Gray & Osborne, Inc.
CONSULTING ENGINEERS

TECHNICAL MEMORANDUM 20434-4

TO:	BILL HUNTER, P.E., ASSISTANT GENERAL MANAGER/DISTRICT ENGINEER
FROM:	KEITH STEWART, P.E. RUSSELL PORTER, P.E.
DATE:	FEBRUARY 15, 2022
SUBJECT:	SUDDEN VALLEY WTP CHEMICAL SYSTEMS ANALYSIS LAKE WHATCOM WATER & SEWER DISTRICT, WHATCOM COUNTY, WASHINGTON G&O #20434.00

INTRODUCTION

In 2019, the Lake Whatcom Water & Sewer District (District) contracted with Gray & Osborne to perform a condition assessment for their existing Sudden Valley Water Treatment Plant (WTP) as part of a larger effort to analyze the District's water treatment facilities in order to prioritize funds for rehabilitation, modification, and/or replacement projects. The goal of the assessment and subsequent analysis is to identify potential improvements for the existing structures and treatment processes in an attempt to maximize treatment efficiency and extend the operational life of these facilities. The reports and technical memoranda generated as part of this assessment project will be used to develop a strategy for prioritizing modifications to the WTP to ensure it can efficiently and cost-effectively provide clean potable water for the existing and projected service areas.

This memorandum summarizes the assessment of the existing chemical systems at the WTP, provides alternatives for chemical delivery, and makes recommendations for modifications to the chemical systems. Cost estimates for the alternatives and recommended modifications are also provided.

BACKGROUND AND EXISTING FACILITIES

The District operates three Group A water systems – South Shore (DOH 95910), Eagleridge (DOH 08118), and Agate Heights (DOH 52957) – all of which are in and around the shores of Lake Whatcom, which lies southeast of Bellingham in Whatcom County, Washington. The District serves approximately 3,900 residential and

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commercial water system connections with a residential population of approximately 10,000 people.

The South Shore system is the largest of the three systems and is supplied wholly by water treated at its Sudden Valley Water Treatment Plant. In addition to the WTP, the District also owns and maintains source, treatment, storage, and distribution system facilities. The distribution system includes multiple pressure zones, four booster stations, and approximately 2.8 million gallons (MG) of storage in five reservoirs. The District also maintains a secondary intertie with the City of Bellingham Water System (DOH 50600) that can be used during emergency situations.

The existing WTP is a rapid-rate, direct filtration plant with a rated capacity of 2.0 million gallons per day (MGD) but currently operates at approximately 1.0 MGD (700 gallons per minute [gpm]). The WTP is housed in a partially below-grade concrete building located on Morning Beach Drive approximately 1 mile northeast of the intersection of Lake Whatcom Boulevard and Marigold Drive. The facility was constructed in 1972 and has undergone several minor improvements since that time, but was most recently upgraded in 1992. The WTP provides coagulation, flocculation, filtration, disinfection, and chlorine contact time before finished water is pumped to the distribution system and storage reservoirs.

Historically, the plant has performed well and provides high-quality finished water with turbidities of less than 0.1 nephelometric turbidity units (NTU). Raw water is collected from the adjacent Lake Whatcom from an outfall located at a depth of approximately 80 feet and approximately 200 feet from the typical shoreline. Lake Whatcom is a large lake that is moderately developed on the northern and western shores but is largely undeveloped on its eastern shore. Raw water quality from the Lake Whatcom source is fairly consistent with turbidities below 1.0 NTU for most of the year. Turbidity increases during the spring and fall runoff seasons, but typically remains below 5.0 NTU during these periods. Raw water pH is typically between 7.5 and 7.7 and raw water temperature varies between 6 and 8 degrees Celsius.

As mentioned above, the District is interested in investigating all of the treatment systems in place at the WTP and assessing whether improvements/modifications are recommended or required, a timeframe to complete any modifications, and how the modifications might fit into the larger picture of improving the overall treatment performance. There are two primary chemical systems in place at the WTP. The District adds potassium aluminum sulfate to the raw water to aid with coagulation of suspended solids, and adds soda ash to the filtered water for pH control. A description of the equipment associated with each of these systems is provided below.

Coagulant

The District adds potassium aluminum sulfate (alum) to raw water upstream of the existing flocculation tank to optimize the coagulation of particles prior to direct filtration. Alum is commonly used as a coagulant aid in water treatment, especially in plants utilizing a surface water source. The District purchases alum from a commercial vendor and has it delivered to the WTP. The vendor connects a hose from the delivery vehicle to a 3-inch diameter tank inlet camlock fitting and pumps the alum solution into a storage tank located within the WTP Main Building approximately once every 3 months. The strength of the alum solution delivered to the WTP is approximately 49 percent and the operations staff target a dose of 27 milligrams per liter (mg/L) (parts per million [ppm]) to the raw water prior to flocculation. Given that the WTP often operates for up to 16 hours during the summer months, this results in an average daily alum solution consumption of approximately 17 to 20 gallons.

The existing storage tank has a capacity of 1,900 gallons, a diameter of 6.2 feet, and an overall height of 8.5 feet. The tank is fully molded and was originally installed in 1992. The existing tank is equipped with a 12-inch threaded manway on top of the tank, a 3-inch diameter vent fitting connected at the top of the sidewall, and a 3-inch drain fitting near the floor. The tank does not contain any seismic bracing or restraints.

The storage tank feeds a single diaphragm metering pump which moves alum solution from the tank to the injection location on the raw water piping upstream of the flocculation tank. The metering pump is a PULSAtron Series E with a capacity of 44 gallons per day (gpd) at a maximum pressure of 100 pounds per square inch (psi). The alum feed pump is manually calibrated daily using a graduated cylinder near the injection location. Based on the daily calibration, the dose rate from the pump is modified and/or the WTP staff performs maintenance on the pump/piping to address flow issues.

The WTP utilizes a current streaming monitor to monitor the dose of alum. It is important to note that the alum dose is manually controlled; however, the operations staff use the current streaming monitor to note abrupt changes in the dosing system and/or raw water quality.

The alum chemical system components are shown on Figures A-1, A-2, and A-3 in Exhibit A.

With regard to the alum chemical dosing system, the Sudden Valley WTP Assessment Report (Assessment Report) completed by Gray & Osborne in July 2020 noted that the existing alum storage tank is in fair/poor condition, is beyond its recommended useful life, lacks seismic restraints or tie-downs, does not have direct line of sight from the parking lot during filling, does not contain level sensing equipment, is adjacent to electrical equipment including MCC 2, and that the chemical metering pump must be calibrated on a daily basis by removing the injection fittings from the raw water piping. Addressing these shortcomings is one of the District's primary goals for improving the chemical delivery system.

Soda Ash

The second chemical utilized at the WTP is soda ash for pH control. Soda ash is mixed and stored in a 1,200-gallon, open-top, welded steel tank with a diameter of 5.6 feet and a height of 6 feet. The tank includes a rim-mounted shaft-driven mixer as well as a polycarbonate hinged access lid. The tank does not contain any seismic restraints, but does contain a 2-inch PVC process water connection where water is added to the tank. The tank is accessed by a set of four steps and a loading platform located adjacent to the tank.

