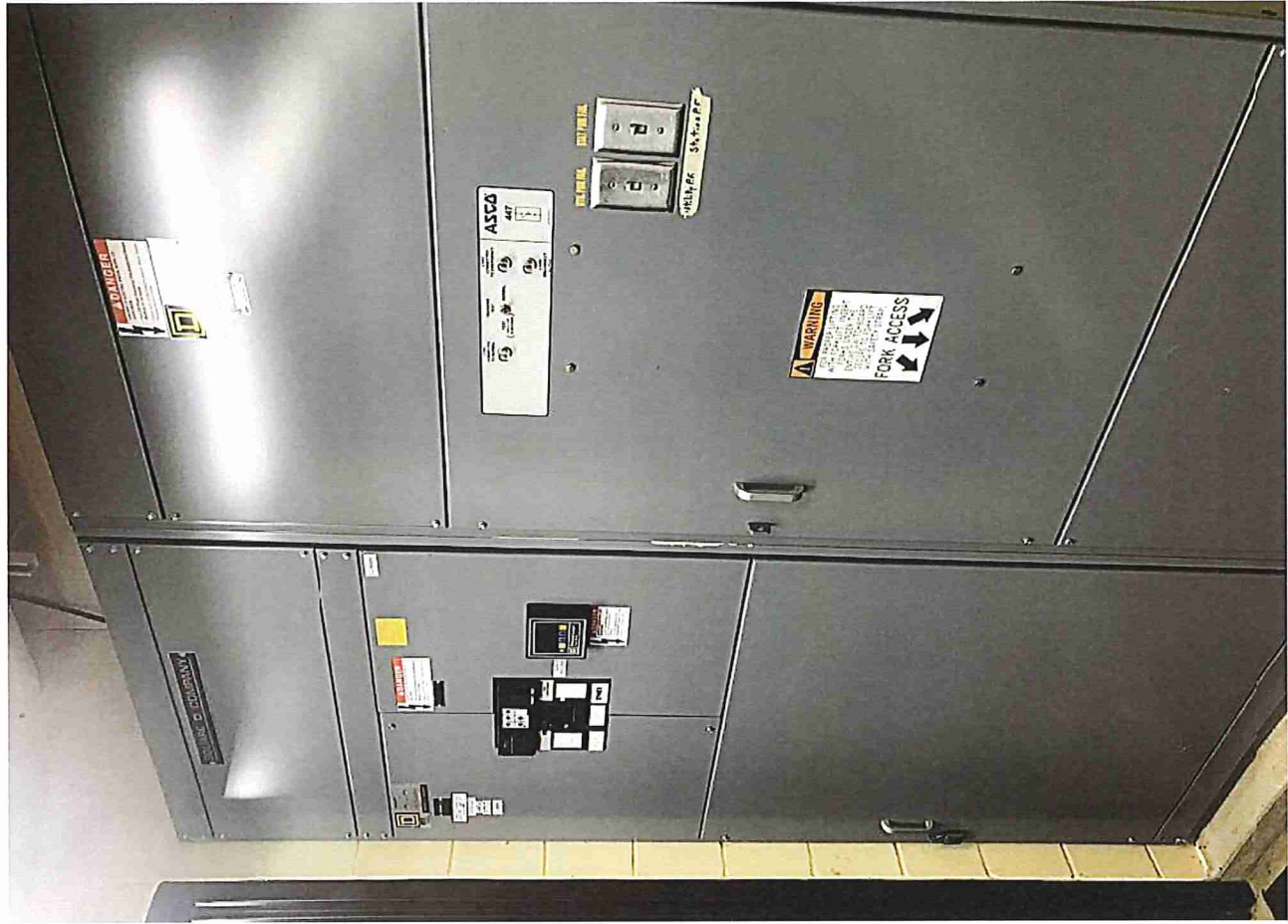












Square D
POWER STYLE®
SWITCHBOARD

ENCLOSURE TYPE

VOLTS HERTZ

MAXIMUM SUPPLY RATING AMPERES

W SYSTEM W

SMALL CIRCUIT CURRENT RATING - SEE LABEL INSIDE FOR ALTERNATE SUPPLY RATINGS - SEE WIRING DIAGRAM

PLANT CODE CATALOG OR DRAWING NO.

SQUARE D COMPANY
MADE IN U.S.A.

UL UNDERWRITTEN LABORATORIES
DISCONNECT SWITCHBOARD SECTION
1 OF 2
SQUARE D COMPANY
MADE IN U.S.A.

THE OVERALL SHORT CIRCUIT RATING OF THIS SWITCHBOARD, WITH THE COMPONENTS INSTALLED AT TIME OF SHIPMENT, IS 42000 R.M.S. SYMMETRICAL AMPERES AT 480 VOLTS
SQUARE D COMPANY A80247-677-01

GROUNDING ELECTRODE CONDUCTOR TERMINAL
REV R 00043-007-01

NEUTRAL DISCONNECT LINK
REV A A80030-457-01

MAIN BONDING JUMPER
CONNECT TO NEUTRAL ONLY
IF USED AS SERVICE EQUIPMENT
REV B A80030-456-01