Bags of dry soda ash are delivered to the WTP by a commercial vendor where staff transfer the bags to a rolling cart, which is used to transport them to their various temporary storage locations within the WTP. WTP staff must prepare the soda ash solution as needed by manually adding 50-pound bags of dry soda ash to the tank. When additional soda ash solution is required, the staff haul the bags up a small platform and manually dump them into the soda ash storage tank. Filtered water is then added to the tank in the appropriate volume to create the dosing solution. Approximately 16 to 20 bags of soda ash are mixed approximately every 11 to 12 days to create the dosing solution, which is equivalent to approximately 80 pounds per day (lb/d). Given the delivery and offloading sequence described above, creating one batch of dosing solution requires three separate lifting sessions of 800 to 1,000 pounds each for WTP staff.

Soda ash solution is delivered from the storage tank to the injection location via a PULSAtron Series E diaphragm metering pump with a listed capacity of 600 gpd and a maximum pressure of 30 psi. The chemical metering pump is located at an elevation near the top level of the soda ash storage tank in order to reduce potential for crystallization within the check valve and to reduce the risk of siphoning. The soda ash feed pump is manually calibrated daily using a graduated cylinder near the injection location. Based on the daily calibration, the dose rate from the pump is modified and/or the WTP staff performs maintenance on the pump/piping to address flow issues. Soda ash solution is injected to the filtered water piping immediately downstream of the filters, just before the water enters the below-grade clearwell.

The soda ash chemical system components are shown on Figures A-4, A-5, and A-6 in Exhibit A.

The Assessment Report noted that the tank is in good condition, the associated rim-mounted mixer is in poor condition, and that the access platform for adding soda ash is in fair condition but occupies a large amount of floor space at the entrance to the WTP. The tank and platform do not contain seismic restraints, and the chemical metering pump system is prone to siphoning and must be manually calibrated on a daily basis by removing the injection fittings. Furthermore, the Assessment Report noted that the storage of large volumes of soda ash, both dry and wet, may be contributing to corrosion and/or degradation of electrical or mechanical equipment within the WTP Main Building. Lastly, it was noted that the current system required staff to move 50-pound bags of soda ash at least three times in order to create the dosing solution.

The District is interested in replacing the alum tank since the existing tank has reached the end of its useful life, providing seismic bracing for the tank, and installing a more reliable, user-friendly metering pump system. The District is also interested in optimizing their soda ash delivery system, providing seismic bracing for the dosing tank, and separating the chemicals from the electrical components to preserve and/or extend their service life. The section below provides alternatives to the current chemical delivery system equipment and locations as a means of achieving these goals.

ALTERNATIVES ANALYSIS

The alternatives listed below are provided to help the District determine the best course of action for their chemical dosing systems. Any modifications to these systems should be considered in the context of other changes that are recommended or desired for the WTP. First, we will discuss alternatives for coagulant addition.

Coagulant

Alternative C1 – Liquid Alum Coagulant

This alternative includes continued use of liquid alum coagulant prior to flocculation. Alum would continue to be delivered by a commercial vendor and transferred from the delivery vessel to a temporary storage tank. A new chemical metering pump skid would then pump the solution from the storage tank to the injection location.

Because the existing alum storage tank is beyond its recommended useful life of 15 to 17 years, the tank should be replaced. The new alum storage tank should be between 1,800 and 2,300 gallons (existing alum storage tank is 1,900 gallons) to provide sufficient storage for alum, minimize frequency for deliveries, and minimize potential for chemical stagnation and/or breakdown of the alum solution. The new tank should include the following components:

- Large (>16-inch diameter) top-side lid for tank access.
- Multiple (two to three) 2- or 3-inch top-side bulkhead fittings to accommodate items such as level sensors, mixers, cables, vent piping, etc.
- Seismic anchors or brace-plates with cables to secure the tank during a seismic event.
- A 3-inch fill connection that is routed to the WTP exterior to provide easy connection for delivery vehicles. This piping should be equipped with a check valve, camlock fitting connection, and should be located in an area where spills or leaks are easily cleaned or can be directed to the municipal sewer system.
- Molded graduated markings to allow for manual estimation of volume of liquid within the tank.
- Level sensor that will relay the liquid level within the tank to the WTP SCADA system.
- A 2- or 3-inch drain fitting that will allow for full and complete drainage of the tank.
- HDPE tank base or concrete equipment pad to accommodate the flange width of the drain connection.

Although the existing storage tank is located in the WTP Main Building, alum is classified as corrosive and its use within the WTP Main Building may expedite degradation of the other mechanical and electrical equipment. Given its corrosivity, it may be beneficial to relocate the alum storage tank to a location outside the WTP Main Building. This could be accomplished by constructing an unenclosed covered area for the storage tank, extending the existing WTP to the north to include a chemical storage room, or constructing a separate Chemical Storage Building.

An unenclosed covered area does not provide protection from moisture or cold temperatures, which would restrict the storage of any dry chemicals and would necessitate the need for insulation and/or heat-trace on any chemical storage tanks or piping. As such, a covered exterior storage space will not be considered further. Additional storage space could be created by extending the existing WTP to the north and enclosing the space which would provide area suitable for chemical storage and any other components as desired. An additional 20 to 25 linear feet should provide suitable space to accommodate alum storage, additional chemical storage, access for deliveries, and isolation from existing treatment equipment and electrical components. A third option is to construct a stand-alone building to house treatment chemicals. The building would include access doors as well as heating and ventilation equipment and should be approximately 500 square feet.

Because of the various uncertainties and unknowns associated with extending an existing building structure, we recommend that if the District wishes to relocate the existing coagulant system in order to provide separation from the existing electrical equipment, a new separate building should be constructed.

For comparison purposes, two installation alternatives are provided here. One is to continue to use liquid alum as a coagulant, to replace the existing storage tank and metering pump system, but continue to store and pump the alum solution within the existing WTP Main Building. This alternative would provide new alum handling equipment but would not address its proximity to electrical equipment, which may be contributing to deterioration and/or corrosion of the electrical components. This alternative is estimated to cost $64,000 which includes construction, contingency (25 percent), Washington State sales tax (9.0 percent), and project design/administration (25 percent). A preliminary cost estimate is included in Exhibit B.

A second installation alternative includes continued use of liquid alum as a coagulant and replacing the existing storage tank and metering pump system, but relocating the new alum handling equipment to a new separate building. This alternative addresses both shortcomings noted with the alum handling equipment as well as the proximity to existing electrical equipment. This alternative is estimated to cost $1,139,000 which includes construction, contingency (25 percent), Washington State sales tax (9.0 percent), and project design/administration (25 percent). A preliminary cost estimate is included in Exhibit B. If a new building is constructed, it would be provided with HVAC equipment to provide heating for the new space. This new heating equipment will increase the electrical load for the WTP. To accommodate this new load, new electrical supply will be sub-fed from the existing electrical service to the Finished Water Pump Building. For the purposes of this investigation, it is assumed that the existing electrical supply is able to accommodate the additional electrical loads for new HVAC equipment. The cost estimate also includes some moderate site improvements including new storm collection equipment and new asphalt paving.

Alternative C2 – Use of Dry Alum Coagulant

This alternative includes utilizing dry alum chemical and installing a dry chemical handling system. The District would then make up their own alum solution as needed, provide temporary storage in a new dosing tank, and meter the alum solution into the raw water via a new metering pump skid.

Dry alum is available in 25-/50-pound bags and as such, must be manually added to a hopper or directly to the solution tank. Dry chemical handling systems are available and allow owners to handle/store large volumes of dry chemical, add various amounts of this chemical to a container to create a dosing solution, then inject that solution into the media of interest. Specialized offloading, handling, storage, and mixing equipment that is very expensive and requires a large footprint can also be used to assist WTP staff with creating the dosing solution.

Very few municipal water treatment facilities utilize dry alum, mostly because it requires additional expensive handling equipment, requires interaction by WTP personnel in which they are exposed to chemical dust, and requires large areas for dry chemical storage. The existing WTP Main Building does not currently have the space required to accommodate this mechanized equipment or the required chemical storage and as such, a new Chemical Storage Building would be required.

For these reasons as well as the fact that the WTP only requires alum delivery approximately every 3 months, this option will not be considered further.

Alternative C3 – Investigate Alternative Coagulants/Polymers

This alternative includes utilization of alternative coagulants which may optimize the flocculation process.

Various coagulant chemicals are used in water treatment, including alum, ferric chloride, polyaluminum chloride (PAC), cationic polymers, and aluminum chlorohydrate, among others. The primary purpose of coagulants is to destabilize the electrical charge for various colloids and suspended particles found in a raw water source in order to promote the creation of larger particles that are more easily removed through filtration. Coagulants are commonly used in water treatment, especially for facilities that utilize a surface water source.

It may be possible to further optimize the coagulation/flocculation process through the use of alternative coagulants. Some considerations for the use of alternative coagulants are summarized in Table 1.

TABLE 1

Coagulant Chemical Summary

Coagulant	Relative Cost	Advantages	Disadvantages
Aluminum Sulfate (Alum)	$	• Most commonly used coagulant • Readily available • Documented success for District	• Can generate large volumes of solids for highly turbid sources
Ferric Chloride	$$	• Excellent for high TOC source water • Readily available • Use is typically 2/3 that of alum	• Highly corrosive
PAC	$$	• Many customized varieties available	• Use is typically 1.3–1.5 that of alum
Cationic Polymers	$$$$$	• Commonly used for low-turbidity water • Typically generates fewer solids when compared to alum • Can reduce alum dose for certain source waters	• Should be optimized regularly • Not as readily available • Often used in *conjunction* with alum
Aluminum Chlorohydrate	$$$$		• Rarely used, except for membrane facilities

Table 1 highlights the relative cost and some of the advantages and disadvantages for each type of coagulant. Alum and ferric chloride are available in large volumes from commercial vendors while PAC, cationic polymers, and aluminum chlorohydrate are typically provided in 55-gallon drums. Because the District has documented success using alum coagulant, alum is the most inexpensive coagulant, is readily available, and is the most commonly used coagulant when compared to other alternatives, we recommend that the District continue to utilize liquid alum for coagulation at the WTP. Additional recommendations on further modifications to the location of the storage tank and method of alum injection are provided later in this memorandum.

Chemical Metering

Regardless of which alternative is selected or whether chemical storage equipment is relocated to a new building, additional chemical metering equipment is recommended. New metering equipment will provide the WTP operations staff with increased flexibility and accuracy for determining the dose of chemicals as well as provide for safeguards against failure or malfunction of the system components.

We recommend that the District provide space and equipment for a chemical delivery skid that includes the piping, appurtenances, and pumps required for chemical injection. These skids can be preassembled and can include pumps provided by a specific manufacturer, or can be left open for pump selection by the District. Figure A-7 shows a schematic diagram for a typical metering pump skid while Figure A-8 shows some photographs of duplex delivery skids used for chemical delivery in a drinking water application. The metering pump skid would include the following components:

- Chemical metering pump(s)
- Isolation valves
- Pressure relief valves
- Backpressure valves
- Pressure gauges
- Pulsation dampener
- Calibration column
- Flexible connections for inlet and outlet
- HDPE backplate of skid for wall/floor mounting

Providing a metering pump skid with a calibration column would allow the WTP operations staff to calibrate the metering pumps daily without having to remove piping connections, which can lead to deterioration of the fittings and chemical leaks or spills. Only one metering pump is proposed as part of this alternative. A second metering pump would provide redundancy and could be provided as a spare if desired or could be integrated to the metering pump skid along with the required valves and controls. A skid that includes two pumping units is typically called a duplex metering skid and examples of these are shown on Figure A-8. The metering pump flow would be flow paced and based off of the raw water flow as measured by the raw water flow meter. The cost for a prefabricated metering skid is between $8,000 (single pump) and $14,000 (duplex) depending on the pump size, type, and features.

Soda Ash

Similar to the alternatives for coagulant listed above, three soda ash addition alternatives are described below. Although there are several methods for pH adjustment of potable water including caustic soda, lime, soda ash, and aeration, these methods utilize chemicals that are more dangerous, expensive, or utilize large, specialized equipment for injection/handling. Furthermore, the District has successfully utilized soda ash for many years to meet their treatment goals. Because other chemicals are more costly, require additional equipment, and because the District has developed a level of familiarity and comfort with using soda ash, they are interested in continuing to utilize soda ash for finished water pH control. As such, only delivery methods and metering pump alternatives are explored in this section.

<u>Alternative S1 – Manual Addition of Dry Soda Ash</u>

This alternative includes manual addition of soda ash to a temporary storage tank where it will be diluted with water to create the dosing solution – identical to the current method of soda ash injection used at the WTP.

Currently, WTP staff carry 50-pound bags of dry soda ash up four steps to the loading platform, where the bags are emptied into the soda ash dosing tank. This process requires that staff move each soda ash bag at least three times – from the delivery truck to a cart, from the cart to the temporary storage location, and from this temporary location to the dosing tank – prior to use. This process is cumbersome, difficult for operations staff, and requires that the soda ash chemical be stored within the WTP Main Building where it is in close proximity to electrical and mechanical equipment.

Based on findings from the Assessment Report, the existing soda ash storage tank is in good condition and could be reused. The loading platform shows signs of corrosion and should be prepared and coated to prevent additional corrosion. The existing rim-mounted mixer is in poor condition, is highly corroded, and should be replaced with a similar size unit. Because soda ash is a corrosive chemical and can contribute to degradation of the electrical and/or mechanical equipment, it may be beneficial to relocate the soda ash storage tank to a location outside the WTP Main Building. This could be accomplished by extending the existing WTP to the north to include a chemical storage room or constructing a separate building as discussed for the coagulant alternative analysis.

Given the difficulties and uncertainties of adding on to an existing building, if the District wishes to provide separation between the soda ash delivery equipment and the electrical equipment, we recommend that the soda ash chemical equipment be relocated to a new building. This building can be CMU/wood truss construction and can be located adjacent (north) to the existing WTP. While approximately 500 square feet is needed for the chemical systems discussed in this memorandum, we recommend that the District construct a building suitable to accommodate other equipment and/or modifications recommended in other supporting technical memoranda prepared as part of this project. If a new building is constructed, the soda ash and coagulant systems should be relocated to the new building in order to provide separation between the chemicals and electrical equipment and to free up space in the existing WTP Main Building.

This alternative includes relocating the existing storage tank to a new separate building, providing the tank with seismic bracing, installing a new chemical metering pump skid, and refurbishing the existing loading platform and access steps for installation in the proposed building. This alternative is estimated to cost $1,128,000 which includes construction, contingency (25 percent), Washington State sales tax (9.0 percent), and project design/administration (25 percent). A budgetary project estimate is provided in Exhibit B. The proposed building would be as described in Alternative C1 and would include HVAC modifications, electrical modifications, and site improvements.

Alternative S2 – Mini-Bulk Addition of Dry Soda Ash

This alternative includes delivery of dry soda ash within a mini-bulk, or super sack storage vessel, offloading the chemical from the delivery vehicle, and staging it onto the loading and distribution equipment where it is delivered to the storage tank via a shaftless screw conveyor or a pneumatic blower.

For this alternative, the District would accept deliveries of dry chemical via super sacks. Super sacks are large, woven bags used to transport various chemicals or other items and are commonly used to transport and/or deliver chemicals to treatment facilities because of their large capacity (~2,000 pounds) and small footprint (4-foot square pallet). Super sacks are filled using specialized equipment by a chemical manufacturer, shipped to a local distribution center, and then delivered to the end user. Because of their large size and weight, super sacks require specialized equipment for offloading and handling. For offloading, the end user is required to provide a forklift to remove the chemical from the delivery vehicle and stage it onto the loading and distribution equipment. One example of loading and distribution equipment is shown on Figure A-9. The equipment includes a steel frame, vibrating hopper, regulation valves, and a shaftless screw conveyor. This structure is typically freestanding and has a footprint of 36 square feet and a height of 15 feet. This equipment will not fit within the existing WTP Main Building and as such, the existing WTP would need to be extended or a separate building must be constructed as described in the discussion on coagulant alternatives.

Super sack or mini-bulk applications are designed to minimize manual handling of chemicals and would minimize the number of chemical additions to the soda ash solution storage tank. Given the current average annual consumption of approximately 80 lb/d, the District would need to procure approximately 15 super sacks each year for their operations.

This alternative includes relocating the existing soda ash storage tank to a new building, providing the tank with seismic bracing, installing a new chemical metering pump skid, and refurbishing the existing loading platform and access steps for installation in the proposed building. It also includes a new super sack handling and dry chemical delivery system with a freestanding frame, vibrating hopper, and shaftless screw conveyor. This alternative is estimated to cost $1,246,000 which includes contingency (25 percent), Washington State sales tax (9.0 percent), and project design/administration (25 percent). A preliminary project cost estimate is provided in Exhibit B.

<u>Alternative S3 – Liquid Soda Ash Delivery</u>

This alternative includes delivery of liquid soda ash solution via a commercial vendor and injection using a new chemical metering pump system.

Liquid soda ash solution would be delivered to the WTP that is ready for immediate use. The solution is typically provided in 55-gallon drums or 300-gallon totes, and the chemical metering pumps can pump directly from these containers to the injection location. The current cost for 10 percent soda ash solution is approximately $0.22 per pound, which is nearly 2.5 times more expensive than dry soda ash delivered in 25-/50-pound bags as described in Alternative C2 above.

Given the current average consumption of approximately 20 gallons of 10 to 11 percent solution each day (80 pounds of soda ash per day), it is estimated that a 55-gallon drum or a 300-gallon tote would last approximately 2.5 and 15 days, respectively. To provide sufficient redundancy and to accommodate temporary delays in chemical supply, the District should have at least five drums and three totes on site at any time. This will create logistical difficulties for storage of sufficient volume of solution, delivery of new solution, and coordination for removal of used barrels.

Bulk storage of liquid soda ash is also possible, but is uncommon in the Pacific Northwest and vendors are reluctant to deliver partial tankers of chemical due to the high cost of transportation and restocking. Alternatively, vendors charge a premium price for bulk delivery, which makes this form of soda ash not cost effective. To avoid these logistical and coordination challenges and because of the low solubility of soda ash and the cost for preparation and delivery from a commercial vendor, this alternative is not cost effective and will not be considered further.

Chemical Delivery

Regardless of which alternative is selected or whether chemical storage equipment is relocated to a new building, additional chemical delivery equipment is recommended. This additional delivery equipment will provide the WTP operations staff with increased flexibility and accuracy for determining the dose of chemicals as well as provide for safeguards against failure or malfunction of the system components.

The recommended chemical injection system is identical to that described above for the coagulant chemical system.

SUMMARY OF RECOMMENDATIONS AND COST ESTIMATES

As noted above, the District has had good success utilizing liquid alum delivered via a commercial vendor as a coagulant for their water treatment process. However, it was noted that the existing alum storage tank is beyond its recommended useful life, does not contain seismic restraints, is cumbersome to fill and lacks direct line of sight between the parking lot and the tank, and the chemical metering pump equipment requires manual calibration on a daily basis. Furthermore, the proximity of chemicals and moisture to electrical and mechanical equipment may be accelerating the corrosion exhibited on this equipment.

Because liquid alum is a cost-effective coagulant with a proven track record of success for the Lake Whatcom source, we recommend that the District continue to utilize liquid alum coagulant delivered by a commercial vendor. Furthermore, we recommend that the WTP relocate the chemical systems to a new building in order to provide separation from the electrical components, additional chemical storage capacity, and line of sight for chemical deliveries. Lastly, we recommend that the chemical metering systems be upgraded to include metering pump skids that include calibration columns and various valves/piping to reduce the level of effort required to calibrate the chemical dosing equipment.

The proposed building would accommodate the new alum storage tank and chemical metering skid. The tank would have the design criteria listed in Table 2.

TABLE 2

Proposed Alum Storage Tank Design Criteria (1)

Parameter	Value
Material	HDPE
Capacity (gallons)	2,500
Diameter (inches)	90–96
Height (inches)	98–107
Access Port Diameter (inches)	18
Accessories Included	3-inch full drain fitting 3-inch topside vent fitting 3-inch topside fill fitting 2-inch topside NPT bulkhead fittings (2x) Ultrasonic level sensor Seismic tiedown package Seismic calculation package Ladder lugs Molded graduated markings

(1) Tank based on Snider 5090000N-(L) and 5090300N–.

We also recommend that the District utilize a chemical metering pump skid to move alum from the storage tank described above to the injection location in the WTP Main Building. The metering pump skid would include a single pump as well as the components listed previously.

For soda ash, we recommend that the existing tank be relocated to the proposed chemical building and provided with seismic bracing. The existing mixer should be replaced with a new, similarly sized unit, and the existing platform should be sandblasted and recoated to prevent additional corrosion. Additionally, we recommend that a custom shelf be fabricated and rest on the wall of the soda ash tank. This will allow WTP staff to rest the soda ash bags on the shelf, cut the soda ash bags, and dump them to the tank with minimal lifting and hoisting, thus reducing the physical load on the staff during soda ash addition.

The proposed building should be at least 500 square feet and would include two double doors and one 10-foot wide manually operated coiling door. This will allow for suitable access to the building and easy chemical delivery. The building should be large enough to accommodate the chemical delivery and storage equipment, additional dry chemical storage, and still be expandable as required based on future needs. The building will be provided with electrical service, and this service will be sub-fed provided from the existing WTP Finished Water Pump Building supply. New heating and ventilation equipment will be provided for the building, which will increase the overall electrical load. The additional load will be relatively small and as such, it is assumed that the existing electrical service has sufficient capacity. The Assessment Report did note several potential issues with both the capacity of the electrical service for accommodating additional load as well as with the existing utility transformer size. If a new building is constructed as recommended, a formal electrical analysis should be provided once preliminary sizing of the HVAC equipment is available to determine the full scope of electrical modifications required.

The proposed additions are shown on Figure A-10 and a budgetary cost estimate for the recommended modifications including contingency (25 percent), Washington State sales tax (9.0 percent), and project design and administration (25 percent is provided in Exhibit B.

EXHIBIT A

PHOTOGRAPHS OF EXISTING EQUIPMENT

FIGURE A-1

Existing Alum Storage Tank

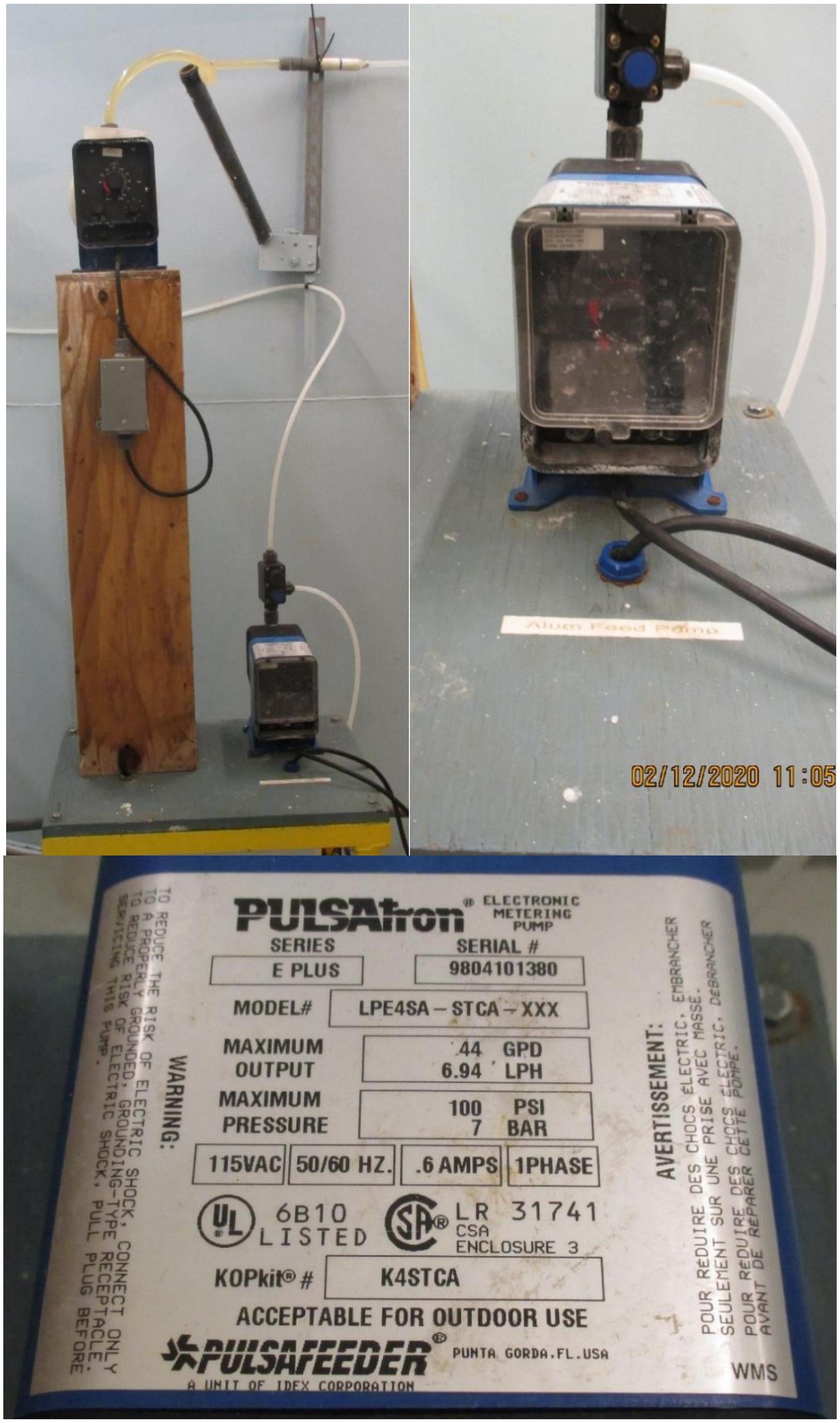


FIGURE A-2

Existing Alum Metering Pump

FIGURE A-3

Existing Alum Injection Location

FIGURE A-4

Existing Soda Ash Storage Tank

FIGURE A-5

Existing Soda Ash Metering Pump

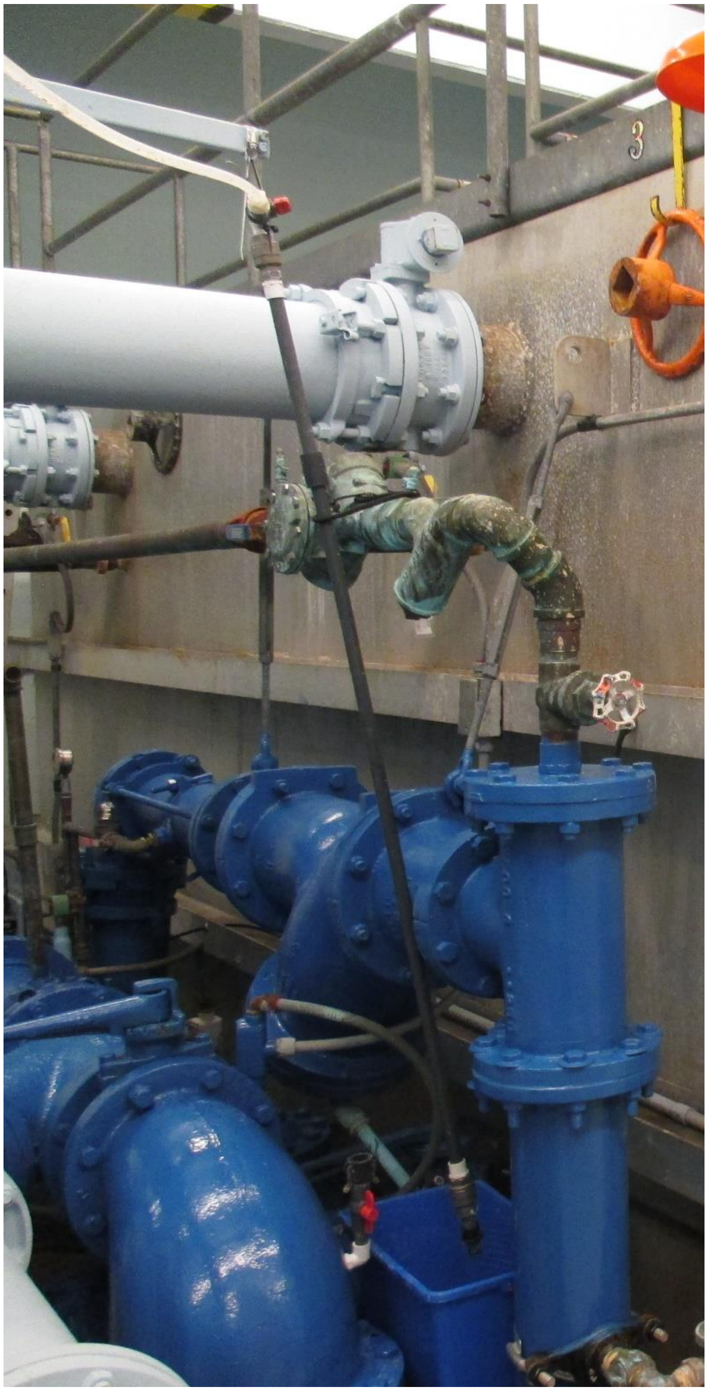
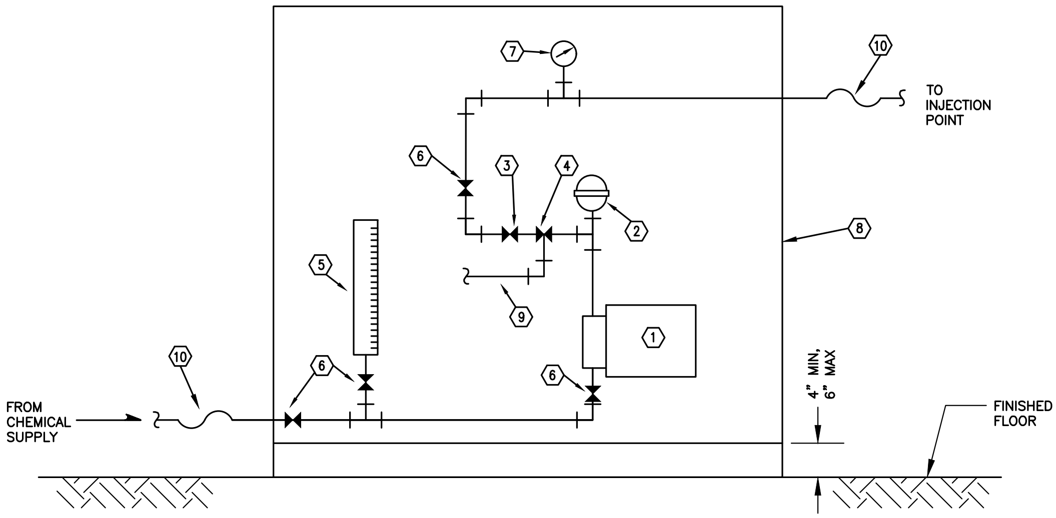


FIGURE A-6

Existing Soda Ash Injection Location



LEGEND:

1. CHEMICAL FEED PUMP
2. PULSATION DAMPENER
3. BACK PRESSURE VALVE
4. PRESSURE RELIEF VALVE
5. CALIBRATION COLUMN
6. ISOLATION VALVE
7. PRESSURE GAUGE
8. FREE STANDING PVC/HDPE SKID & BACKPLATE
9. TO PRESSURE RELIEF CONTAINMENT UNIT
7. FLEXIBLE CONNECTION

CHEMICAL METERING SKID TYPICAL SCHEMATIC

SCALE: 3/8"=1'-0"

0 1"

ONE INCH AT FULL SCALE.
IF NOT, SCALE ACCORDINGLY

LAKE WHATCOM WATER AND SEWER DISTRICT

TECHNICAL MEMORANDUM 20434-4
CHEMICAL SYSTEMS ANALYSIS

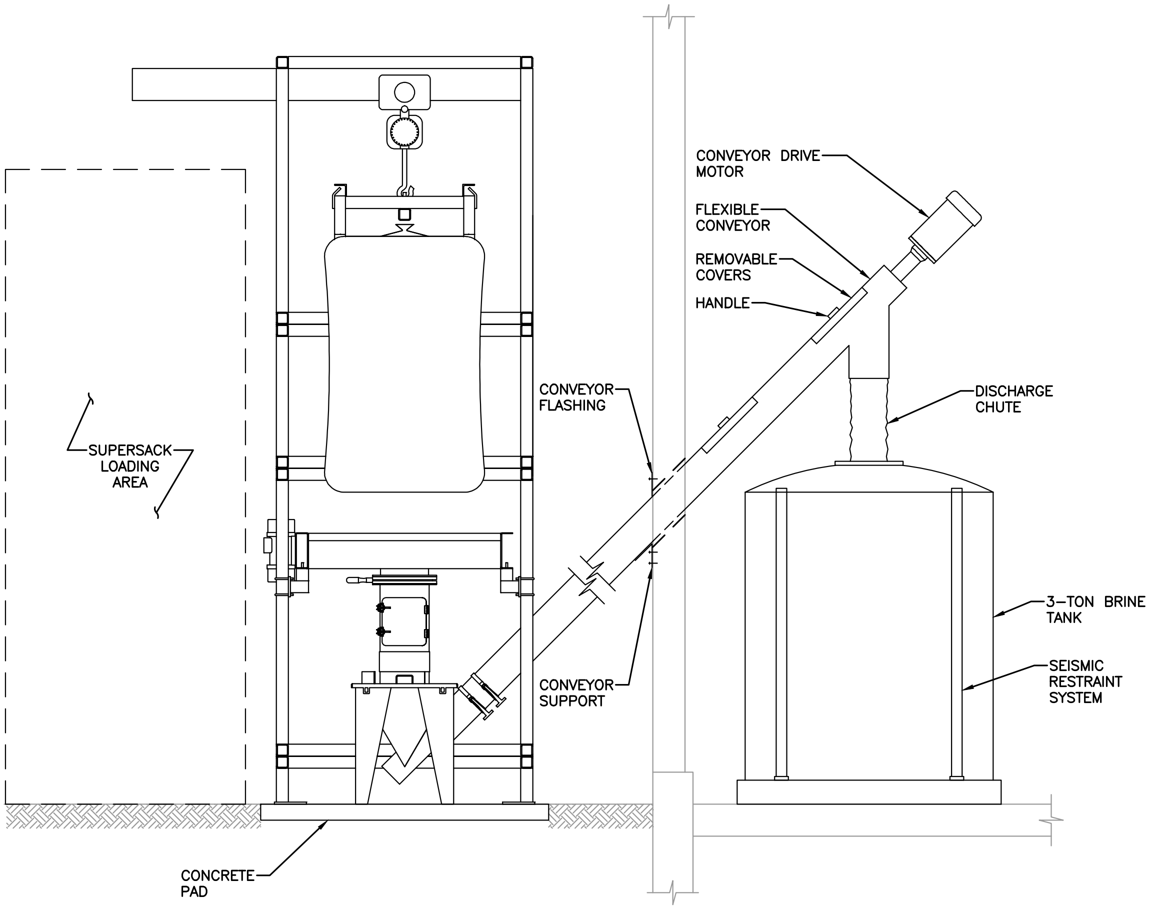
FIGURE A-7

CHEMICAL PUMP SKID SCHEMATIC

Gray & Osborne, Inc.
CONSULTING ENGINEERS

FIGURE A-8

Typical Duplex Chemical Metering Pump Skids



A
–

ELEVATION

SCALE: 1/4"=1'-0"

0 1"

ONE INCH AT FULL SCALE.
IF NOT, SCALE ACCORDINGLY

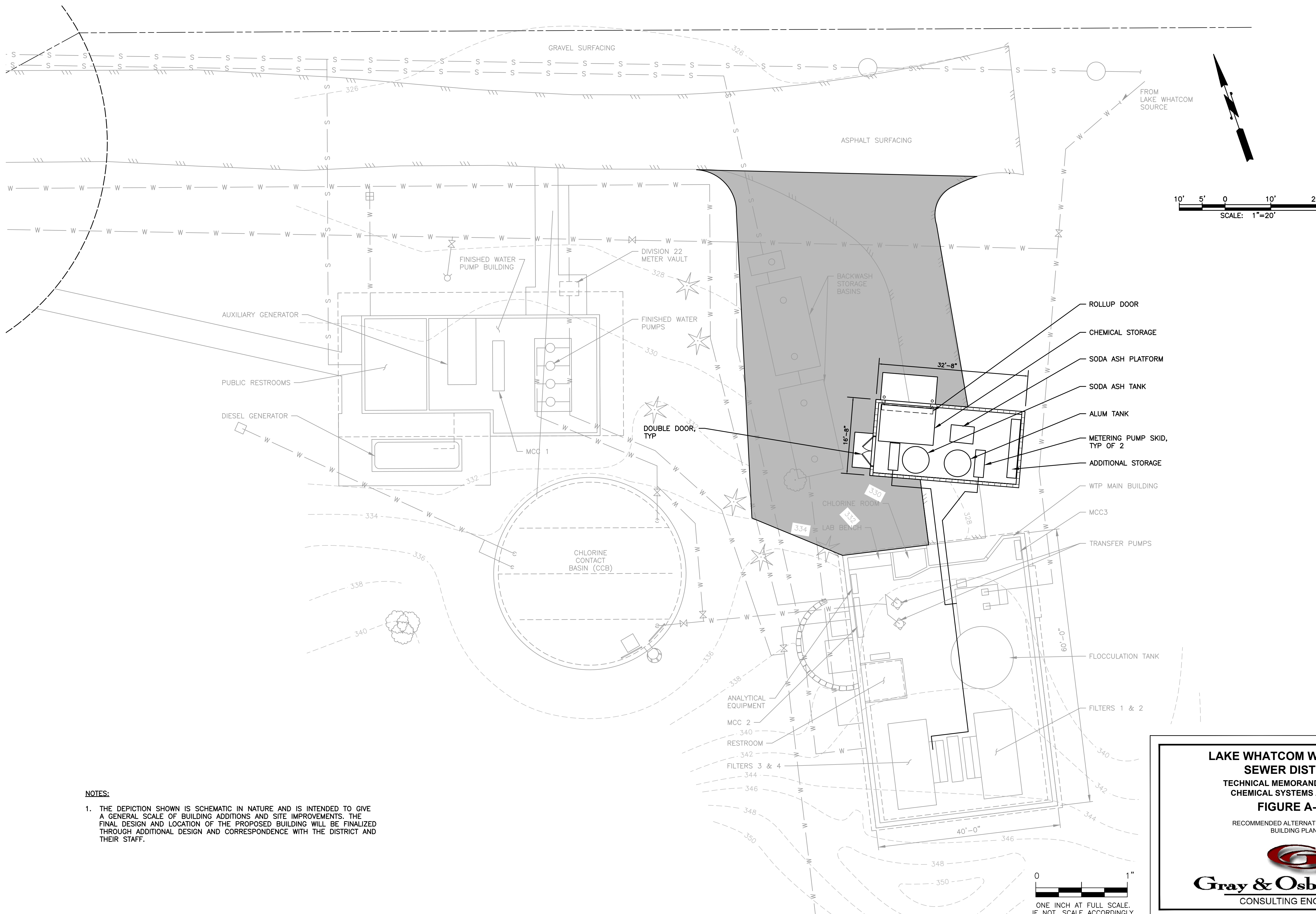
LAKE WHATCOM WATER AND SEWER DISTRICT

TECHNICAL MEMORANDUM 20434-4
CHEMICAL SYSTEMS ANALYSIS

FIGURE A-9

SUPERSACK HANDLING EQUIPMENT

Gray & Osborne, Inc.
CONSULTING ENGINEERS



NOTES:

1. THE DEPICTION SHOWN IS SCHEMATIC IN NATURE AND IS INTENDED TO GIVE A GENERAL SCALE OF BUILDING ADDITIONS AND SITE IMPROVEMENTS. THE FINAL DESIGN AND LOCATION OF THE PROPOSED BUILDING WILL BE FINALIZED THROUGH ADDITIONAL DESIGN AND CORRESPONDENCE WITH THE DISTRICT AND THEIR STAFF.

LAKE WHATCOM WATER AND SEWER DISTRICT

TECHNICAL MEMORANDUM 20434-4
CHEMICAL SYSTEMS ANALYSIS

FIGURE A-10

RECOMMENDED ALTERNATIVE SITE AND BUILDING PLAN

Gray & Osborne, Inc.
CONSULTING ENGINEERS

EXHIBIT B

RECOMMENDED ALTERNATIVE COST ESTIMATES

LAKE WHATCOM WATER AND SEWER DISTRICT

SUDDEN VALLEY WTP ASSESSMENT AND ALTERNATIVES ANALYSIS PROJECT
PRELIMINARY COST ESTIMATE

Technical Memorandum 20434-4 - Liquid Alum in Existing WTP Main Building
November 4, 2020
G&O# 20434.00

NO.	ITEM	QUANTITY	UNIT	UNIT PRICE	AMOUNT
1	Mobilization and Demobilization	1	LS	$ 6,500	$ 6,500
2	Alum System Modifications	1	LS	$ 18,000	$ 18,000
3	Piping, Valves, and Appurtenances	1	LS	$ 5,000	$ 5,000
4	Telemetry / SCADA Modifications	1	LS	$ 8,000	$ 8,000

Subtotal*	**$ 37,500**
Contingency (25%)	$ 9,400
Subtotal	**$ 46,900**
Washington State Sales Tax (9.0%)**	$ 4,200
Subtotal	**$ 51,100**
Design and Project Administration (25.0%)***	$ 12,800
TOTAL CONSTRUCTION COST	**$ 64,000**

* Costs listed are in 2020 dollars
** Current sales tax rate is 8.7%.
*** Standard project design and administration fees are 25% of the subtotal including contingency and tax

LAKE WHATCOM WATER AND SEWER DISTRICT

SUDDEN VALLEY WTP ASSESSMENT AND ALTERNATIVES ANALYSIS PROJECT
PRELIMINARY COST ESTIMATE

Technical Memorandum 20434-4 - Liquid Alum in New Chemical Building
November 4, 2020
G&O# 20434.00

NO.	ITEM	QUANTITY	UNIT	UNIT PRICE		AMOUNT	
1	Mobilization and Demobilization	1	LS	$	60,800	$	60,800
2	Minor Change	1	LS	$	15,000	$	15,000
3	Erosion / Sedimentation Control	1	LS	$	10,000	$	10,000
4	Site Improvements	1	LS	$	25,000	$	25,000
5	New Chemical Building	500	SF	$	750	$	375,000
6	Alum System Modifications	1	LS	$	18,000	$	18,000
7	Piping, Valves, and Appurtenances	1	LS	$	15,000	$	15,000
8	Electrical Modifications	1	LS	$	100,000	$	100,000
9	HVAC Modifications	1	LS	$	40,000	$	40,000
10	Telemetry / SCADA Modifications	1	LS	$	10,000	$	10,000

Subtotal*	**$**	**668,800**
Contingency (25%)	$	167,200
Subtotal	**$**	**836,000**
Washington State Sales Tax (9.0%)**	$	75,200
Subtotal	**$**	**911,200**
Design and Project Administration (25.0%)***	$	227,800
TOTAL CONSTRUCTION COST	**$**	**1,139,000**

* Costs listed are in 2020 dollars
** Current sales tax rate is 8.7%.
*** Standard project design and administration fees are 25% of the subtotal including contingency and tax

LAKE WHATCOM WATER AND SEWER DISTRICT

SUDDEN VALLEY WTP ASSESSMENT AND ALTERNATIVES ANALYSIS PROJECT
PRELIMINARY COST ESTIMATE

Technical Memorandum 20434-4 - Manual Addition of Soda Ash in WTP Main Building
November 4, 2020
G&O# 20434.00

NO.	ITEM	QUANTITY	UNIT	UNIT PRICE	AMOUNT
1	Mobilization and Demobilization	1	LS	$ 60,200	$ 60,200
2	Minor Change	1	LS	$ 15,000	$ 15,000
3	Erosion / Sedimentation Control	1	LS	$ 10,000	$ 10,000
4	Site Improvements	1	LS	$ 25,000	$ 25,000
5	New Chemical Building	500	SF	$ 750	$ 375,000
6	Soda Ash System Modifications	1	LS	$ 12,000	$ 12,000
7	Piping, Valves, and Appurtenances	1	LS	$ 15,000	$ 15,000
8	Electrical Modifications	1	LS	$ 100,000	$ 100,000
9	HVAC Modifications	1	LS	$ 40,000	$ 40,000
10	Telemetry / SCADA Modifications	1	LS	$ 10,000	$ 10,000

Subtotal*	**$ 662,200**
Contingency (25%)	$ 165,600
Subtotal	**$ 827,800**
Washington State Sales Tax (9.0%)**	$ 74,500
Subtotal	**$ 902,300**
Design and Project Administration (25.0%)***	$ 225,600
TOTAL CONSTRUCTION COST	**$ 1,128,000**

LAKE WHATCOM WATER AND SEWER DISTRICT

SUDDEN VALLEY WTP ASSESSMENT AND ALTERNATIVES ANALYSIS PROJECT
PRELIMINARY COST ESTIMATE

Technical Memorandum 20434-4 - Mini-Bulk Addition of Soda Ash in New Chemical Building
November 4, 2020
G&O# 20434.00

NO.	ITEM	QUANTITY	UNIT	UNIT PRICE		AMOUNT	
1	Mobilization and Demobilization	1	LS	$	66,500	$	66,500
2	Minor Change	1	LS	$	15,000	$	15,000
3	Erosion / Sedimentation Control	1	LS	$	10,000	$	10,000
4	Site Improvements	1	LS	$	25,000	$	25,000
5	New Chemical Building	500	SF	$	750	$	375,000
6	Soda Ash System Modifications	1	LS	$	15,000	$	15,000
7	Dry Chemical Handling Equipment	1	LS	$	60,000	$	60,000
8	Piping, Valves, and Appurtenances	1	LS	$	15,000	$	15,000
9	Electrical Modifications	1	LS	$	100,000	$	100,000
10	HVAC Modifications	1	LS	$	40,000	$	40,000
11	Telemetry / SCADA Modifications	1	LS	$	10,000	$	10,000

Subtotal*	**$**	**731,500**
Contingency (25%)	$	182,900
Subtotal	**$**	**914,400**
Washington State Sales Tax (9.0%)**	$	82,300
Subtotal	**$**	**996,700**
Design and Project Administration (25.0%)***	$	249,200
TOTAL CONSTRUCTION COST	**$**	**1,246,000**

* Costs listed are in 2020 dollars
** Current sales tax rate is 8.7%.
*** Standard project design and administration fees are 25% of the subtotal including contingency and tax and is

LAKE WHATCOM WATER AND SEWER DISTRICT

SUDDEN VALLEY WTP ASSESSMENT AND ALTERNATIVES ANALYSIS PROJECT
PRELIMINARY COST ESTIMATE

Technical Memorandum 20434-4 - Chemical System Modification Recommendations
November 4, 2020
G&O# 20434.00

NO.	ITEM	QUANTITY	UNIT	UNIT PRICE		AMOUNT	
1	Mobilization and Demobilization	1	LS	$	63,300	$	63,300
2	Minor Change	1	LS	$	15,000	$	15,000
3	Erosion / Sedimentation Control	1	LS	$	10,000	$	10,000
4	Site Improvements	1	LS	$	25,000	$	25,000
5	New Chemical Building	500	SF	$	750	$	375,000
6	Soda Ash System Modifications	1	LS	$	15,000	$	15,000
7	Coagulant System Modifications	1	LS	$	18,000	$	18,000
8	Piping, Valves, and Appurtenances	1	LS	$	25,000	$	25,000
9	Electrical Modifications	1	LS	$	100,000	$	100,000
10	HVAC Modifications	1	LS	$	40,000	$	40,000
11	Telemetry / SCADA Modifications	1	LS	$	10,000	$	10,000

Subtotal*	**$**	**696,300**
Contingency (25%)	$	174,100
Subtotal	**$**	**870,400**
Washington State Sales Tax (9.0%)**	$	78,300
Subtotal	**$**	**948,700**
Design and Project Administration (25.0%)***	$	237,200
TOTAL CONSTRUCTION COST	**$**	**1,186,000**

* Costs listed are in 2020 dollars
** Current sales tax rate is 8.7%.
*** Standard project design and administration fees are 25% of the subtotal including contingency and tax and is